Mobilizing Learning: Transforming pedagogy with mobile web 2.0.

Thomas Donald Cochrane

B.E. (Electrical & Electronic), University of Auckland, 1986

B.D., Melbourne College of Divinity, 1995

M.T.S., Bible College of New Zealand, 2000

G.D.H.E., Unitec New Zealand, 2001

M.Comp., Unitec New Zealand, 2005

THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN THE DEPARTMENT OF EDUCATION

MONASH UNIVERSITY

March 2011

COPYRIGHT NOTICE

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

GLOSSARY OF TERMS AND ACRONYMS

3G	–	Third generation mobile ‘broadband‘
Android	–	Google’s mobile device operating system
Android Market	–	Google’s mobile device application store
Blog	–	Weblog: online journal
COP	–	Community Of Practice
Eportfolio	–	Collection of online media
Gmail	–	Google email service
Google Reader	–	Google RSS aggregation service
iOS	–	Apple Computer’s mobile device operating system
iTunes Store	–	Apple Computer’s online music, video and mobile application store.
LMS	–	Learning Management System: for example Blackboard or Moodle.
Mlearning	–	Mobile learning
Mobile Web 2.0	–	Web 2.0 services optimised for use with mobile phones.
Ovi Store	–	Nokia’s mobile device application and media store.
Picasa	–	Google online photo album service
Qik	–	A free mobile video streaming service, http://qik.com

QR Code – Quick Response Code, a two dimensional graphical code that is decoded by an application using the built-in camera of cameraphones.

RSS – Rich Site Summary: for subscribing to update information to web 2.0 sites.

Smartphones – Mobile phones with an extensible operating system

Symbian – Nokia's standard cellphone and smartphone operating system, prior to Windows 7.

UStream – A free mobile video streaming service http://www.ustream.tv

Web 2.0 – Interactive, customisable web services, facilitating user-generated content

WiFi – Wireless ethernet connectivity

Wiki – Editable collaborative web page

WMD – Wireless Mobile Device

YouTube – Google online video sharing service

ABSTRACT

This thesis reports on three years of action research mlearning (mobile learning) projects encompassing five different courses, forming five case studies spanning from one to three years of implementation and refinement. The five case studies involved thirteen mlearning projects undertaken between 2007 and 2009 with a total of 280 participants. The aim of the research was to investigate the potential of mobile web 2.0 tools to facilitate social constructivist learning across multiple learning contexts, including: both formal and informal, geographically disperse, synchronously and asynchronously. The research focused upon the use of smartphones termed Wireless Mobile Devices (WMDs), coupled with mobile formatted web 2.0 social software. The research used a participatory action research methodology, and based its pedagogical decisions upon the foundation of social constructivist learning theory. This thesis captures the learning journeys of the researcher and participants as they moved from initial skepticism to personal appropriation of the new technologies. Highlighting the ontological shifts required for integrating the unique affordances of these mobile web 2.0 technologies into the participants' pedagogical practice and courses. Resulting in enabling collaborative learning environments that bridge multiple contexts.

The research led to the development of an intentional community of practice model for lecturer professional development and scaffolding student learning. A resultant pedagogical design framework was established. Critical success factors were identified, and an implementation strategy for the integration of mlearning within tertiary education was developed. The research provides an example of action-research informed institutional change. This change involved the development of strategies that embed the purposeful appropriation of student-owned WMDs enabling

social constructivist pedagogy. The mlearning projects have driven a reconceptualisation of teaching and learning across several courses within the institution.

Additionally the thesis explores and extends emergent critical practice-based mlearning literature. The research adds the insights of a significant longitudinal study to the relatively new body of knowledge around mlearning.

STATEMENT OF AUTHORSHIP

The thesis contains no material that has been accepted for the award of any other degree or diploma in any university or other institution. To the best of my knowledge, the thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

[redacted]

Thomas Cochrane

March 2011

ACKNOWLEDGEMENTS

I would like to thank my supervisors: Dr Bernard Holkner and Dr Michael Henderson for their help throughout the journey of this research and Thesis writing.

Special thanks goes to my wife Bronwyn, without whose support this Thesis would not have been possible.

Thomas Cochrane, March 2011.

1 INTRODUCTION

This research investigated the pedagogical impact of integrating the use of wireless mobile devices (WMDs) within a variety of tertiary education courses. The acronym WMD is used to highlight the importance of the wireless connectivity and mobility of these devices, while at the same time capturing the readers attention with the acronym's more typical reference to "weapons of mass destruction" that in the context of the research is used to allude to the disruptive and catalytic nature of mobile devices within education. It was found that mobile devices integrated with a campus wireless network and wider mobile broadband (cellphone data) connectivity can enable the use of social software (Web 2.0) tools to enhance tutor-student and student-student communication, collaboration, reflection and critique in both formal and informal learning contexts. In thus facilitating pedagogical transformation for both lecturers and students, lecturers can move to 'pedagogy 2.0' (the proposed successor to teacher-directed pedagogy, similar to interactive web 2.0 succeeding the original static web, a phrase coined by McLoughlin and Lee (2007)) facilitating learner-generated content and learner-generated contexts within social constructivist learning environments. This thesis outlines how the researcher has achieved these significant outcomes at Unitec New Zealand, and presents a model for integrating the pedagogical use of WMDs and social software within a variety of tertiary education contexts including different courses and levels.

The research involved a series of action research projects using WMDs to harness the potential of current and emerging social constructivist e-learning tools, for example: Moodle, Blogs, Wikis, and Podcasting. The research was based upon an explicit social constructivist pedagogy (Bijker, Hughes, & Pinch, 1987; Lave &

Wenger, 1991; Vygotsky, 1978; Wenger, McDermott, & Snyder, 2002). The goal was to develop sound pedagogical guidelines, and inform strategic planning for implementing the incorporation of WMDs into tertiary education in New Zealand. The underlying social constructivist tools are not bound to any single WMD technology, or specific learning context, and therefore the outcomes, strategies, and pedagogies identified by the research are intended to be generalizable and transferable to other teaching contexts. It is postulated herein that WMDs are 'disruptive' technologies that are useful in challenging established pedagogies, providing a catalyst to move tertiary education from entrenched instructivist pedagogical models towards social constructivist pedagogies.

While there are several examples of integration of Palm, PocketPC, Smart phone and laptop devices in tertiary education in overseas institutions, few have been based on theoretical models of learning (Traxler, 2009b). It has also been noted that the majority of early mobile learning trials have not used rigorous evaluation techniques, have failed to measure student learning, and have not attempted to provide a well-defined pedagogical basis for the research or learning activities used (Kukulsa-Hulme & Traxler, 2005b; Traxler & Kukulska-Hulme, 2005). This project attempts to address these concerns.

This research investigates the application of WMDs in a variety of Tertiary education courses within New Zealand. The researcher is part of Te Puno Ako (formerly the Centre for Teaching and Learning Innovation team) at Unitec, and as such is ideally situated at Unitec to promote and research the potential of WMDs to enhance the delivery of courses and student learning. The research covers a series of mobile web 2.0 projects implemented within courses from different schools at Unitec between 2007 and 2009, with the aim of informing an institutional mlearning strategy.

The project developed an intentional Community Of Practice (COP) model for supporting new technology integration, pedagogical development, and institutional change. Beginning with a small selection of early adopter projects, the results of the research are now informing a wider integration of wireless mobile computing.

A participatory action research methodology was chosen because of the researcher's desire to facilitate positive institutional change. Mlearning projects were implemented to establish support for the concept from lecturers and students at Unitec. The initial proof-of-concept projects then led to the integration of mlearning into the newly developed institutional elearning strategy, which has had significant input from both the researcher and participating WMD project lecturers. Thus the projects played an important role in exploring the potential of mlearning while building the skills and confidence of lecturers in utilizing the technology, and informing the subsequent full implementation of mlearning within their courses. Hence the research follows the journey of discovery for the key participants, including the researcher and the lecturers involved. The issues and findings have been published in 41 research outputs during the past four years. These include peer-reviewed Journals (Cochrane, 2009b, 2009e, 2010a; Cochrane & Bateman, 2009d, 2010d; Cochrane, Flitta, & Bateman, 2009a; Flitta, Cochrane, & Bateman, 2009), peer-reviewed book chapters (Cochrane, 2009a, 2009c), and peer-reviewed conference papers (Cochrane, 2005b, 2005c, 2006c, 2006e, 2007b, 2007c, 2007d, 2007f, 2007g, 2007h, 2008b, 2008d, 2008f, 2009d, 2010d, 2010e; Cochrane & Bateman, 2008c, 2008d, 2009a, 2009b, 2009c, 2010a, 2010b, 2010c, 2010e; Cochrane, Bateman, Cliffin, et al., 2009; Cochrane, Bateman, & Flitta, 2009a, 2009b;

Cochrane & Flitta, 2009; Cochrane, Flitta, & Bateman, 2009b; Cochrane & Kligyte, 2007a, 2007b).

1.1 Overview of the Research

Mlearning (Mobile learning) has quickly developed as a field of educational research and practice driven by rapid changes in the capabilities of mobile technologies and their integration with web 2.0 social software. Worldwide market share of mobile devices has rapidly increased, eclipsing traditional computer ownership (ITU, 2009). With over four billion cellphone users worldwide in 2009, there were in comparison only around 800 million computer owners (ITU, 2009). The smartphone market is projected to exceed computer users by 2014 when sales of smartphones are expected to reach 30 percent of the worldwide cellphone market (Hendery, 2009). When this research project began in 2006, neither the iPhone or low cost 3G netbooks existed, the iTunes Store was unavailable in New Zealand, wireless connectivity speeds were limited to first generation 3G (UMTS or CDMA) with limited coverage available, and the WiFi data rate had a maximum of 54Mbps. The mobile Internet was limited to WAP enabled sites, Google's Mobile suite of tools were immature, media-rich smartphone applications required Java implementation across a wide range of different interfaces, and Prensky's assertion for education: "What can you learn from a cell phone? Almost anything!" (2005b) appeared to be a hopeful fairytale. However, by 2009, over five billion songs and one and a half billion iPhone applications (within a year of the opening of the iTunes App Store, with a 2009 catalogue of over one hundred thousand applications available) had been downloaded from the iTunes store. The 2006 New Zealand census (Statistics New Zealand, 2006) indicated that the majority of our students owned at least a cameraphone capable of mobile blogging, recording and uploading video to YouTube, email, and browsing the Internet. During this timeframe smartphones have matured into feature-rich miniature multimedia computers, including features such as; HSPA connectivity (3.6Mbps and higher wireless mobile broadband connectivity), built-in virtual or physical keyboards for easy text entry, a high-resolution digital still and video camera, a GPS, high capacity memory storage (8GB and higher), high resolution touchscreen user interfaces, and a wide variety of pre-installed and downloadable applications that integrate with web 2.0 social software. Thus providing a rich set of affordances that could be investigated for their educational potential.

This research built upon previous mlearning research and was informed by the critiques of educational mlearning research by Traxler (2007), who identified two main limitations: a lack of explicit underpinning pedagogy, and limited longitudinal studies within the published research. Litchfield, Dyson, Lawrence and Zmijewska (2007), identified the need for mlearning that supports both the on and off-campus learning environments with ubiquitous connectivity that is cost effective. In response to these critiques, this research was based upon an explicit foundational theory of learning (social constructivism, see Chapter 3 for an in depth discussion) and spanned four years of implementation, beginning with small case studies followed by wider and larger implementations, leading to informing the implementation of a new institutional elearning strategy. The research was thus underpinned longitudinally and based within a variety of learning contexts creating a model for implementing mlearning in tertiary education. The approach taken within this research project was unique. The emphasis was on using standard smartphones and freely available web 2.0 tools that require minimal technical knowledge to appropriate and integrate within tertiary education, creating transferable mlearning scenarios for multiple contexts.

The research also provides a unique window into the journey of the participants and the researcher via authentic video reflections captured along the course of the research and made available on YouTube and various web 2.0 social software sites. These provide rich media snapshots recording the stories of the key participants longitudinally throughout the research.

1.2 The Researcher

The researcher is an Academic Advisor (elearning and Learning Technologies) with Unitec New Zealand (March 2004 to present), New Zealand's largest Institute of Technology. My role at Unitec includes providing support for elearning and learning technologies for Unitec teaching staff, and pushing the boundaries of educational technology for enhancing teaching and learning at Unitec. The prime driver behind this research is my own experience of developing as a tertiary lecturer. In my observations as an academic advisor, reflective teachers develop their own synthesis of various pedagogical models, choosing the aspects that align with their own learning and teaching style, and their ever developing understanding of the learning environment. This comes from reflecting upon teaching experiences, and aligning these with current learning theory (Brookfield, 1995; Larrivee, 2000). There have been several key influences in the development of my pedagogical outlook:

1. Constructive learning theory (Bruner, 1966; B. Wadsworth, 1996; Weimer, 2002)
2. Constructive alignment (Biggs, 2003)
3. Diana Laurillard's Conversational Framework (Laurillard, 2001)

4. Social Constructivism in its many emergent forms (Herrington & Herrington, 2006b; McLoughlin & Lee, 2008b)
5. Communities of Practice (Wenger, White, Smith, & Rowe, 2005)

These have resonated with my personal experiences of teaching and learning, and from these I have developed a synthesis that I have successfully used in teaching, in particular in utilizing technology to enhance the learning environment for myself and my students. My experience of establishing a wireless laptop scheme for students in my previous role of Audio Engineering and Music Production lecturer (Cochrane, 2003; Webster, 2004) convinced me of the transformative impact of WMDs in education. My experience of multimedia learning object development for my Masters Thesis also convinced me of the limitations of multimedia content delivery with its reliance upon specialised developer skills (Cochrane, 2005a, 2007a). Therefore I favour a student-centred, interactive, collaborative approach to developing a unique learning community for each different group of learners, enhanced by collaborative communications made available by technology. Wireless mobile computing and social software are maturing into useful tools to facilitate this approach to learning communities within mainstream tertiary education.

However this is not the norm in tertiary education, as Herrington and Herrington (2006a) observe, behaviourism and content transmission are still the dominant paradigms, which is supported by my own observations in 2010. Good pedagogy, as defined by Dewald (1999) focuses upon enhancing the student experience and the desired graduate profiles. Graduate profiles include student capabilities and how they will be expected to engage in the workforce community (Allen Consulting Group, 2004). Today's graduates need to be life-long learners, and capable of critical, reflective, and creative thinking, able to work in and contribute to teams (Hager & Holland, 2006). Behaviourism focuses upon teacher-centred approaches in higher education (Ally, 2008; T. Brown, 2006; Dewald, 1999), whereas social constructivism focuses upon learner-centred approaches that model and facilitate the type of graduate profiles described above (Bruns, 2007; McLoughlin & Lee, 2008b). For example, Herrington and Herrington (2006a) critique the predominant behaviourist, knowledge-transmission pedagogies found in higher education, and present authentic learning as an alternative:

> Typically university education has been a place to learn theoretical knowledge devoid of context… What employers, governments and nations require are graduates that display attributes necessary for knowledge building communities: graduates who can create, innovate, and communicate in their chosen profession. (Herrington & Herrington, 2006a, p. 2)

The researcher was driven by a desire to bring about positive pedagogical change, informed by this research, in the areas of: professional development for lecturers to utilize and integrate mobile web 2.0 tools into their curricula to facilitate flexible social constructivist learning environments for their students, and facilitating the changes in institutional strategy and wireless infrastructure required to facilitate a student-owned wireless mobile device model of computing. Several factors have contributed to make this a possibility: the roll-out of almost ubiquitous wireless connectivity via wifi and 3G broadband, the maturing of smartphones into powerful mobile multimedia computers with unique affordances to augment how we conceptualise and interact with the world around us, the rapid development of mobile web 2.0, and the conceptualisation of new social constructivist pedagogies such as authentic learning (Herrington & Herrington, 2006b; Herrington & Oliver, 2000), pedagogy 2.0 (McLoughlin & Lee, 2008a, 2010), connectivism (Siemens, 2004) and navigationism (Brown, 2005, 2006).

The researcher views mlearning as a catalyst of pedagogical change that can be leveraged by lecturers modeling the pedagogical use of mobile web 2.0 tools for facilitating reflective reconception of teaching and learning, moving from teacher-directed pedagogy to learner-generated content and learner-generated contexts.

1.3 Defining MLearning

While there have been many attempts to define the unique essence of mobile learning (mlearning), most have either focused on the mobility of the device, the learner, or on the facilitation of informal learning beyond the confines of the classroom (Kukulsa-Hulme & Traxler, 2005b). Sharples, Taylor, et al., (2007) proposed a form of Laurillard's (2001) conversational framework, excluding the teacher, combined with an Activity Theory framework to define mobile learning by its contextual and informal learning characteristics. However, a key element in the conversational framework is the dialogue between teacher and student. In contrast to Sharples, Taylor, et al. (2007), Laurillard (2007) emphasizes the teacher's input in mobile environments through good pedagogic design that facilities continuity between the face to face and remote peer learning contexts. Her definition of mobile learning incorporates the critical pedagogical design input of the teacher: "M-learning, being the digital support of adaptive, investigative, communicative, collaborative, and productive learning activities in remote locations, proposes a wide variety of environments in which the teacher can operate" (Laurillard, 2007, p. 172). The contexts of the mlearning research in the five case studies herein bridge both the formal and informal learning contexts, and were informed by Laurillard's conversational model that emphasizes the crucial role of the pedagogical input of the lecturer, involving input into the design of the mlearning activities and formative and summative feedback.

Researchers have attempted to create definitions of mobile learning that are independent of specific technologies, but often these definitions become so generalised that the uniqueness of mobile connectivity is lost. For example, Sharples, Taylor, and Vavoula's (2006) definition of mlearning, though widely accepted, is purposely vague and technology agnostic: "The processes of coming to know through conversations across multiple contexts amongst people and personal interactive technologies" (p. 4). Thus the focus of this definition is on the type of processes involved in mlearning that can be facilitated by 'personal interactive technologies', but is not useful in informing the reader what these technologies might actually be. Wali, Winters, and Oliver (2008) present an even vaguer definition of mlearning. They take 'context crossing' (Wali, et al., 2008, p. 48) as the basis for their conceptualisation of mlearning. Similarly to Sharples et al. (2006) they use Activity Theory as a basis for defining mlearning. The resultant definition is extremely broad with no hint of what these technologies might be: "learning that occurs as a result of pursuing learning activities that are directed towards achieving some objective in multiple contexts (physical and social)" (Wali, et al., 2008, p. 45). Wali et al. believe "definitions of mobile learning should cover conventional devices as well as any other technology" (Wali, et al., 2008, p. 50). These researchers want to get away from a technology focus within the definition of mlearning, to a focus upon the "continuity of learning activities in different contexts" (Wali, et al., 2008, p. 56). However, in the researcher's view, non-wireless devices cannot bridge communication and user generated content across multiple contexts with the ease and immediacy afforded by wireless enabled digital devices. In the researcher's opinion, these attempts at technology neutral mlearning definitions fail to acknowledge the unique affordances of Wireless Mobile Devices (WMDs). Thus the research herein is focused on portable digital devices that have ubiquitous wireless connectivity built-in and user content creation capabilities. These include: cell phones, smart phones, 3G equipped netbooks, and emerging wireless portable computing devices such as the Apple iPad, that users are likely to carry with them beyond the classroom. Excluded from the main focus of the research are more traditional mobile computing devices such as laptops that currently have limited battery life high cost and are heavy to carry, and proprietary mono-functional wireless devices such as ‘clickers’ or wireless presentation tablets. The researcher’s focus on smart phones (converged multifunctional devices) and exclusion of laptops is similar to the mlearning research emphasis of Pachler, Bachmair and Cook (2010).

> Given our emphasis on convergence, the normalisation of technology and its seamless integration into the fabric of everyday life and into users’ life-worlds, we consider laptops to lie outside the range of devices we focus on in the context of mobile learning as they mostly still lack true portability and ubiquity as well as penetration of a wide range of social contexts… important characteristics of mobile devices, which make them attractive to us from an educational perspective... include among other things increasing portability, functional, multimedia convergence, ubiquity, personal ownership, social interactivity, context sensitivity, location awareness, connectivity and personalization. (Pachler, et al., 2010, p. 7)

Therefore, mobile learning, as defined by the researcher, involves the use of wireless enabled mobile digital devices (Wireless Mobile Devices or WMD’s) within and between pedagogically designed learning environments or contexts. Mlearning can support and enhance both the face to face and off campus teaching and learning contexts by using the mobile wireless devices as a means to leverage the collaborative use of web 2.0 tools. The WMDs wireless connectivity and data gathering abilities (for example: photoblogging, video recording, voice recording, and text input) allow for bridging the on and off campus learning contexts – facilitating "real world learning" (Unitec New Zealand, 2010). It is the potential for mobile learning to bridge pedagogically designed learning contexts, facilitate learner generated contexts, and content (both personal and collaborative), while providing personalisation and ubiquitous social connectedness, that sets it apart from more traditional learning environments. From an activity theory perspective, WMDs are the tools that mediate a wide range of learning activities and facilitate collaborative learning environments (Uden, 2007). However, the use of Wireless Mobile Devices (WMDs) as part of the teaching and learning environment requires changes in pedagogy and integration into the teaching and learning processes.

One of the key realisations of previous large mlearning projects (for example: MOBILearn) was that it is the learner that is mobile, and the learners interacts continually throughout the day facilitated by mobile devices. Therefore focusing on the mobility of the learner is central to mlearning (Sharples, 2010). While technology continually changes, how learners learn and interact, and what educators want our student graduates to be able to achieve is persistent. Mlearning by nature involves interaction with continually changing technologies, but rather than being eventually assimilated into traditional computing, the researcher argues that mlearning is reinventing and transforming computing from a tool to integrating computing into our lifestyles. Two-thirds of the world's population already own and carry a cellphone (ITU, 2009). Mlearning is not just the miniaturization and convenience of portable computing, but is transforming how we conceptualise and interact with computing and our environment, communicate, and create and manipulate information (Cheney, 2010; Pachler, et al., 2010). Mlearning is about ubiquitous social connectivity, instant information access, and enhancing how we view the world through digital augmentation (Cook, 2010). It is empowering for learners, who can become content and context generators within authentic learning environments (Herrington & Herrington, 2006a, 2007) rather than simply consumers of transmitted content in classrooms. Additionally, emerging touch and voice interactivity with mobile computing will change our expectations of how learners interact with computing.

1.3.1 Mobile Web 2.0

An explicit social constructivist pedagogy underpinned each of the mlearning projects, forming the basis for the selection of tools to support this pedagogical approach. Mobile web 2.0 tools are web 2.0 services that are formatted for use with mobile devices. These web 2.0 (O'Reilly, 2005), or 'social software' tools (Alexander, 2006; Mejias, 2006), share many synergies with social constructivist learning pedagogies. Web 2.0 supports collaborative group work, peer critique, formative feedback, user generated content, user tagging (categorizing and collating), and other processes similar to those used in social constructivist learning environments where the focus is on what the students do and discover. Mejias (2006) argues that "the application of social software in this manner supports a constructivist pedagogy where students feel empowered to take charge of their own learning" (p. 5).

Increasingly educators are harnessing web 2.0 tools for creating engaging student-centred learning environments. This appropriation of web 2.0 tools within a social constructivist pedagogy has been termed "pedagogy 2.0" (McLoughlin & Lee, 2008a). This research was interested in appropriating the benefits of web 2.0 and pedagogy 2.0 anywhere anytime using mobile web 2.0 and wireless mobile devices (or WMDs), in particular WiFi (wireless Ethernet) and 3G (third generation mobile ‘broadband’) enabled smartphones, and 3G enabled netbooks. To help the research participants visualize the interaction of the variety of tools used in the research projects, a visual map was created. Figure 1 is a concept map developed to graphically illustrate how a smartphone can capture and share user generated content from multiple learning contexts, via freely available web 2.0 tools formatted for smartphones. An interactive online version of the concept map (html version available at: http://web.me.com/thom_cochrane/MobileWeb2/mobileweb2concept2.htm, a proprietary Flash version is available at: http://prezi.com/kr94rajmvk9u/) provides brief explanations of the various elements within the concept map. These are explored in detail in the literature review of this thesis.

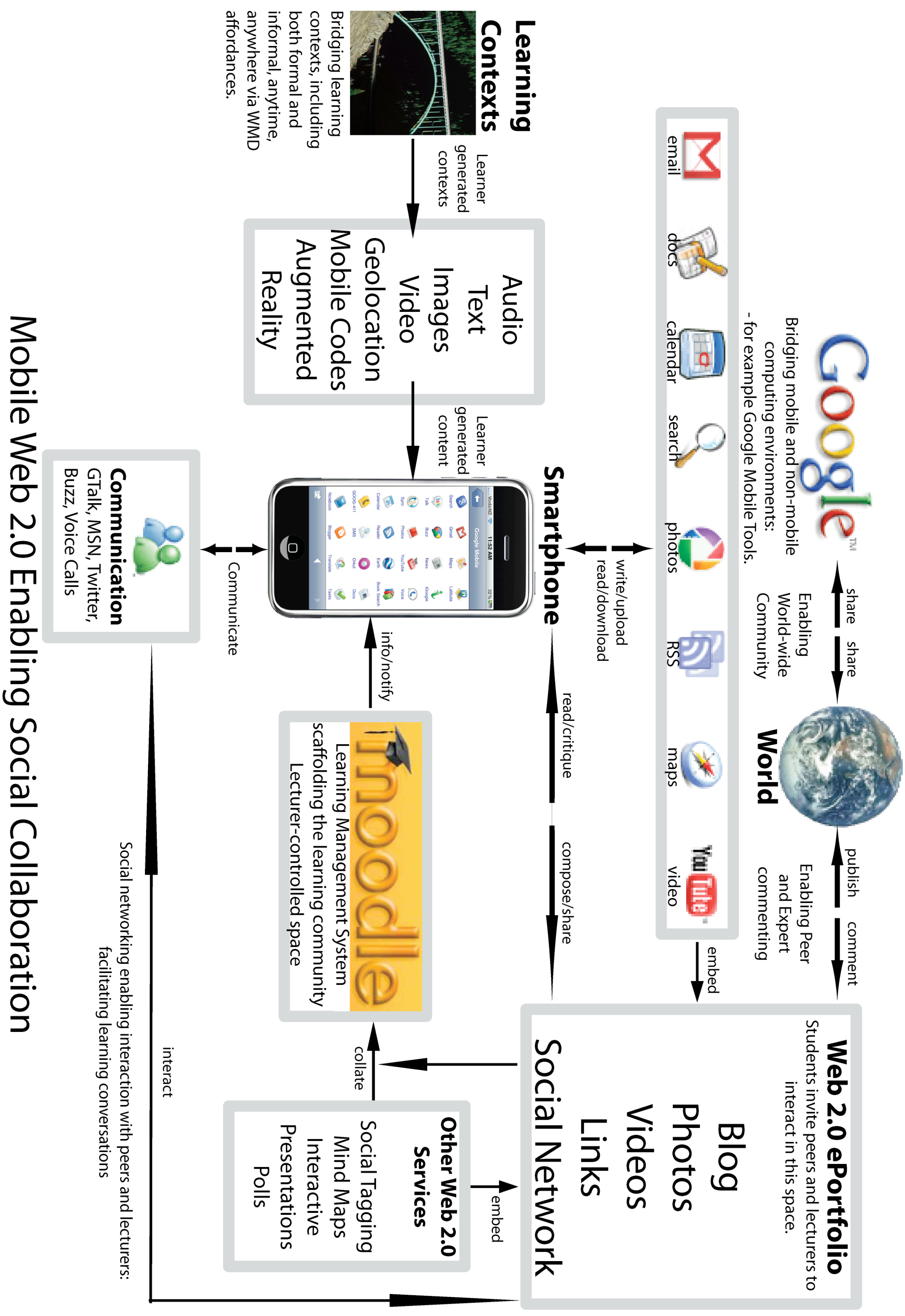


Figure 1: MLearning concept map used for the projects.

Figure 1 illustrates the range of mobile web 2.0 tools and supporting functions explored iteratively over the course of the participatory action research projects, and represents a framework indicating how these tools relate. A visual representation was found to be important for the participants, particularly because of the range of tools used to create their online eportfolios. A mashup (the collation of several interoperable but originally discrete web 2.0 tools to create a more personalised and functional tool) of several freely available web 2.0 tools was used rather than a single dedicated eportfolio platform, allowing for the integration of new web 2.0 tools as they became available. The smart phones were used to bridge multiple learning contexts (both the formal and informal learning contexts), providing constant connectivity with peers, lecturers, course content, and student's own online eportfolios, while enabling student creation of new context-aware media via the smart phones variety of recording, and content sharing affordances. Students were able to immediately document and share ideas, inspiration, and events in a range of multimedia formats (video, audio, text, images) and annotate these with text, and geolocation information, automatically announcing new media and reflections via communications tools such as Twitter or instant messaging. Students created their own personal and collaborative learning and mobile-friendly eportfolio spaces online, inviting their peers and lecturers into these spaces, allowing collaboration via commenting, social networking, and RSS subscriptions (See the literature review for definitions of these terms). Google's mobile formatted suite of tools including: calendar, maps, docs, search, Gmail, Picasa, YouTube, and Google Reader, were used to bridge the mobile and the more traditional desktop computing environments. Student created content could be made available at a variety of access levels: private, specified groups, or publically worldwide. Within this learning scenario, the institution's LMS (Learning Management System) was used as a scaffold for the communities of practice (COPs) established to support the mlearning projects.

1.3.1.1 Context Bridging

Research into mlearning has highlighted the context 'awareness' of mobile devices (Cook, Bradley, Lance, Smith, & Haynes, 2007; Luckin, et al., 2008; Sharples, 2009a), and the ability to 'span' learning contexts (Wali, et al., 2008), focusing on the continuity of learning activities between different contexts. However, what is unique about WMDs for mlearning is their ability to bridge contexts (Vavoula, 2007a) not only asynchronously (as implied by 'span') but also synchronously – that is to provide ubiquitous connectivity independent of the context of use, thus linking multiple contexts into the learning environment, continuing learning 'conversations' via synchronous and asynchronous communication technologies. Vavoula (2007a) describes how mlearning bridges contexts as illustrated by an mlearning guided museum project:

> The benefits go beyond simple mobility of artefacts - learners are able to continue their learning experiences across different locations and contexts…. Mobile devices can form steady bridges between technologies, contexts, experiences and learning spaces. (Vavoula, 2007b, p. 36)

Context within the definition of this research refers to more than simply spatial relationships between learners and their learning environment. For example, Sharples and Brown (2009) take an interaction view of context, defining context as "the constructive interaction between people and technology" (p. 4). Also taking an interaction view of context, Luckin et al. (2008) argue for a focus upon learner-generated contexts where "learners can now take greater agency in the creation of their learning contexts" (pp. 3-4). Based upon an interaction view of context, mlearning can support and enhance both the face to face and off campus teaching and learning contexts by linking the students' experience and their learning communities in these different contexts. Wireless mobile devices can be used as a means to leverage the affordances of current and emerging collaborative and reflective e-learning tools (for example: blogs, wikis, RSS, instant messaging, podcasting, social book marking). These are often called social software or web 2.0 tools. The WMDs wireless connectivity and data gathering abilities (for example: photoblogging, video recording, voice recording, and text input) allow for bridging the on and off campus learning contexts. In particular, the context bridging and media recording capabilities of smart phones make them ideal tools for mobile blogging. Smart phones allow a user to send text, photos, video and audio directly from the site of recording to the user's online Blog. An example of the use of mobile blogging is the rise of citizen journalism (Cameron, 2006; Elmendorp, 2007; Fulton, 2007; Skoeps, 2007) where people directly involved in incidents record and share the incidents as they happen using their camera phones to upload video footage to web 2.0 news sites for the world to view before official news reporters are able to be on the scene. Similarly student collaboration and communication with peers and lecturers can be maintained in any context using WMDs with a variety of mobile communication technologies (email, online LMS, Instant Messaging, audio and video conferencing, live video streaming, SMS, MMS, mobile phone calls).

1.4 Research Questions

The research project was based upon social constructivist pedagogy drawing on the work of theorists such as: Bijker et al. (1987), Lave and Wenger (1991), Vygotsky (1978), and Wenger et al. (2005). This pedagogical framework is explored in detail in section 3.1 of the thesis. The underlying social constructivist tools are not bound to any single WMD technology, or specific learning context, and therefore strengthen the generalisability and transferability of the outcomes, principles, and strategies identified as a result of the action research. A review of the mlearning literature led to the identification of gaps in the understanding of mlearning, and the development of the research questions, which were:

1. What are the key factors in integrating Wireless Mobile Devices (WMDs) within tertiary education courses?
2. What challenges/advantages to established pedagogies do these potentially disruptive technologies present?
3. To what extent can these WMDs be utilized to support learner interactivity, collaboration, communication, reflection and interest, and thus provide pedagogically rich learning environments that engage and motivate the learner?
4. To what extent can WMDs be used to harness the potential of current and emerging social constructivist e-learning tools?

In order to answer the research questions a series of participatory action research mlearning projects were used. Five mlearning case studies were situated within a variety of educational contexts (Landscape Design, Product Design, Contemporary Music, Architecture, and Performing and Screen Arts), including different educational levels ranging from a level five diploma to a level seven undergraduate bachelors degree. Each case study took place longitudinally across one to three years of implementation. The five case studies involved thirteen mlearning projects representing action research cycles within each case study, providing opportunities for reflection and refinement with the earlier project results informing the design of subsequent projects.

1.5 Structure of the Thesis

Chapter One: Introduction

The introduction chapter outlines the significance of the research, introduces the generic approach of the mlearning projects, establishes the researcher's motivation and defines mlearning within the context of the research. The chapter finishes by outlining the research questions.

Chapter Two: Substantive Literature Review

The substantive literature review summarises the scope of current mlearning research, and explores mlearning as a catalyst for pedagogical change. The chapter then defines the technologies and related terms used throughout the research process, and locates these technologies within the associated educational research literature, exploring mobile web 2.0 as a framework for mainstream adoption of mlearning.

Chapter Three: Theoretical Literature Review

The theoretical literature review explores relevant learning theories and their applications to mlearning, as well as situating the research within this relatively new field of educational research. The chapter also critiques theoretical frameworks used in mlearning research, and identifies several critical success factors in mlearning.

Chapter Four: Methodology

This chapter outlines the research method, introduces the research questions and the research participants. Chapter four then explores the development of the core pedagogical and technological support model used, explains the development of the research instruments, and outlines the general approach taken to the case studies. Following this, the chapter outlines the resource choices and management process used.

Chapter Five: Case Study 1

Chapter five provides an overview and analysis of the Diploma of Landscape Design mlearning projects from 2007 to 2009. The Diploma of Landscape Design projects form iterative action research cycles and the chapter describes how each subsequent mlearning project was informed by the reflections upon the previous project. The chapter draws out the impact of the critical success factors that were identified in the literature review. The case study highlights the disruptive impact of mobile web 2.0 on tertiary education and the importance of technology support scaffolding mlearning integration.

Chapter Six: Case Study 2

Chapter six overviews and analyses the Bachelor of Product Design mlearning projects from 2008 to 2009 using the identified critical success factors as a critical framework, and illustrates the influence of the 2006 trials and 2007 Diploma of Landscape Design project on the Product Design projects implementation. The case study highlights the potential of mlearning integration as a catalyst for pedagogical change and enabling context bridging learning scenarios beyond the face-to-face classroom.

Chapter Seven: Case Study 3

Chapter seven overviews and analyses the Diploma of Contemporary Music mlearning projects from 2008 to 2009 using the identified critical success factors as a critical framework. The case study highlights the importance of course integration of mlearning and sustained engagement to bring about lecturer ontological shifts reconceptualising pedagogy.

Chapter Eight: Case Study 4

Chapter eight overviews and analyses the 2009 Bachelor of Architecture mlearning project using the identified critical success factors as a critical framework. The case study highlights the critical factor of getting lecturers on-board with a supporting community of practice scaffolding the implementation and pedagogical integration of the mlearning projects within a course.

Chapter Nine: Case Study 5

Chapter nine overviews and analyses the 2009 Bachelor of Performing and Screen Arts mlearning project using the identified critical success factors as a critical framework. The case study illustrates the importance of building a supportive learning community around the mlearning projects.

Chapter Ten: Discussion

The discussion outlines the unique affordances of mobile web 2.0 aligned with a social constructivist pedagogy as identified by the five case studies. The chapter then describes how the research has informed Unitec's new elearning strategy, enabling positive institutional change as part of the action research goal. Then the discussion draws together the implications of the five case studies for answering the research questions, finishing with a summary of pedagogical and support principles and strategies that can be extrapolated from the research findings.

Chapter Eleven: Conclusions

The final chapter highlights the significance of the research and summarises the key findings of the research. The limitations of the research are identified and recommendations are made for further research.

2 SUBSTANTIVE LITERATURE REVIEW

This section of the thesis summarises the scope of current and previous mlearning research, informing the research direction, and provides an explanation of the terms, web 2.0 services and core technologies used throughout the research process. This is followed by an overview of those mobile web 2.0 services outlined in the researcher's mlearning concept map (See Figure 1).

2.1 Summary of Current Mlearning Research

This section briefly overviews a short history and critique of mobile learning research, indicating the research gaps that this study attempts to fill, and situates the research project within the context of current mobile learning activity.

The twenty-first century has seen the consolidation and maturing of mobile learning research (Traxler, 2008). However, at the beginning of this research wireless and mobile computing was still in its infancy in New Zealand tertiary education with only a few active researchers (Chan, 2006, 2007; Cochrane, 2005b, 2006c, 2007f, 2007g, 2007h; Mellow, 2005; Parsons & Ryu, 2007; Ryu, Brown, Wong, & Parsons, 2007). Internationally, many early (pre 2005) mlearning studies were typically short-term pilot studies. In their summary of the scope of mlearning research, Traxler and Kukulska-Hulme's (Kukulsa-Hulme & Traxler, 2005b; 2005) main critique of these early mlearning research projects was for a general lack of rigour in evaluation and epistemological underpinnings.

> The field of mobile learning is at present characterized by a proliferation of pilots and trials that allow mobile technologies to be tested out in a variety of learning contexts. The sustained deployment of mobile learning will depend on the quality of these pilots and trials, which includes evaluation methodology and reporting… The vast majority of pilots and trials in our sample had no explicit or apparent

> educational or epistemological foundations. (Traxler & Kukulska-Hulme, 2005, p. 65)

Therefore one of the first goals of this research was to explore and choose appropriate foundational pedagogies.

According to Cook (2009a) and Sharples (2009a, 2010), the development of mobile learning research has been characterised by three general phases:

1. A focus upon devices (For example: Handheld Computers in Schools (Perry, 2003))
2. A focus on learning outside the classroom (For example: MOBILearn (O'Malley, et al., 2005))
3. A focus on the mobility of the learner (For example: MyArtSpace (Sharples, Lonsdale, Meek, Rudman, & Vavoula, 2007), CONTSENS (Cook, 2010))

Since the beginning of this research there has been a flurry of mlearning research and case studies, particularly from the United Kingdom (UK). Mlearning and web 2.0 technologies have been identified as emerging tools to enhance teaching and learning (Anderson, 2007; Becta, 2007; Johnson, Levine, & Smith, 2009; McFarlane, Roche, & Triggs, 2007; McLoughlin & Lee, 2008a; New Media Consortium, 2007, 2008; Sharples, Milrad, Sanchez, & Vavoula, 2007; Traxler, 2007; Trinder, Guiller, Marggaryan, Littlejohn, & Nicol, 2008), but are not usually explicitly linked together. The increase in mlearning-focused conferences (For example: MLearn, Handheld Learning, mICTe, IADIS mlearning conference), research projects and briefing papers from organizations such as JISC and BECTA, articles in educational journals such as Educause, and JCAL, demonstrate an increase in mainstream interest in mlearning.

Approaches to mlearning vary from a focus upon content delivery (McKinney, Dyck, & Luber, 2009), SMS (Mellow, 2005), polling (Dyson, Litchfield, Lawrence, Raban, & Leijdekkers, 2009), and location awareness (Educause Learning Initiative, 2009a; Pachler, et al., 2010), to facilitating student generated content sharing (Sharples, Peter Lonsdale, et al., 2007), and augmented reality (Priestnall, Brown, Sharples, & Polmear, 2009; Sharples, 2009a). In their review of one hundred and two innovative mobile learning projects published between 2002 and 2007, Frohberg et al. (2009) found that only five percent of these projects focused upon social learning, less than four percent required higher level thinking, with eighty nine percentage targeting novice learners, and ten percent facilitated user-generated content. Many mlearning studies focus upon content delivery for small screen devices (Stead & Colley, 2008) and the personal digital assistant capabilities of mobile devices (Corlett, Sharples, Bull, & Chan, 2005) rather than leveraging the potential of mobile devices for collaborative learning as recommended by Hoppe, Joiner, Milrad and Sharples (2003):

> 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, p. 1)

Informal mlearning case studies in museum tour environments have been popularized by the work of Sharples and Lonsdale et al. (2007). Other popular mlearning project contexts include the use of Podcasts (McKinney, et al., 2009) or mobile devices for language learning (Thornton & Houser, 2005), and geolocation (Priestnall, et al., 2009). Many recent mlearning research projects while focusing on the informal learning environment, often presuppose a "self-motivated learner"

(Cook, Pachler, & Bradley, 2008, p. 4) such as pre-service teachers. Few studies have yet to explicitly bridge both the formal and informal learning contexts within ‘mainstream’ tertiary education. One exception was the AMULETS (CeLeKT, 2009) project (Advanced Mobile and Ubiquitous Learning Environments for Teachers and Students), which explored collaboration in a variety of contexts, bridging indoor and outdoor learning experiences using mobile and location aware devices in both secondary and tertiary scenarios.

Several larger mobile learning projects have tended to focus on specific groups of learners, rather than developing pedagogical strategies for the integration of mlearning within tertiary education in general. For example: the “m-learning project” extended over four years, focusing on retention of at risk learners by using cell phone technologies (Attewell, 2005). The RAMBLE (Remote Authoring of Mobile Blogs for Learning Environments) mobile learning project (Trafford, 2005) investigated the use of mobile devices for blogging and accessing a VLE (virtual learning environment). However the mobile devices (Palm OS PDAs) were not wireless capable, relying upon desktop computers for synchronization to update the students’ blogs. In comparison, Corlett, Sharples, Bull and Chan (2005) identified wireless connectivity as a key factor in the success of their implementation of a mobile learning organizer. Other examples of large-scale mlearning projects include: MOBILearn (Europe), MobilED (South Africa) and MoLeNET (UK). MoLeNET was possibly the largest mlearning research project undertaken so far. MoLeNET was UK based, focused on FE (Further Education institutions) and funded by the Learning and Skills Council. In its initial phase (2007 to 2008), the MoLeNET project included thirty-two FE institutions undertaking a variety of mlearning implementations. In its third year, MoLeNET provided twelve million pounds of funded investment in mlearning in the UK to one hundred and fifteen Colleges and twenty-nine Schools, involving around twenty thousand learners and four thousand staff. MoLeNET funding has been directed towards wireless infrastructure and the purchase of mobile devices, and it is yet to be seen whether this approach can be sustainable or transferable to student-owned devices (Traxler, 2009a, 2010) and newer mobile devices as those purchased quickly become out-dated. Many of the MoLeNET projects investigated the affordances of a variety of mobile devices loaned to students for accessing course related content. The focus of these projects tended to be on the delivery of content for access on a range of mobile devices. This approach is explicit in MoLeNET's definition of mobile learning: "exploitation of ubiquitous handheld hardware, wireless networking and mobile telephony to enhance and extend the reach of teaching and learning" (Learning and Skills Network, 2009, p. 1). As such, the MoLeNET project can be characterised as a step backwards to the first 'phase' of mobile learning, a focus upon devices. However, the MoLeNET project had a robust focus on developing a model of professional development and support for educators, and a rigorous evaluation process.

The level of government funding of mlearning projects in the United Kingdom has spawned a very active mlearning research community, and as a consequence the United Kingdom is regarded as 'leading' the world in mlearning research (Sharples, 2009a). The availability of mlearning research funding has sometimes led to the exploration of bizarre, and overly complicated projects (Priestnall, et al., 2009; Sharples, 2009a; Sharples, Corlett, Bull, Chan, & Rudman, 2005) that push the boundaries of the current mobile technology but do not produce widespread adoption or pedagogical transformation. However, some of these projects have produced sustainable models, for example the development of OOKL as a framework for interactive museum visits facilitating links to reflective classroom presentations (Sharples, 2009a; Mike Sharples, Peter Lonsdale, et al., 2007; Sharples, Vavoula, Meek, Lonsdale, & Rudman, 2007). The focus of much of this government funding has been on 'at-risk' learners, accounting for the high percentage of mlearning projects in this context. In comparison, mlearning research projects in Australia and New Zealand are typically funded on a 'shoe-string' budget. As a result Australian and New Zealand mlearning projects are generally smaller in scale than the large-scale United Kingdom projects such as MoLeNET, and have tended to be more focused upon exploring cost-effective mlearning implementation strategies (Bell, Cockburn, Wingkvist, & Green, 2007; Chan, 2006, 2007; Clark, Sutton-Brady, Scott, & Taylor, 2007; Herrington, Herrington, Mantei, Olney, & Ferry, 2009b; Jamieson, 2004; MacCallum & Kinshuk, 2007; Mackay, 2007; Mellow, 2005; Nalder, Kendall, & Menzies, 2007; Ragus, et al., 2005; Scornavacca, Huff, & Marshall, 2007).

A list of a range of up to date mlearning projects from around the world can be found on the International Association for Mobile Learning website http://mlearning.noe-kaleidoscope.org/projects/ (2008). The listed projects encompass a wide variety of mlearning implementations. Many projects involve the development and use of proprietary software (and sometimes hardware) that is often platform specific (for example: Windows Mobile), or Java-based, and also often only has a limited 'shelf-life' as the designed-for devices go out of date quickly. The software is also usually task specific and hard to customise. These projects balance investment in high levels of technology support and development against low levels of user training required (simple and task-specific interfaces). These projects require high technical expertise (specialist mobile application programming knowledge) and are therefore often complicated and difficult to transfer to widespread adoption.

European mlearning research has focused upon the context affordances of mobile devices. In their summary of European mlearning research Kukulska-Hulme et al. (2009) concluded:

> While delivery of educational content to mobile devices may have specific uses in training and professional development, there are other approaches to mobile learning that can make better use of the distinctive properties of mobile technology, including context-based guidance, learning through conversation, and mobile media creation. (p. 19)

For example, Cook's (2010) mlearning research projects focused upon augmenting the learners experience in the field, and in reflection he asks "How do we get beyond good and useful exemplars?" (Cook, 2009b, p. 35). He proposed that to get wide scale practitioner and institutional up-take requires an institutional cultural change. Several criticisms can be leveled at these 'exemplars': the projects do not demonstrate a focus upon student-generated content or contexts as they are pre-defined, there is no long-term change in student learning paradigms as these are short day-long projects with no longitudinal scaffolding for students to personally appropriate the use of the mobile tools beyond the project, the students involved are self-motivated learners and involve small numbers minimizing transferability, and there is a high technical requirement for these projects involving the development of project-specific and intricate augmented reality multimedia.

To minimise the technical expertise required for mlearning implementation and maximise transferability, while explicitly using a social constructivist pedagogical foundation, the researcher decided to focus upon the potential of mobile web 2.0. Mobile web 2.0 enables learner-generated content and learner-generated contexts as suggested by Cook et al. (2007) and Luckin et al. (2008), guided by the pedagogical integration of these into their courses as emphasised by Herrington and

Herrington (2007), and Laurillard (2007). Examples of mlearning projects with a focus on freely available mobile web 2.0 tools and a social constructivist pedagogy include the work of Chan (2007), the JISC funded MORSE project (Andrew, Hall, & Taylor, 2009), and the mlearning projects at the University of Wollongong (Herrington, 2008; Herrington, Herrington, et al., 2009b; Herrington, Mantei, Herrington, Olney, & Ferry, 2008). Chan investigated the potential of moblogging to support work-based learning for apprentice bakery chefs. The MORSE project (November 2008 to October 2010) investigated the use of mobile web 2.0 tools to support students away from the institution during fieldtrips and work placement (ranging from one day to two weeks duration up to 15 times per year). The University of Wollongong projects were a series of short-term (six week long) mobile learning projects based around the affordances of institutionally loaned Palm Treo smart phones and iPods in tertiary education. While following a similar approach to mobile web 2.0 implementation to that of the researcher, these mlearning projects were all limited either by a focus upon a single course context or the short-term nature of their implementation.

There is a wealth of research into the use of mobile devices in education that can be utilized for future research, for example: JISC have produced a guide to implementing mobile learning within a tertiary institution (JISC, 2005c), user evaluation surveys for implementation trials, and a manager's framework for implementing WMD's in higher education (Knight, 2005). These resources were used to inform the design of the mobile projects reported in this thesis, along with the results and lessons learnt from the range of mlearning projects reviewed. In summary the literature indicates that there is a gap in mlearning research around the integration of mobile web 2.0 within longitudinal projects focused upon learner-generated content and learner-generated contexts.

2.1.1 What the Research Indicates: The Impact of Mobile Learning

The third annual international mobile learning conference MLEARN 2004 was organised by two of the earlier large-scale mobile learning research projects: the MOBILearn and m-learning projects. The m-learning project concluded:

> Overall, analysis of the evidence suggests that mobile learning can make a useful contribution to attracting young people to learning, maintaining their interest and supporting their learning and development. (Attewell, 2004, p. 12)

The MOBILearn project (2002-2005) resulted in four key observations (Sharples, 2010):

- Focusing on the mobility of the learner is central.
- The need to be flexible, modular, blended, integrated with existing tools, rather than developing a monolithic system.
- A user/learner learns throughout the day, it is interwoven with everyday life.
- Context is constructed by learners through movement and interaction.

The lessons of these earlier large mlearning projects informed the development of another UK-based large-scale mlearning project, MoLeNET (2007-2009).

2.1.1.1 MOLENET – Towards Widespread Adoption

MoLeNET was the United Kingdom's (UK), and probably the world's, largest and most diverse implementation of mobile learning (Learning and Skills Network, 2009). As such, it is useful to overview the MoLeNET project and its initial research findings. One hundred and fifteen colleges and twenty-nine schools have been, involved in MoLeNET. All MoLeNET projects were led by English Further Education (FE) colleges, and the main focus was mobile learning in the learning and skills sector. Approximately ten thousand learners were involved in 2007/08 with around twenty thousand learners involved by the end of the 2008/09 academic years together with more than four thousand staff.

The Learning and Skills Council and consortia led by Further Education colleges together invested over twelve million pounds in MoLeNET (Learning and Skills Network, 2009). Interested institutions bidded for participation in the funding, and were then required to contribute their own funds towards accepted projects. The first phase included thirty-two projects, involving one hundred and thirty six partner organisations. The second phase of MoLeNET included thirty new projects, some involving organisations from phase one and some introducing mobile learning for the first time. All projects were supported by the "MoLeNET Support and Evaluation Programme" led by the Learning and Skills Network (LSN), which established a strong peer and expert support group model (Continuing Professional Development or CPD), including:

- Face to face events
- On-line events
- Advice, assistance, peer-to-peer support, knowledge and resource sharing delivered through on-site visits and via moodle
- Knowledge sharing seminars. (Attewell, 2008, p. 34)

Initial MoLeNET research findings (Attewell, Savill-Smith, & Douch, 2009) (summarised below) indicated that the use of mobile technologies for teaching and learning can produce significant benefits for learners, staff, institutions, and the wider sector.

In summary, the MoLeNET findings are very pragmatically focused, providing useful guidelines for future mlearning project implementation. While the first report covered results from the first two years of implementation only, many MoLeNET project managers reported that the full benefits of introducing mobile learning emerge over a timescale longer than one academic year and become more apparent over the length of a project (Attewell, 2008; John, 2010).

2.1.1.2 Mlearning Research Methodologies

Chen, Millard, and Wills (2008) evaluated the forty research papers submitted to MLearn2007, categorizing the seventeen mlearning scenarios described according to a four category framework (Learning Objective, Learning Environment, Learning Activity and Learning Tools) to establish how student-directed these projects were. Only two papers demonstrated alignment with being student-directed in all four categories (One of these was the researcher's paper (Cochrane, 2007f)). The authors therefore concluded:

> In essence m-learning researchers are reinventing the VLE on the mobile device, rather than looking at how we could use them to support more subtle aspects of informal learning, and thus the increasingly important PLE area. (Chen, et al., 2008, p. 88)

This selection of the mlearning research literature therefore indicates that the majority of current research has focused upon delivery of content to mobile devices (teacher generated and controlled) rather than student generated content and contexts.

Another review of MLearn2007 and 2008 papers (Wingkvist & Ericsson, 2009) classified and critiqued the research methodologies reported in these papers.

All seventy-six full papers were classified according to eight research methodologies (Case study, Field study, Action research, Experiment studies, Survey research, Basic research, Applied research, and Normative research) and four research purposes (describing, developing, understanding, and evaluating). The reviewers found that the representative mlearning research consisted predominantly of small-scale descriptive case studies with little evaluation and reflection witnessed. An action research methodology was used by only five percent of these papers. This indicates that there is a significant gap in the literature of mlearning research dealing with longitudinal action research projects. With some notable exceptions (for example: MoleNET), mlearning research has been predominantly characterised by short-term case studies focused upon the implementation of rapidly changing technologies with early adopters but with little evaluation, reflection or emphasis on mainstream tertiary education integration.

2.2 Why Mlearning? – Facilitating Pedagogical Change

The goal of the research and project was to move pedagogical approaches in tertiary education from instructivist pedagogies to a social constructivist pedagogy (Head & Dakers, 2005; McLoughlin & Lee, 2008a; McMahon, 1997; Vygotsky, 1978) and to facilitate a context bridging collaborative learning environment (Cook, et al., 2008; Laurillard, 2007; Stead, 2006; Trinder, et al., 2008; Vavoula, 2007b). The disruptive nature of mlearning and web 2.0 can act as a catalyst for such pedagogical change (Fielder, et al., 2004; Herrington, Herrington, et al., 2009b; Herrington, et al., 2008; McLoughlin & Lee, 2008a; Mike Sharples, 2001, 2005; Stead, 2006). The following sections introduce and critique popular arguments for engaging with mlearning and the disruptive nature of introducing mlearning within tertiary education. The section then finishes by identifying gaps in mlearning research.

2.2.1 The Net Generation

Oblinger and Oblinger (2005) observe that the majority of school leavers can be described as: technically literate, multitasking, collaborative, connected. They have been nicknamed the 'net-generation' and 'digital natives' (Oblinger & Oblinger, 2005; Prensky, 2005a). Boyd and Ellison (2007) add that increasingly school leavers are entering tertiary education with content creation skills honed from their immersion in digitally facilitated social network sites. These learners have also been named 'generation C', the content creation generation (Bruns, 2007). As Bruns argues (2007, 2008), this is not necessarily age related, but "a loose but significant grouping of participants who (on average, and perhaps implicitly rather than explicitly) share a set of common aims and practices" (Bruns, 2007, p. 2).

This portrayal of school leavers immersed in web 2.0 use has been challenged. For example, Kennedy et al. (2007) refute Prensky's (2001) assertion that school leavers are "fundamentally different" from previous generations of learners, or wired differently, their surveys indicate a generally high usage of some web 2.0 tools by these students, and indicates a very high percentage of first year students had access to computers, internet and mobile phones (almost ubiquitous in 2006). This was supported by the researcher's own student surveys from 2006 to 2009, for example see Figure 30 comparing three different groups of students' previous experience of technology. Thus the researcher argues that it is in general these students' willingness (and in many cases preference) to adopt new technology that sets them apart from previous generations of learners, rather than a fundamental difference as asserted by

Prensky. This is consistent with the findings of a JISC (2007) survey of tertiary students. Therefore there is potential to engage and guide these learners in education by leveraging web 2.0 tools within pedagogically designed, collaborative, technologically rich social constructivist environments (Alexander, 2006; Herrington & Herrington, 2006b; McLoughlin & Lee, 2008a). However, while Prensky's assertions are criticized for being fundamentally flawed extrapolations based on flimsy statistics (Sheely, 2008), Prensky can at least be credited with increasing awareness and starting a discussion around the use of technology in education. Sheely (2008) pulls apart and critiques Prensky's assertions around "digital natives", but then concludes that although Prensky's argument was based on poor statistical analysis leading to a false assertion that these learners are fundamentally different to their predecessors, technology does have a place in designing engaging social constructivist learning environments.

To engage learners a lot of thought must be given as to how their preferred means of communications technologies (mobile devices) can be integrated into the teaching and learning environment. Mobile devices are inherently social, enabling rich social interaction, and have the potential for enhancing group work and communication within educational settings (Cameron, 2006; Carroll, Howard, Peck, & Murphy, 2003; Herrington, et al., 2008; Pachler, et al., 2010). In general younger tertiary learners are constantly connected to their social networks via their wireless mobile devices (JISC, 2009a). A 2006 survey of Australian students born since 1980 indicated that 95 percent owned mobile phones, 73 percent owned MP3 players or iPods, 23 percent had their own games console and 15 percent had a personal digital assistant (Litchfield, et al., 2007). Their preferred method of communication was text messaging (65 percent (Cameron, 2006)), followed by instant messaging (New

Zealand Herald, 2006). An ECAR survey of 27,846 students at 103 USA higher education institutions indicated 84.1 percent of students used instant messaging daily while 81 percent used social networks daily (Caruso & Salaway, 2007).

In comparison, many lecturers may be unfamiliar or uncomfortable with the use of the tools described above (Blogs, wikis, RSS, instant messaging) (JISC, 2009a). Before lecturers can implement mobile learning they require understanding and experience of a range of foundational learning technologies (Lang, Vargas, & Conover, 2007). Most mobile learning projects involve only a small number of lecturers, who are already techno-savvy enough to be confident incorporating mlearning (Dyson, Raban, Litchfield, & Zmijewska, 2008; Keegan, 2005a; Stead, 2005). To move mobile learning into the mainstream of an institution requires a strategy for up-skilling academics in integrating technology into their pedagogies (Kukulska-Hulme & Pettit, 2007; Moser, 2007).

*2.2.2 **Intentional Disruption***

Disruptive technologies (Sharples, 2000, 2001, 2005; Stead, 2006) are those technologies that challenge established systems and thinking, requiring change and are thus viewed by many as a threat to the status quo. Disruptive technologies potentially democratise education environments challenging the established power relations between lecturers and students. Koszalka and Ntloedibe-Kuswani (2010) cite Alexander (2004) and Jenkins (2006) to define this pedagogically democratizing effect: “M- technologies can empower learners by shifting the balance of control from learner as consumer of teacher knowledge to learner as communicative participant” (p. 142). Mishra et al. (2007) argue that managing this disruption positively requires careful pedagogical design: “appropriate use of technology in teaching requires the thoughtful integration of content, pedagogy, and technology" (p. 2). They go on to expand upon their argument:

> The addition of a new technology reconstructs the dynamic equilibrium between all three elements forcing instructors to develop new representations of content and new pedagogical strategies that exploit the affordances (and overcome the constraints) of this new medium. Similarly, changing pedagogical strategies (say moving from a lecture to a discussion format) necessarily requires rethinking the manner in which content is represented, as well as the technologies used to support it. (Mishra, et al., 2007, p. 8)

Mishra et al. (2007) illustrate the types of changes the introduction of WMDs in education require. These include changes in pedagogical strategies, content (reformatted for small screens and lower data bandwidths), and contexts (beyond the face-to-face classroom environment). In a social constructivist view of learning, creating a student centred, self-directed learning environment is seen as necessary for deep learning to occur. The disruptive nature of web 2.0 and mobile technologies facilitates a move from instructivist pedagogies to social constructivist pedagogies. The personal, social networking, and context awareness of mobile devices democratise power relationships as the focus shifts from teacher-generated content and contexts to student generated content and contexts. Sharples et al. (2006) refer to this as a "democratic synergy" that creates a "re-conception of learning" (p. 22). The disruptive nature of mobile devices requires educators to rethink learning environments and assessments in order to integrate the technology into their pedagogical approach. As Laurillard (2007) reinforces, the role of the educator in designing and facilitating effective mobile learning environments is critical. For many lecturers this will require an 'ontological shift' in their understanding of what it means to teach, and can represent a fundamental challenge to the lecturer's understanding of self within the context of the nature of teaching and learning. An 'ontological shift' is "the re-assignment or re-categorizing of an instance from one ontological category to another" (Chi & Hausmann, 2003, p. 432), or simply put, a reconceptualisation. This shift involves a reconceptualisation of lecturers' understanding of teaching and learning from their prior experience to understandings built upon the foundation of learning theory such as social constructivism. This ontological shift can take significant time as lecturers reconceptualise and develop new and appropriate forms of assessment, collaboration, and communication strategies. Hameed and Shah (2009) explore issues surrounding the institutional implementation of mlearning and the changes required. They identify "Cultural Re-alignment" (Hameed & Shah, 2009, p. 340) as a key driver to facilitate the institutional implementation of mlearning.

This disruption is not limited to the role of the educator, but also to students' workflow and perceptions of education and their self understanding within this context. As WMDs are used to facilitate a move to social constructive learning environments, many students will be forced to undergo an ontological shift, or reconceptualisation of the nature of learning. For many students the facilitation of anytime anywhere learning and the use of their social devices will be met with feelings of intrusion and resistance. However, some students will find a new sense of empowerment and connectedness in this new educational environment. Both of these reactions have been experienced during the mobile projects at Unitec referenced later in this thesis. The Diploma of Landscape Design mlearning case study (Cochrane, 2009e) provides a clear example of the disruption in teaching and learning facilitated by the integration of WMDs into a course.

The disruptive nature of WMDs also allows them to be used as catalysts for students to look at 'threshold concepts' in new ways to facilitate their understanding of these 'conceptual gateways'. Land, Cousin, Meyer and Davies (2005) describe ‘threshold concepts’ as key concepts that transform the perception of a particular subject, and are often ‘troublesome’ or difficult for students to grasp.

2.2.3 Identifying the Gaps in the Mlearning Research Literature

The researcher’s review of the mlearning literature indicates that to date there are several common shortcomings in the majority of mlearning research. The identified shortcomings can be addressed by the explicit planning and investigation of these issues within research project design.

- A lack of explicit underlying pedagogical theory (Traxler & Kukulska-Hulme, 2005).
- A lack of transferable design frameworks (Armstrong, et al., 2008; Sharples, et al., 2009)
- A general lack of evaluation of the projects (Kukulsa-Hulme & Traxler, 2005b; Vavoula & Sharples, 2009).
- A lack of longitudinal studies (Traxler & Kukulska-Hulme, 2005).
- A lack of the importance of pedagogical integration (Laurillard, 2007).
- A lack of explicit student and lecturer support and scaffolding (Attwell, 2007; Herrington & Oliver, 2000).
- A lack of awareness of the ontological shifts (Chi & Hausmann, 2003) required for both the learners conception of learning and the lecturers conception of teaching. Often ‘net generation’ skills are assumed (Barbaux, 2006), and most of the case studies consist of lecturers who are early technology adopters (Armstrong, et al., 2008).

While the first four shortcomings of mlearning research have been signaled by several researchers’ there has been little emphasis upon the last three shortcomings identified here. The researcher believes that this is the result of the focus of the three phases of mlearning research (characterized in section 2.1) upon short-term projects that expore mlearning mainly within informal learning contexts with little focus upon sustainable integration of mlearning into formal education contexts. These last three identified shortcomings were explored in this research thesis.

2.3 Wireless Mobile Devices – Ubiquitous Connectivity

As ubiquitous wireless connectivity is a key component in facilitating the context-bridging social constructivist learning environments investigated by the research, an introduction to wireless connectivity is appropriate. This section outlines the wireless connectivity options available for the research projects, and provides a brief overview of the types of wireless devices considered for the research.

Wireless Mobile Devices include; the wireless enabled ultra mobile PCs (UMPC Community, 2006), netbooks (small, low priced laptops with 3G connectivity built-in), cell phones, smart phones, PDAs, and wireless enabled portable media devices (for example: the Apple iPod Touch). While the use of wireless laptops has been well established, but still mostly in an ad hoc mode within the tertiary education scene (Bryan, 2007; the Node Learning Technologies Network, 1999; Wolff, 2006), WMDs potentially provide all the processing power and communication applications that students need, at a lower cost, greater portability and longer battery life than a laptop computer. Additionally, a WMD is not made redundant by a laptop or desktop computer, but is usually designed to complement them. Moreover, a WMD usually includes context aware (for example: GPS, Compass) and content generation tools (for example: high quality still and video camera, and handwriting recognition capable touch-screens) that are unique to these small mobile devices. WMDs tend to have longer battery life than laptops, lower prices, and due to their relatively small size, are much more portable. New mobile and context-aware technology can enable students to learn by exploring their world, in continual communication with and through technology (Sharples, 2005). This continual communication is enabled by wireless connectivity that comes in a variety of forms. The two main forms of wireless Internet connectivity for WMDs (WiFi and 3G) are outlined in the following sections.

2.3.1 WiFi Connectivity

WiFi is the popular name for the 802.11 wireless Ethernet standard (IEEE Standards Association, 2009). WiFi is basically an extension and bridge to a wired network. Anything that can be done on a wired network can be done on the WiFi network (unless IT departments limit the functionality of the WiFi network). This allows WMDs to connect to the Internet via the institutions network.

The numbers of students that have limited or no Internet connectivity at home have dramatically reduced since 2006. A 2009 (unpublished) Unitec student survey indicated 80 percent of Unitec students had broadband Internet access at home, and increasingly students have access to broadband Internet coupled with a home WiFi network. In comparison, in 2006, WiFi access points on campus were rare, covering only a small percentage of the Unitec campus. Since 2009 most Unitec teaching spaces, and designated student learning spaces have WiFi coverage on campus. Similarly, since 2006 many Tertiary education institutions in New Zealand that had limited or no WiFi networks, have implemented WiFi access on their campuses. The almost ubiquitous nature of WiFi connectivity on tertiary education campuses provides a cost-effective connectivity solution for WiFi enabled WMDs.

The flexibility of wireless connectivity is one of the keys to the collaborative use of mobile technologies. In conjunction with WMDs, wireless connectivity promotes the establishment of a virtual collaborative learning community producing a higher level of communication between lecturers and students and between students themselves from anywhere on campus (WiFi access was free for Unitec students and lecturers throughout the period of the research) or any publically accessible wireless hotspot. The majority of public WiFi networks require paid access, or limited complimentary access with retailer purchases. For example, in 2009 there were 363 Telecom WiFi hotspots listed throughout NZ, and 116 in Auckland (Telecom NZ, 2009), including Starbucks cafes, hotels, and most shopping Malls, providing students with options beyond campus for WiFi Internet connectivity.

2.3.2 3G Connectivity

An initial wireless mobile device trial at Unitec (2006) indicated that one of the key aspects of wireless mobile device utilization is the potential for ubiquitous (anywhere) connectivity. Students value anytime anyplace connectivity with classmates, lecturers, and resources (JISC, 2007). However, WiFi wireless connectivity offers limited wireless coverage and range, with limited free availability, whereas 3G cellphone data connectivity offers virtually ubiquitous wireless connectivity, but at a higher cost to the user. The observed trend throughout the period of the research has been consumer-driven demand resulting in increasing coverage of 3G mobile connectivity and decreasing costs. As new wireless technologies are developed, faster and more cost-effective services become available. For example, the New Zealand Telco-based 3G wireless infrastructure provides access to 97 percent of the New Zealand population (Drinnan & Twose, 2009), providing a viable wireless data connectivity option. However along with 'broadband' Internet connection fees New Zealand experiences one of the highest user costs of 3G data and therefore has experienced one of the slowest uptakes in the OECD (Putt, 2007a). However, since August 2008, the price of prepaid and on account mobile 3G broadband connectivity has significantly decreased, leading to a much higher adoption (Newman, 2009). The rapid roll-out of wireless connectivity options in New Zealand paralleled the development of the research project, indicating that the time was right for the introduction of the innovative use of WMDs. Figure 2 outlines the development of 3G connectivity availability in New Zealand. As indicated in Figure 2, 2008 and 2009 saw significant changes in the 3G technologies and competition of supply available in New Zealand, which has also been reflected in the lowering of the cost of these services.

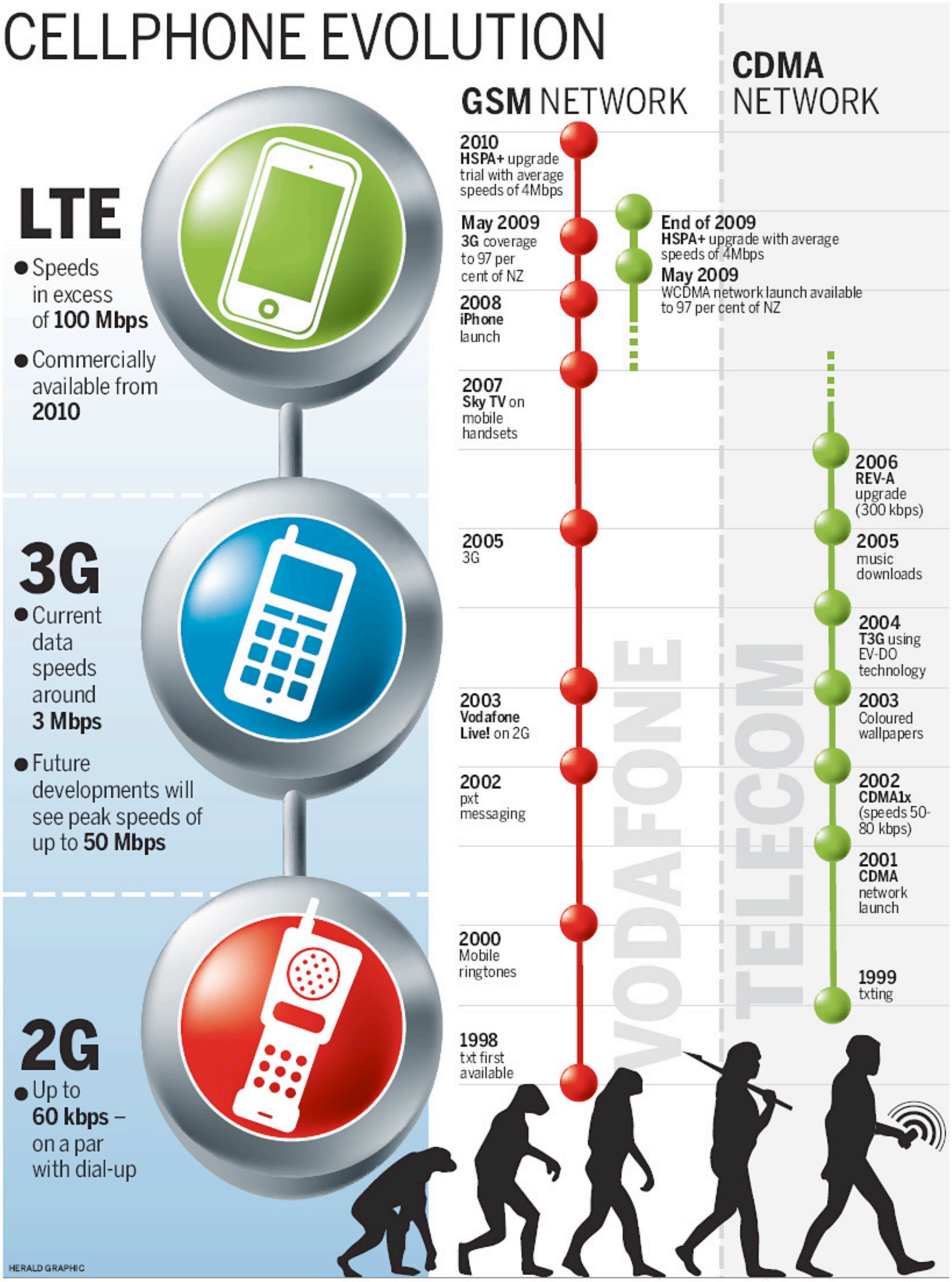


Figure 2: Cellphone Evolution. (Drinnan & Twose, 2009)

As Figure 2 indicates, the speed and coverage of 3G Internet access has increased dramatically since 2006. However, for students and lecturers, the cost of 3G data during 2007 to 2009 was a critical factor. The high cost and small data caps of 3G data available in New Zealand have made it an unviable solution in education. However, mobile broadband options introduced in 2008 and 2009 by both Vodafone and Telecom finally made 3G data connectivity viable for students, at near traditional broadband costs and speed. Most of the web 2.0 activities utilised in the mlearning projects were very cost-effective, the exception being the direct upload of high quality video from smartphones to the Internet.

2.3.3 Cell phones

Mobile phones have become powerful computers. The catch phrase of Nokia's 2007 add campaign for its N-Series smart phones was: "It's what computers have become" (Nokia, 2007). The New Media Consortium (NMC) has signalled the impact of these emerging smart phones on education in consecutive reports from 2007 to 2009. For example, in the 2007 NMC report Johnson, Levine and Smith (2007) reported that:

> The convergence of ubiquitous broadband, portable devices, and tiny computers has changed our concept of what a phone is meant to be. A pocket-sized connection to the digital world, the mobile phone keeps us in touch with our families, friends, and colleagues by more than just voice. Our phones are address books, file storage devices, cameras, video recorders, way finders, and hand-held portals to the Internet—and they don't stop there. The ubiquity of mobile phones, combined with their many capabilities, makes them an ideal platform for educational content and activities. We are only just beginning to take advantage of the possibilities they will offer. (Johnson, et al., 2007, p. 15)

According to Google the largest growth area of Internet usage is mobile access. "'Mobile, mobile, mobile,' were the words of Google chief executive Eric Schmidt when asked what technologies are most intriguing to the computer Web search leader" (Wakabayashi & Auchard, 2007, p. 1). The advantage of the cell phone is that virtually every student and lecturer already own one. A 2009 report from the International Telecoms Union (ITU, 2009) illustrates the rapid growth in world-wide cellphone uptake, and the use of mobile broadband. The report's summarized findings (illustrated graphically in Figure 3) are:

- Mobile cellular has been the most rapidly adopted technology in history. Today it is the most popular and widespread personal technology on the planet, with an estimated 4.6 billion subscriptions globally by the end of 2009
- Mobile broadband subscriptions overtook fixed broadband subscribers in 2008, highlighting the huge potential for the mobile Internet
- In 2009, more than a quarter of the world's population are using the Internet (ITU, 2009, p. 1)

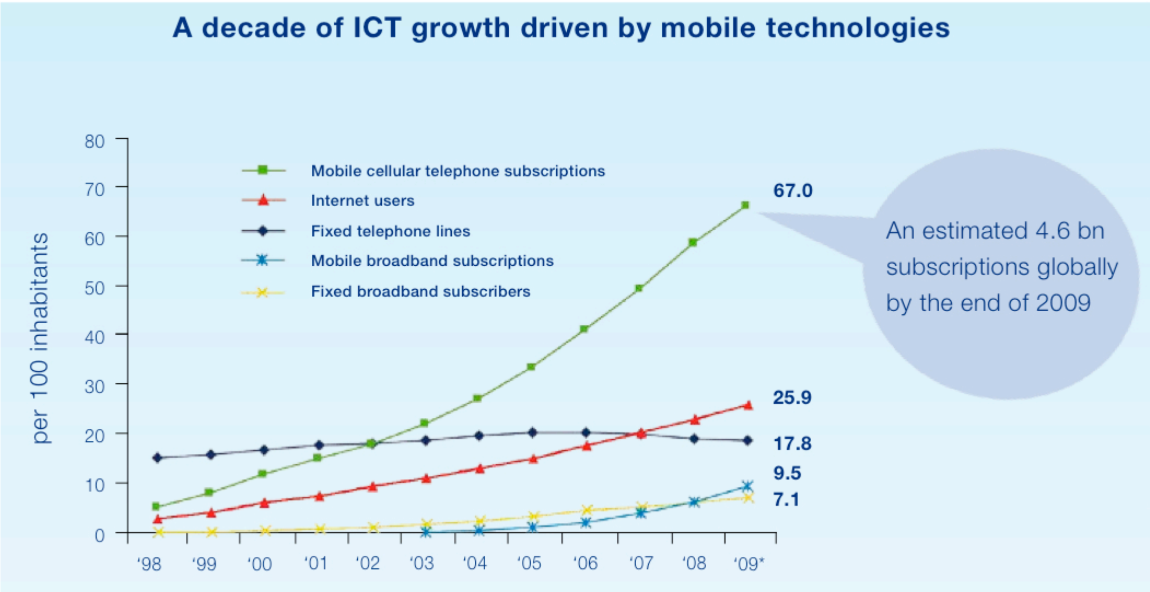


Figure 3: A decade of ICT growth driven by mobile technologies. (ITU, 2009, p. 1)

Because of the virtually ubiquitous ownership of mobile phones by students, Pachler, Bachmair and Cook (Pachler, et al., 2010) argue that mobile phone ownership among students has created a socio-cultural change that educators need to engage with. Marc Prensky (2005b) postulated that mobile phones can be used for a wide variety of learning activities. Prensky remarks: “What can you learn from a cell phone? Almost anything!” (Prensky, 2005b, p. 1). The ubiquitous personal ownership of cell phones by students creates issues around appropriate behaviour (particularly in primary and secondary education), for example their use for bullying (McLoughlin & Burgess, 2009), and also issues around integration into the educational curriculum (Fielden & Malcolm, 2007). These issues were dealt with within the research project by a combination of: an explicit acceptable use policy, and regular monitoring of participant issues via the communities of practice.

Cell phones facilitate the use of popular web 2.0 tools by including pre-installed mobile web 2.0 clients, particularly for Blogs and RSS feeds (Gohring, 2006). Even older ‘standard’ cell phones can leverage a growing host of web 2.0 tools using SMS, email, and downloadable Java applications.

‘Smart phones’ are cell phones with a multimedia capable operating system (OS). Smartphone operating systems include: Symbian OS, Palm OS (Web OS), iOS (on the iPod Touch, iPhone, or iPad), Windows Mobile, or Google’s Android mobile platform. These smartphones have many more options for integrating web 2.0 than cheaper cell phones (see Table 46), they often come pre-loaded with a range of useful applications, and can easily be upgraded with additional user-installable applications. While it is understood that operating systems such as those mentioned are subject to rapid change and eventually obsolescence, the research project has worked within their current limitations and potential, while keeping up to date with advances as they occurred. Therefore the research findings and implementation strategies are not dependent upon any particular mobile platform, and will be transferable to future mobile technologies.

Because of the ubiquity and the continual development of unique cell phone affordances, this research project focused primarily upon the potential of cell phones, and in particular smartphones. The following section explores the relationship between WMDs and web 2.0.

2.4 Mobile Web 2.0 – a Framework for Mainstream Adoption

It has been observed and asserted that school-leaving learners naturally engage with technology as an everyday part of their lives (Prensky, 2005a). However, when attempting to use technology to engage learners, there is often a disconnect between the technology appropriation of the learners and the lecturers. A 2007 article in the New Zealand TUANZ Topics magazine asked: "Are web2 communication tools such as blogs, wikis, webcasts and podcasts now an essential part of the teacher's toolkit?" (Putt, 2007b, p. 35). The article was written from a secondary school perspective, and Putt observes the tension between student access to cell phones and their teachers' general response:

> Most kids are walking around with one or two cellphones in their pocket, using them to text their friends, surf the Web, take photos, and post to their blogs. And yet as soon as they get to school they're told to turn the cellphones off. (Putt, 2007b, p. 35)

In comparison to the students characterised by Putt, many lecturers are unfamiliar or uncomfortable with the use of the mobile web 2.0 tools mentioned above (JISC, 2009a). Before lecturers can implement mobile learning they require understanding and experience of a range of foundational learning technologies. Most mobile learning projects involve only a small number of lecturers, who are already techno-savvy enough to be confident in moving to mobile learning. To move mobile learning into the mainstream of an institution requires minimizing the technological requirements, and strategies for supporting and up-skilling academics in integrating technology into their pedagogies (Cochrane, 2007h). The researcher proposes that focusing upon the educational use of freely available mobile web 2.0 tools is one way to achieve this. In this scenario, lecturers and students can focus upon the pedagogical affordances of mobile web 2.0 without requiring multimedia production or mobile application development skills.

The term web 2.0 was coined in 2005 (O'Reilly, 2005) as a way of characterizing the emerging interactive, user-centred web-based tools that have revolutionised the way the Internet is conceptualized and used. While O'Reilly's term was originally set within a business context, it has been appropriated as an overarching moniker for interactive web-based tools (JISC, 2009b). These tools include: blogs, wikis, image sharing (for example: Flickr), video sharing (for example: YouTube) and podcasting to identify a few. While definitions of web 2.0 are difficult to pin down, it is their similar characteristics that link these diverse web services. "Ultimately, the label "Web 2.0" is far less important than the concepts, projects, and practices included in its scope" (Alexander, 2006, p. 33). Accordingly McLoughlin and Lee (2007) define web 2.0 as: "a second generation, or more personalised, communicative form of the World Wide Web that emphasizes active participation, connectivity, collaboration and sharing of knowledge and ideas among users" (p. 665).

The characteristics of Web 2.0 include (Alexander, 2006, pp. 33-44):

- Web-based, usually requiring only a web browser and internet connectivity
- Moving beyond content delivery to personal publishing
- Ease of use
- Interactivity
- Collaboration and sharing
- End user customization
- User tagging and rating
- Either free or low-cost

These characteristics align with social constructivist pedagogy that is characterized by collaboration, and student exploration and guided discovery (Alexander, 2006; JISC, 2009b; McLoughlin & Lee, 2007). Social software, though often used synonymously with web 2.0, is a subset of web 2.0. Social software is usually specifically focused on collaboration, sharing and user personalization. McLoughlin and Lee (2007) list some of the key educational affordances of social software as:

> - Connectivity and social rapport
> - Collaborative information discovery and sharing
> - Content creation
> - Knowledge and information aggregation and content modification. (p. 667)

Leveraging these affordances of social software in education has gained a lot of interest from educational researchers (Alexander, 2006; Alexander, et al., 2006; Attwell, 2006; Bryant, 2006; Cych, 2006; Mejias, 2006; Wilson, 2006). Because of the close relationship between web 2.0 and social software, the researcher uses the term “web 2.0” to encompass both within the rest of this thesis.

Examples of web 2.0 tools include: blogs, wikis, RSS (Farmer, 2004; Glogoff, 2005; Kaplan-Leiserson, 2004), instant messaging, podcasting, social book marking, mobile video streaming, and augmented reality (such as Wikitude). These tools can be used to create rich personal and collaborative learning environments. Within the context of tertiary education, the term Personalized Learning Environments (PLEs) is often used to refer to combinations of tools that facilitate student ownership, customization, and sharing of content and social networking (Attwell, 2006; Chen, et al., 2008). However most institutional Learning Management Systems (LMS’s), such as Blackboard or Moodle, are hosted by the institution and typically require secure login access, limiting customization and sharing beyond the enrolled class and lecturers. In contrast, a combination of web 2.0 and mobile devices can be used to create flexible personalised learning environments (Cochrane, 2009a; Traxler & Kukulska-Hulme, 2006). A number of educators advocate this second approach to online learning environments (Alexander, 2006; Attwell, 2006; Bruns, 2007; Downes, 2005; Farmer & Bartlett-Bragg, 2005; Jafari, McGee, & Carmean, 2006; JISC, 2009b; McLoughlin & Lee, 2007). Attwell (2006) aptly describes this concept:

> Social software underpins what is loosely referred to as Web 2. Whereas Web 1 was largely implemented as a push technology - to allow access to information on a dispersed basis, Web 2 is a two way process, allowing the internet to be used for creating and sharing information and knowledge, rather than merely accessing external artifacts… The idea of the Personal Learning environment is in effect a Web 2, social software concept. (Attwell, 2006, p. 4)

However a PLE facilitated by web 2.0 does not have to be mutually exclusive with institutionally hosted LMSs. Jafari et al. (2006) proposed a model for a next generation e-learning environment that integrates social software tools:

> Stakeholders across the spectrum want an anytime, all-the-time, personalized experience of teaching and learning - one that utilizes all the currently available social tools, intuitive tools, smart agents, and interactive environments of Web 2.0 and social computing. In short, faculty, students, and administrators are waiting for an e-learning environment that is smart, environmental, archival, multi-modal, collaborative, and mobile. (Jafari, et al., 2006, p. 57)

Such an integrated system can be achieved using a mashup of web 2.0 tools and an institution's LMS. This approach allows for the greatest flexibility allowing students to choose from the wide variety of available web 2.0 services while continuing to access support and administrative services via the LMS. The use of web 2.0 in education therefore raises the importance of digital literacies for students. Walsh (2008) describes this as 'multimodal literacy', which she defines as: "the literacy needed in contemporary times for reading, viewing, responding to and producing multimodal and digital texts" (p. 101). Web 2.0, or 'social software' tools, share many synergies with social constructivist pedagogies. This appropriation of web 2.0 tools within a social constructivist pedagogy facilitates what has been termed "pedagogy 2.0" (McLoughlin & Lee, 2007). Pedagogy 2.0 is characterized by "personalization, participation, and productivity" (McLoughlin & Lee, 2010, p. 80). McLoughlin and Lee (2007, 2008a, 2008b, 2010) advocate the exploration of the potential of the alignment of web 2.0 tools and emerging learning theories based loosely upon social constructivism such as navigationism (Brown, 2006), and connectivism (Siemens, 2004).

> Pedagogy 2.0 integrates Web 2.0 tools that support knowledge sharing, peer-to-peer networking, and access to a global audience with socioconstructivist learning approaches to facilitate greater learner autonomy, agency, and personalization. (McLoughlin & Lee, 2008a, p. 1)

McLoughlin and Lee (2008a, 2010) make an explicit link between the affordances of web 2.0 and social constructivist learning theories, exploring the symbiotic link between social software (web 2.0) and new social constructivist learning theories to enable the transformation of pedagogy. The alignment of these ideas with the addition of the Pedagogy-Andragogy-Heutagogy continuum (Luckin, et al., 2008; Luckin, et al., 2010) are explored in section 3.6 of this thesis, and are developed further by the researcher in the discussion section 10.2 of this thesis.

However, the use of web 2.0 within education is not without its critics and precautions. Keen (2007) argues that web 2.0 has created a “cult of the amateur” (p. 10). Keen’s critique of web 2.0 is born out of his 2004 FOO Camp (Friends Of O’Reilly) experience, where he went from web 2.0 proponent to skeptic in response to the anarchistic approach to knowledge and media promoted by the radical web 2.0 movement. He calls this “Digital Darwinism” or “the survival of the loudest and most opinionated” (Keen, 2007, p. 8). The radical web 2.0 movement promotes a radical democratization of knowledge that can be equated with user generated content and context without pedagogical guidance. However, mobile web 2.0 that focuses on informal learning and the implied redundancy of formal learning institutions is not the researcher’s perspective. In the researcher’s view, web 2.0 is a tool to be utilised within a pedagogical framework, that in the process of disrupting entrenched pedagogies enables transformation of that pedagogy and the continued expert guidance of the informed lecturer. Kop (2008) comes to a similar conclusion after investigating whether web 2.0 is disruptive or liberating for adult education.

In their review of higher education in five countries, Armstrong et al. (2008) note that web 2.0 use in higher education is found across all sectors but generally limited to "early adopter" lecturers "using Web 2.0 to enhance their teaching because of the affordances that it offers, or because their students are using the technologies already and it helps with engagement" (p. 1).

2.4.1 Mobile Web 2.0 Pedagogies

The pedagogical integration of web 2.0 and mlearning is introduced in this section.

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), and the conversational framework (Laurillard, 2001). The researcher proposes that such a mobile (mlearning) pedagogical framework will focus upon enhancing communication and collaboration within a dynamic learning environment, and will be student-centred. For example, Barbaux (2006) outlines pedagogical principles and teaching implications for mobile learning with a focus on communicative constructivist paradigms.

Sotillo (2003) describes further the pedagogical impact of ubiquitous wireless computing:

> In summary, the advantages of wireless computing in education are ubiquity, portability, and flexibility for collaborative learning projects. Computer power everywhere and all the time means the ability—and the challenge—to integrate computers into every aspect of teaching,

> learning, and research. This represents a Copernican revolution in instruction, with the professor as guide and mentor rather than "fount of knowledge" or ultimate classroom authority. (Sotillo, 2003, p3)

Squire, Johnson, Holland, Nataf, and Klopfer (2002) argue that the advantages WMDs have in facilitating collaborative mlearning environments include:

> *Portability* - can take the computer to different sites and move around within a location
> *Social Interactivity* - can exchange data and collaborate with other people face to face
> *Context Sensitivity* - can gather data unique to the current location, environment, and time, including both real and simulated data
> *Connectivity* - can connect handhelds to data collection devices, other handhelds, and to a common network that creates a true shared environment
> *Individuality* - can provide unique scaffolding that is customized to the individual's path of investigation. (p. 7)

Wireless networks have been described as 'disruptive technologies', and so have the social web 2.0 tools that have developed (such as blogs, and wikis) (Alexander, 2004a; Fielder, et al., 2004; Lamb, 2004). Their disruptive nature forces a rethink of pedagogical strategies and relationships in education. Wireless mobile computing facilitates the development of collaborative learning communities, enhancing student-student and student-lecturer communication and interaction. Thus the researcher proposes that Wireless Mobile Devices coupled with web 2.0 tools potentially provide the basis for enhancing teaching and learning in virtually any discipline.

Herrington et al. (2008) have proposed that mobile technologies can facilitate authentic learning. Herrington and Herrington (2007) note that: "Despite the significant potential of mobile technologies to be used as powerful learning tools in higher education, their current use appears to be predominantly within a didactic, teacher-centred paradigm, rather than a more constructivist environment" (p. 4).

Stead and Colley (2008) categorise approaches to mobile learning within three broad approaches:

> 1. Shallow or supplementary learning: Typically, these may be SMS prompts, School-generated podcasts, and mobile games. They are good as a supplement to other activities.
> 2. Focused learning: Typically these resemble a mobile-friendly version of classic “e-learning”, with targeted nuggets of learning that can be engaged with while on the move - possibly context aware.
> 3. Deep learning: Deep learners are immersed in a mix of mobile technologies, as creators or originators as well as the more common consumers of mobile media, following a constructivist model. (p. 363)

The popularity of social, mobile web-based tools is demonstrated by their integration into a range of consumer mobile devices. An example is the inclusion of RSS news reading capability into Nokia (Ward, 2004) and Sony Ericsson camera phones (Sony Ericsson, 2006), and the Sony PSP (Playstation portable, released 2004, software updated with RSS reader 2006). Sony Ericsson camera phones have featured integrated mobile photo blogging (Gohring, 2006), and Nokia’s NSeries cell phones (Nokia, 2007) allow direct posting of captured photos and video to Flickr, Ovi, and Vox via the built-in Shareonline client. Additionally, the two giants of the Internet, Google and Yahoo, have invested (2005 onward) in supporting and promoting the mobile Internet by developing a suite of mobile social networking tools (see http://mobile.google.com and http://mobile.yahoo.com). The rapid development of mobile web 2.0 during 2006 and onwards provided a rich environment for the researcher to appropriate and explore as a basis for this mlearning research project. The focus was upon utilising freely available web 2.0 services that were easily accessible via smartphones. The smartphone’s constant connectivity, and built-in media capturing affordances allowed students to capture, share and critique ideas and continue learning conversations within virtually any context. The mobile web 2.0 concept map (Figure 1) illustrates this process with some of the core web 2.0 tools used in the research projects, which are expanded upon in the following section. These tools were chosen for use in the research because of their support for a wide range of WMDs, and their match with social constructivist pedagogy.

The following sections provide an introduction to the tools used in the research projects and summarise how the affordances of the tools chosen for the research projects support social constructivist pedagogies, in particular: collaboration (Herrington, et al., 2008; Lomas, Burke, & Page, 2008; Sharples, 2005), COP formation (Langelier, 2005; Wenger, et al., 2002; Wenger, White, & Smith, 2009; Wenger, et al., 2005), student-generated content (Bruns, 2007; Cameron, 2006; Herrington & Herrington, 2007), and student-generated contexts (Cochrane, 2010c; Cochrane & Bateman, 2010d; Cook, et al., 2007; Luckin, et al., 2010; Sharples, 2009a; Stead, 2006; Vavoula, 2007b).

2.4.2 Google Mobile Tools - bridging mobile and traditional computing environments

Google provide a gateway into the Google Mobile services (http://mobile.google.com) via a phone's web browser. The Google mobile tools were chosen for use in the research because of: their ability to bridge both the mobile and traditional (desktop/laptop) computing environments, because they are free to use, offer high levels of security, and because of their potential longevity in comparison to tools offered by smaller web companies.

Affordances supporting social constructivist pedagogy:

Google mobile creates links to mobile formatted software tools that support social constructivist pedagogy (Ally, 2009). Table 1 summarises the social constructivist pedagogical affordances of the Google mobile tools as identified by the researcher (Cochrane, 2009c, 2010c), successive reports from the New Media Consortium (Johnson, et al., 2007; Johnson, Levine, & Smith, 2008; Johnson, et al., 2009), and illustrated by several briefing papers from the Educause Learning Initiative (Educause Connect, 2008b; Educause Learning Initiative, 2010).

Table 1: Google mobile tools pedagogical affordances.

Mobile Web 2.0 Tool	**Supporting Social Constructivist Pedagogy**	**Example Application of Affordances**
Maps	Bridging contexts between formal and informal collaborative environments (Vavoula, 2007b)	Use of built-in GPS for geolocation of shared events and information. http://maps.google.com (Educause Learning Initiative, 2008)
Calendar	Supporting COPs: organization, and collaboration (Wenger, et al., 2005).	Ubiquitous connectivity to calendar for scheduling group activities. http://calendar.google.com (Educause Connect, 2008b)
Reader	Collation of distributed publishing for knowledge flow and interaction in communities (Wenger, et al., 2005)	Anytime anywhere updates from RSS subscriptions. Facilitating peer and lecturer commenting and critique of work. http://reader.google.com (Educause Learning Initiative, 2007)
Picasa	Supporting learner-generated content (Bruns, 2008) and presentations (Developing metacognition).	Direct upload of cameraphone captured images for visual organisation and story-telling online. Ability to geotag captured ideas and events that can be shared. http://picasaweb.google.com
Gmail	COP support: administration and communication across contexts (Lomas, et al., 2008).	Mobile formatted communication with the learning community for quick updates. http://gmail.com
Docs	Collaborative editing for group publication and sharing, supporting community publishing (Wenger, et al., 2005).	Supporting group editing, publication and sharing of student group projects via WMDs. http://docs.google.com (Educause, 2005a)
YouTube	Sharing and presentation of learner-generated content (Stead & Colley, 2008)	Student generated interviews, VODCasts, event recording, captured and uploaded from cameraphones. http://www.youtube.com (Educause, 2005e)
Search	Supporting group knowledge building, research, and information literacy (Walsh, 2008).	Ubiquitous access to online information searchs from WMDs. http://m.google.com

2.4.3 Learning Management Systems - scaffolding the learning community

Learning Management Systems (LMSs or Virtual Learning Environments, VLEs) have been around almost as long as the web. They provide secure e-learning environments for students and teachers that are integrated with institutional enrolment systems. However, newer, open-source LMSs are characterized by integration of a range of social software tools, and support RSS, the enabling technology behind social software. An example is Moodle (http://moodle.org). While Blackboard was the LMS of choice for Unitec as an institution at the start of the research, a strategic decision was made to migrate the institution to Moodle during the research. Moodle was evaluated and found to have several advantages over Blackboard for wireless mobile devices including:

- Integration with web 2.0 tools such as RSS, Wikis, and Blogs.
- Based upon social constructivism (Dougiamas, 1998; 2005).
- The availability of a PDA template for courses that makes courses small-screen, PDA-friendly.
- Intuitive file management.
- Moodle is an open source platform, therefore the software and extensions are free.
- A large (and growing) support and development base has been established within New Zealand for the Moodle platform.

Moodle is a mobile friendly Learning Management System, hosted on a production level Unitec server. Course notes, discussion forums, and various activities can be hosted on Moodle. Learning Management Systems are usually controlled by the institution, and courses are administered by the course lecturers. As a typically closed system, the LMS is often used for course administration and content delivery, and such use does not align with a social constructivist learning environment. Herrington, Reeves and Oliver (2005) critique the typical instructivist use of LMSs, arguing that "action must be taken to slow the proliferation of information-based courses on the Web and to replace such courses with more authentic tasks, based on recent constructivist principles and the guidelines derived from situated learning theory" (p. 369). Herrington (2006) continues: "the recent prevalence of learning management systems often militates against the effective use of situated learning" (p. 3166). Similarly it is the researcher's view that LMSs are an institutionally owned tool focused upon the administration of online learning spaces and the dissemination of lecturer-generated content. Within the context of supporting social constructivist learning the institutional LMS can be used to provide course administration functions and scaffold the establishment of student-created web 2.0 eportfolios for hosting student-generated content outside of the LMS.

Affordances of LMSs supporting social constructivist pedagogy:

Though generally used to create teacher-controlled learning spaces, the LMS can be used to scaffold the pedagogical and technical development of students and as a virtual home-base for COP support (Cochrane, 2006e; Farmer & Bartlett-Bragg, 2005; Jafari, et al., 2006; Samarawickrema, 2007). In the researcher's projects students' content was hosted outside of Moodle on web 2.0 site accounts, while Moodle was used as a tutorial space for scaffolding the technology support for the projects, and as a collation point for participants' web 2.0 account details.

2.4.4 ePortfolios

An eportfolio is an electronic portfolio that provides a way for students to manage and share collections of their work. There are a variety of open source eportfolio systems available (Lorenzo & Ittelson, 2005a, 2005c). Elgg (http://elgg.org) and Mahara (http://mahara.org) are examples of open source software that can be used as institutionally hosted eportfolios that include integration with Moodle. Elgg and Mahara support: Blogging, File Sharing, RSS aggregation, tagging, creation of groups, podcast hosting, and external blog editors via the metaweblog API. Several online web 2.0 blog hosts also include aspects of eportfolios. A good example of this was Vox (http://www.vox.com), which closed on 30th September 2010. Vox included support for mobile blogging and media uploads and was integrated into the Nokia Share online client (Nokia, 2010; Vox, 2007). Combined with social networking tools built-in for facilitating group collaboration, Vox was chosen as the participant-owned mobile eportfolio for the mlearning projects.

Vox included media sharing (video, audio, documents, images, links) and linking of additional web 2.0 tools (for example YouTube and Flickr) as well as social networking. Vox's Neighbourhood feature allowed Vox users to define a group and give secure access to content. A weekly neighbourhood email update facilitated a community environment. The core element of a Vox eportfolio was a blog. Mobile blogging has been explored in the literature in various forms (Bryant, 2006; Chen, et al., 2008; Laine & Suhonen, 2008; Stead, 2006; Trafford, 2005) and is established as a foundational mlearning activity for student reflection, peer critique and lecturer feedback. The researcher has published and presented several overviews and tutorials specifically on mobile blogging, including:

- Conference papers (Cochrane, 2007d, 2007e, 2007f).
- Video tutorials (http://thomcochrane.podomatic.com).
- A wiki tutorial page (Cochrane, 2007e).
- An mlearning overview wiki page (Cochrane, 2006d).

In comparison to desktop or laptop blogging mobile blogging adds the extra dimension of anywhere, anytime media capture and uploading to blogs. Mobile blogging formed the core activity for students in each of the mlearning projects, creating media-rich journals of students' learning journeys.

Affordances supporting social constructivist pedagogy:

Web 2.0 eportfolios facilitate collaborative sharing of media and peer critique (Alexander, 2006; Anderson, 2007; Andrew, et al., 2009; Attwell, 2006; Bower, Hedberg, & Kuswara, 2009; Chan, 2007; JISC, 2009b; Lee & McLoughlin, 2010; Lorenzo & lttelson, 2005b; McLoughlin & Lee, 2010). A student-generated eportfolio formed the basis for a career portfolio for the participants beyond the end of the projects and their courses. Table 2 outlines the social constructivist pedagogical affordances of web 2.0 tools that can be used to create these eportfolios. These tools were chosen for use in the research because of their support for a wide range of WMDs.

Table 2: ePortfolio pedagogical affordances.

Web 2.0 Tool	**Supporting Social Constructivist Pedagogy**	**Example Application of Affordances**
Blogs	Formation of collaborative communities (Farmer, 2004). Facilitating a move from a centralized to distributed publishing model for learning communities (Wenger, et al., 2005).	Creation of Student's mobile eportfolio base, forming a reflective journal collating media supporting their learning and progress (Bain, Ballantyne, Packer, & Mills, 1999), facilitating peer and expert reflection, critique, feedback and evaluation via commenting (Panday, 2007). Platform for publication and collation of student-generated content (Educause, 2005e; Educause Learning Initiative, 2005; Farmer & Bartlett-Bragg, 2005; Luca & McLoughlin, 2005; Trafford, 2005). http://www.vox.com
Wikis	Collaborative student-generated content (Bruns, 2008).	Group document editing and publishing. (Educause, 2005f; Litchfield & Nettleton, 2008) http://www.wikispaces.com
Social Book marking	Categorisation of online resources for building a shared repertoire of resources within a learning community (Alexander, 2006; Downes, 2005; Mejias, 2006).	Information linking and sharing, via group-defined tagging (Educause, 2005d). http://del.icio.us
Podcasting	Collaborative sharing of student-generated content (Bruns, 2007; Windham, 2007).	Shared audio recordings, including student reflections, and student-recorded expert interviews. (Educause, 2005c)
Social Networking	Community Of Practice formation and nurturing, including facilitating learning conversations, collaboration, and peer support and critique (Bryant, 2006; Cych, 2006).	Interaction with Peers and Lecturers beyond the confines of the classroom. (Educause Connect, 2008c) http://www.ning.com http://www.vox.com
RSS	Content aggregation facilitating bridging between learning communities (Kaplan-Leiserson, 2004; Wenger, et al., 2005)	Collation of COP content and information, creating shared resources and artifacts from student groups. http://reader.google.com/

2.4.5 Smartphones

The smartphone's wireless connectivity and data gathering abilities (for example: photoblogging, video recording, voice recording, and text input) allow for bridging the on and off campus learning contexts, and facilitating situated learning. A variety of mobile friendly web 2.0 tools are available for use on smartphones. Common smartphone specifications include: WiFi capability for free web access while on campus, 3G for fast web access off campus, a built-in camera, media playback, alternative text entry capability, GPS integration, and support for a variety of web 2.0 applications.

Affordances supporting social constructivist pedagogy:

Smartphones facilitate collaborative sharing of student generated media (Cameron, 2006; Evans, 2005; Fulton, 2007; Stead & Colley, 2008), peer critique and communication (Johnson, et al., 2008, 2009; Laurillard, 2007; Sharples, 2005), and learner generated contexts (CeLeKT, 2009; Cook, 2007a; Cook, et al., 2008; Elias, 2009; Pachler, et al., 2010; Vavoula, 2007b). Smartphones facilitate a wide range of social collaboration options including direct upload of student generated media from the smartphone to a variety of web 2.0 sites beyond the Google Mobile tools, and also direct download of peer and lecturer generated media to the smartphone. Table 3 outlines the social constructivist pedagogical affordances of a range of smartphone functionality.

Table 3: Smartphone pedagogical affordances.

Smartphone Capability	**Supporting Social Constructivist Pedagogy**	**Example Application of Affordances**
Mobile Media Sharing	Collaboration, sharing and collation of student generated content (A. Herrington, 2008), facilitating context bridging (Vavoula, 2007b).	Eportfolio content creation via the smartphone's built-in camera and microphone and direct upload to online web 2.0 sites. http://www.pixelpipe.com
Text	Group communication. Creation of a shraed repertoire of resources via collaborative document editing and publishing, and social tagging (Wenger, et al., 2005).	Providing ubiquitous connectivity for Blog posts and comments, media annotation, Instant Messaging, and email communication. (Educause, 2005b, 2005d; Educause Connect, 2008a; Educause Learning Initiative, 2009b)
Image Capture	Student content generation and sharing situated learning contexts (Bruns, 2008; Stead & Colley, 2008).	Situated learner-generated content, including: geotagging of photos on smartphones, and direct upload to Web 2.0 sites for sharing. (Educause Connect, 2008a; Educause Learning Initiative, 2009a))
Video Recording	Learner-generated content and sharing of situated learning contexts (Bruns, 2008; Stead & Colley, 2008).	Situated user-generated content such as VODCasts, interviews, real-time streaming or asynchronous upload to Web 2.0 sites and Skype video calls. Capturing critical incidents in students' learning journeys. http://www.qik.com, http://www.ustream.tv (Educause, 2005e; Educause Connect, 2007; Educause Learning Initiative, 2008b)
Audio Recording	Collaborative sharing of student-generated content (Bruns, 2007; Windham, 2007).	Student created PODCasts from location and environmental recordings, interviews, and student reflections. http://www.audioboo.com (Educause, 2005c)
GPS for Geolocation	Facilitating situated learning or authentic learning (A. Herrington & Herrington, 2007).	Group activities involving: Mapping, Geocaching, and Navigation. http://maps.google.com (Educause Learning Initiative, 2008)
Augmented Reality	Bridging learning contexts by supporting learner-generated contexts (Cook, 2010; Luckin, et al., 2010).	Using the built-in camera, GPS and compass to overlay the physical environment with student created POIs (points of interest) and location-based data. http://www.layar.com http://www.wikitude.com (Educause Learning Initiative, 2009a)
Microblogging	Collaborative publishing and communication across contexts (Luckin, et al., 2010), such as geographic and time-zone barriers.	Asynchronous communication, collaboration & media sharing beyond the classroom. http://www.twitter.com (Educause Learning Initiative, 2009b)
Instant Messaging	Synchronous communication for dialogic interaction (Laurillard, 2007).	Ubiquitous connectivity for synchronous questioning and communication. http://www.fring.com (Educause, 2005b)
Mobile Codes	Concept linking and sharing of learner-generated content (Bruns, 2008).	Student QRCode creation and decoding. http://reader.kaywa.com http://mobilecodes.nokia.com (Educause Learning Initiative, 2009c)

In summary, the range and variety of affordances built into smartphones allow many options for user-generated content, and provide avenues for developers to create applications enabling new ways users can interact with their environment. Examples of these include the addition of built-in sensors such as: a GPS, a compass, accelerometers, near-field-computing, and proximity sensors. The implications for enhancing students' personal and collaborative learning experiences have barely begun to be explored.

2.5 The Impact of WMDs

The unique potential impact of WMDs on education is founded upon their rise to almost ubiquitous ownership (ITU, 2009) and their primary functionality as ubiquitously connected communication devices. These two characteristics of wireless mobile devices enable their use as disruptive devices to act as catalysts for pedagogical change by mediating student-generated learning contexts and sharing student-generated content as key elements of social constructivist learning or Pedagogy 2.0 (McLoughlin & Lee, 2008a). The 2010 JISC mobile review (Belshaw, 2010) concludes that mobile learning presents the potential to drive innovation in education.

> Mobile learning may mean different things to different people, but it is the dialogue that an institution begins with itself, its' staff, its' learners, its' community - that matters. It is certainly not time for 'business as usual'. It is time to define and start driving innovation. (p. 63)

This potential for innovation is both driven and hampered by the rate of change in mobile technologies, summarized in sections 2.3 and 2.4. Although the rate of change of mobile technology is very high the choice of a pedagogical framework and foundational pedagogical theory can guide the appropriate pedagogical use of future WMD developments. The rise of mobile application ecosystems (for example: the iTunes Store for dissemination of iOS WMD applications and media, the Android Market for Android WMD devices, and the Nokia Ovi Store for Symbian based WMDs) that bridge information, content and productivity with laptop or desktop computing via web 2.0 platforms, has created a mobile learning framework that can be easily appropriated by a wide range of educators without requiring specialist computing skills, creating the potential for mainstream adoption of mlearning in tertiary education. WMDs can be utilized as content creation devices for students' online eportfolios, and for establishing a digital identity that can become a key element of their on-going professional careers. WMDs can also be utilized as communication and collaboration tools within an increasing range of social networking tools. Mobile Learning (mlearning) has moved beyond the realms of fantasy to become a viable platform for contextual learning that bridges formal and informal learning environments in and beyond the classroom.

2.6 Chapter Summary

In this chapter I have identified gaps in the mlearning literature and research, and proposed mlearning as a catalyst for pedagogical change. The chapter then defines the technologies and related terms used throughout the research process, and locates these technologies within the associated educational research literature, exploring mobile web 2.0 as a framework for mainstream adoption of mlearning. The chapter finishes with a summary of the pedagogical affordances of several mobile web 2.0 tools, in particular those affordances that support collaboration, student-generated content, and student-generated learning contexts. The impact of these mobile web 2.0 tools introduced in this section is investigated and implemented in the five case studies detailed in chapters five to nine. The following chapter investigates the application of a range of learning theories and theoretical frameworks to mlearning.

3 THEORETICAL LITERATURE REVIEW

This section outlines the pedagogical foundations driving the choice and use of wireless mobile devices and web 2.0 tools throughout each of the action research cycles (projects) in the research. As Pachler et al. (2010) observe, the mlearning literature is still in developmental stages, with a variety of theoretical themes used as frameworks by mlearning practitioners and researchers.

> Only few books on mobile learning have been published to date (e.g. Kukulska-Hulme and Traxler 2005; Metcalf 2006; Pachler 2007; Ryu and Parsons 2008; Ally 2009; Vavoula et al. 2009), and those that do exist tend to be collections of chapters from a range of contributors rather than authored titles if they don't focus more on the technical, rather than educational and pedagogical dimensions of the field in the first place. This, among other things, makes it very difficult for interested parties to gain an overview of dominant discourses. (Pachler, et al., 2010, p. 5)

Because of this lack of a generally accepted under-pinning pedagogical theory of mlearning the research involved a journey of investigating the relevance of established and developing pedagogical frameworks. The researcher was particularly interested in investigating the potential of mlearning to support student-generated content and student-generated contexts within collaborative learning environments facilitated by the pedagogical guidance of their lecturers across both formal and informal learning contexts. Thus the main focus of this research was on the support and enhancement of both the face to face and off campus teaching and learning contexts by using wireless mobile devices (WMDs) as a means to leverage the potential of current and emerging collaborative and reflective elearning and web 2.0 tools (for example: blogs, wikis, RSS, instant messaging, podcasting, social book marking). The WMDs wireless connectivity and data gathering abilities (for example: photo blogging, video recording, voice recording, and text input) allow for bridging

(Cook, et al., 2008; Trinder, et al., 2008; Vavoula, 2007b) formal and informal learning contexts both on and off campus, facilitating situated learning (Brown, Collins, & Duguid, 1989; Collins, Brown, & Newman, 1989; Lave & Wenger, 1991).

The intended learning outcomes for students included:

- Developing critical reflective skills
- Facilitating group communication
- Developing an online eportfolio
- Developing a potentially world-wide peer support and critique network
- Learning how to maximise technology to enhance the learning environment across multiple contexts

The collaborative, constant connectivity and communications affordances of WMDs led to a focus upon social constructivism (Vygotsky, 1978) and its offshoots. It was also found that pedagogical frameworks based upon social constructivism were the focus of much of the theoretically grounded research contributions to mlearning. A review of the literature led the researcher to draw on concepts from communities of practice (Lave & Wenger, 1991), a conversational framework (Laurillard, 2001), learner-generated content and learner-generated contexts (Luckin, et al., 2008; Luckin, et al., 2010), and authentic learning (Herrington & Herrington, 2007; Herrington, 2006; Herrington & Oliver, 2000).

This chapter begins with an outline of constructivism and social constructivism that form the foundations of the four chosen pedagogical frameworks. This is followed by an overview of pedagogical frameworks used in mlearning research, with a critique of the application of activity theory to mlearning in particular. Critical success factors for implementing mlearning are then identified in section 3.3. The contributions of the four chosen pedagogical frameworks to informing mlearning are investigated in sections 3.4 to 3.7, with a focus on their contribution to identifying and understanding mlearning critical success factors.

3.1 Pedagogical Foundations

Teaching and learning innovations are best implemented when informed by learning theory (Ally, 2004, 2008; Mishra, et al., 2007). A review of the literature (Cobcroft, 2006; Koszalka & Ntloedibe-Kuswani, 2010; Laine & Suhonen, 2008; Naismith, Lonsdale, Vavoula, & Sharples, 2004; Wingkvist & Ericsson, 2009) indicates that the field of mlearning educational research is relatively young and theoretical framework development has been hampered by the rapid changes in mobile technologies.

> There exist as yet no comprehensive theoretical and conceptual frameworks to explain the complex interrelationship between the characteristics of rapid and sometimes groundbreaking technological developments, their potential for learning as well as their embeddedness in the everyday lives of users. (Pachler, et al., 2010, p. 3)

Theorists in the field of mlearning have been filling the void described by Pachler et al. (2010) by drawing upon established pedagogical theories and frameworks for application to mlearning. For example, Sharples, Taylor, et al. (2007) utilised a combination of Activity Theory and a modified version of Laurillard's Conversational Framework. Wali et al. (2008) appropriated Activity Theory, while Herrington, Herrington, Mantei, Olney and Ferry (Herrington, A. Herrington, et al., 2009b) used Authentic Learning (based upon situated learning and social constructivism) as a theoretical framework for their mlearning research projects.

The literature indicates that much of the early mlearning research and implementation focused upon the potential of mlearning to facilitate ubiquitous access to lecturer created content, without a significant change in pedagogy from established instructivist pedagogies (Herrington & Herrington, 2007; Kukulsa-Hulme & Traxler, 2005a; Traxler, 2007). However, the heart of this research is the choice of a social constructivist pedagogical foundation that informed the various choices governing the direction of the research, including both the design and support of the research process and the technological choices, facilitating social constructivist teaching and learning environments.

Social constructivism is built upon constructivism. Ally (2008) briefly outlines the differences between instructivist and constructivist pedagogies within the context of online learning in general, however the principles apply to mlearning as well:

> Behaviorist strategies can be used to teach the facts (what); cognitivist strategies to teach the principles and processes (how); and constructivist strategies to teach the real-life and personal applications and contextual learning. There is a shift toward constructive learning, in which learners are given the opportunity to construct their own meaning from the information presented. (Ally, 2008, p. 39)

Constructivism is based on the work of Dewey (1916), Piaget (1973), and Bruner (1966). According to these theorists, knowledge is constructed from our own experiences, and enabled by teachers. The learner learns best by being involved in the learning process, discovering new concepts, and developing life-long learning skills. The role of the teacher varies in the thinking of these founders of constructivism. For Dewey education is an inherently social process. For Piaget the teacher's role was mainly to provide a stimulating environment for learning within which the learner can construct knowledge based upon their experiences. While for Bruner the teacher plays a much more significant role in directing the student in their construction of knowledge, planning a unique learning programme based upon the student's previous knowledge (Sutherland, 1992). Comparing these various schools of thought, Sutherland (1992) concludes that “teachers should use the appropriate cognitive-development model for the needs of particular pupils” (p. 124).

The application of constructivism in education is not without critics. For example, Osborne (1996) critiques the limitations of constructivism within science education. Mayer (2004) critiques the inappropriate extension of constructivism to pure discovery in comparison to the effectiveness of guided discovery for student learning. Kirschner, Sweller and Clark (2006) claim constructivist learning approaches, or minimal guidance during instruction, have failed to provide evidence of more effective or efficient learning outcomes for students than instructional design models. However Kirschner et al. (2006) focus on radical constructivism that eschews any form of scaffolding, and base their arguments within the disciplines of science and medical education, where there is arguably much more of a role for foundational instructional knowledge than in other more creative disciplines (Mullen, Buttignol, & Diamond, 2005).

At a simplified level social constructivism posits that we learn best in social environments. Constructivism and social constructivism are usually seen in contrast to the more instructivist, content-driven pedagogies implemented in tertiary education based on behaviourism or cognitive theories of learning (Brown, 2006; Dewald, 1999). Herrington and Herrington (2007) argue that “the advances in philosophical and practical developments in education have created justifiable conditions for the pedagogical use of mobile technologies” (p. 1), and argue for the appropriation of newer learning theories that find their roots in social constructivism such as: authentic learning (Herrington & Herrington, 2006a), communities of practice (Lave & Wenger, 1991; Wenger, 1998), connectivism (Siemens, 2004), and activity theory (Engestrom, 1987). Social constructivism focuses upon students being involved in learning as an explorative and social process (Kim, 2001; McLoughlin & Lee, 2008a). This is in contrast to the instructivist pedagogies that have dominated tertiary education in the past that focus upon the teacher as the expert holder of knowledge from whom students learn directly (Dewald, 1999). Social constructivism became popularized in the late twentieth century, but the predominant pedagogical paradigm in tertiary education still remains instructivism (Herrington & Herrington, 2006a). In general, education based on social constructivist pedagogies is interested in enabling students to develop creative, critical thinking, and collaborative skills, rather than focusing upon course content (Evans, 2005). The underpinning pedagogy of a course will determine how particular tools and technologies are used and integrated within the course, "since learning strategies are informed by specific epistemological assumptions" (McMahon, 1997, p. 1).

Some of the seminal thinking behind Social Constructivism is attributed to Vygotsky (1978), according to whom the social context is very important in constructing knowledge. According to Vygotsky the role of the teacher is to create and maintain the Zone of Proximal Development (Head & Dakers, 2005), an environment that will help move the learner from their current understanding to a potential deeper level. Vygotsky argued that learning is a collaborative process. Vygotsky's ideas have subsequently been expanded by many learning theorists, including Bandura (1986). Kim (2001) provides a brief synopsis of these extensions.

> Instructional models based on the social constructivist perspective stress the need for collaboration among learners and with practitioners in the society … Social constructivist approaches can include reciprocal teaching, peer collaboration, cognitive apprenticeships, problem-based instruction, webquests, anchored instruction and other methods that involve learning with others. (Kim, 2001, p. 4)

Social constructivism forms the underlying basis for learning theories drawn upon in this research such as Communities of Practice (Lave & Wenger, 1991), the Conversational Framework (Laurillard, 1993, 2001), and Authentic Learning (Herrington & Oliver, 2000). However, the researcher acknowledges that the choice of social constructivsm as a pedagogical foundation for the mlearning research projects does not exclude the appropriate use of other pedagogical theories in other contexts. As McMahon (1997) notes, one of the greatest criticisms of social constructivism is that it mainly suits collaborative understanding of unstructured subject matter, rather than subjects that include a body of authoritative knowledge. In the context of this thesis, the research projects were all situated within learning contexts based in creative industries courses, making the choice of social constructivism in these contexts an appropriate foundational pedagogy. Social constructivism informed the focus upon collaborative activities and tools within the research projects.

3.2 Theoretical Frameworks for MLearning

This section overviews the predominant theoretical pedagogical frameworks used as a foundation for mlearning. The literature reveals that there is no widely recognised theory of mobile learning, establishing the need to appropriate existing pedagogical frameworks for guiding the design and implementation of mlearning. In this section the researcher critiques the use of Activity Theory as the most popular pedagogical framework appropriated for mlearning. This then leads to the exploration of the contributions of: Communities Of Practice (Lave & Wenger, 1991), the Conversational Framework (Laurillard, 2001), Learner-Generated Contexts (Luckin, et al., 2008; Luckin, et al., 2010), and Authentic Learning (Herrington & Herrington, 2007), informing mlearning design and practice in section 3.4 to section 3.7.

E-learning tools have been established as valuable enhancements to both distance and face-to-face tertiary education, particularly in facilitating collaborative, reflective, student-centred learning environments (JISC, 2004). Building on this foundation, a review of innovative practice with e-learning in the UK suggests that mobile and wireless learning is the natural next step wherever institutions and practitioners have already adopted e-learning (Knight, 2005). However, as Sharples (2009b) argues, mlearning must not be seen merely as an extension of e-learning:

> Mobile learning is not simply a variant of e-learning enacted with portable devices, nor an extension of classroom learning into less formal settings. Recent research has focused on how mobile learning creates new contexts for learning through interactions between people, technologies and settings, and on learning within an increasingly mobile society. (Sharples, 2009b, p. 18)

MLearning (mobile Learning) is a relatively new field of educational research, yet the subject has gathered several dedicated, annual international conferences (MLearn, IADIS mobile learning, Wireless Mobile and Ubiquitous Technologies in Education, WMUTE), peer-reviewed journals (International Journal of Mobile and Blended Learning, International Journal of Mobile Learning and Organization), and a variety of symposia (for example the London Mobile Learning Group). Several educational research agencies have signaled the potential of mlearning in tertiary education, including: Becta (2007), New Media Consortium (Alexander, et al., 2006; Johnson, et al., 2007, 2008, 2009), Educause (Alexander, 2004a, 2004b; Corbell & Valdes-Corbell, 2007; Wagner, 2005), and JISC (Evans, 2005; JISC, 2005b, 2007, 2009a; Kukulska-Hulme, 2005). There are several mlearning literature reviews (Cobcroft, 2006; Naismith, Lonsdale, Vavoula, & Sharples, 2005) and overview papers (Duncan-Howell & Lee, 2007; Traxler, 2009b) that provide a broad overview of the nature and depth of mlearning. Kukulska-Hulme and Traxler (2007) categorise mlearning case studies in the following broad approaches:

- Technology-driven mobile learning: – a specific technological innovation is deployed to demonstrate technical feasibility and pedagogic possibility.
- Miniature but portable e-learning: – mobile, wireless and handheld technologies are used to re-enact approaches and solutions found in 'conventional' e-learning, perhaps porting an established e-learning technology onto mobile devices.
- Connected classroom learning: – the same technologies are used in a classroom setting to supported static collaborative learning, perhaps connected to other classroom technologies; personal response systems, graphing calculators, PDAs linked to interactive whiteboards etc.
- Mobile training and performance support: – the technologies are used to improve the productivity and efficiency of mobile workers by delivering information and support just-in-time and in context for their immediate priorities, roles and duties.
- Large-Scale Implementation: – the deployment of mobile technologies at an institutional or departmental level to learn about organisational issues.
- Inclusion, assistivity and diversity: – using assorted mobile and wireless technologies to enhance wider educational access and participation, for example personal information management for students with dyslexia.
- Informal, personalised, situated mobile learning: – the same core technologies are enhanced with additional unique functionality, for example location-awareness or video-capture, and deployed to deliver educational experiences that would otherwise be difficult or impossible; for example informal context-aware information in museum spaces.
- Remote, rural and development mobile learning: – the technologies are used to address environmental and infrastructural hurdles to delivering and supporting education where 'conventional' e-learning technologies would fail. (Kukulsa-Hulme & Traxler, 2007, pp. 104-105)

Sharples (2009a) proposed an overview of mlearning research that categorises mlearning by three different approaches, calling this the "three ages of mlearning":

1. Classroom enhanced (Focus on mobile device)

a. Clickers – dedicated classroom response systems

b. eBooks – electronic books on mobile devices

c. Laptops – mobile computing

2. Learning across contexts (Focus on the mobile learner)

a. Field trips – enabling situated learning

b. MOBIlearn – a large-scale mlearning project 2002 to 2005

3. Ambient Learning (Focus on a learning enabled world)

a. Augmented reality – digitally enhancing the real world

b. Learning enhanced physical spaces – for example: wikitude

While this categorization follows the development of Sharples' own mlearning projects, it is a useful general categorization as well. MLearning is developing into a new unique way to interact with and enhance real world learning with a focus that has moved from the mobile devices to how mlearning uniquely enhances contextual learning. However, Traxler (2009b, p. 6) argues that the field of mlearning research is still searching for a unique theoretical pedagogical base, with researchers in the meantime borrowing from conventional e-learning theory. Pachler, Bachmair and Cook (2010) critiqued the predominant theoretical frameworks utilised by mlearning researchers, including: Activity Theory, situated learning theory, the Conversational Framework, and the Ecology of Resources Model. Pachler et al (2010) conclude that no single framework fully encapsulates the unique affordances of mlearning, and instead offer their own developing socio cultural framework.

The various frameworks that have been devised to describe the unique pedagogical affordances of mobile learning are typically based on either functional or discursive approaches. An example of a functional framework is that of Pattern, Arnedillo-Sanchez, and Tangney (2006). Pattern et al. (2006) propose a design for mlearning on the basis of "collaborative, contextual and constructionist learning theories" (p. 294).

An example of a discourse model is that popularized by Sharples et al. (2006). This definition of mlearning has become somewhat of a de facto standard (Sharples, 2006; Sharples, Corlett, et al., 2005; Sharples, Taylor, & Vavoula, 2005; Sharples, et al., 2006). "The processes of coming to know through conversations across multiple contexts amongst people and personal interactive technologies" (Sharples, et al., 2006). Sharples (2005) synthesized Engestrom's expansion of Activity Theory (Engestrom, 1987) and Laurillard's Conversational Framework (Laurillard, 2001), creating an mlearning theoretical framework defined succinctly as 'communication in context'.

Most of Sharples' research has been based in pre-tertiary education, and highlights the disconnect between students' personal and informal use of mobile technology and social networking, and the formal school learning environments where these technologies are typically prohibited (Sharples, 2000, 2001). In "Mobile Learning: Small devices, Big issues" (Sharples, et al., 2007), Sharples et al. present a more balanced view than previously, putting some focus back upon the need for sound pedagogical design and input in mobile learning scenarios: "A central task in the design of technology for mobile learning is to promote enriching conversations between learners and teachers within and across contexts" (Sharples, et al., 2007, p. 5). However, the Chapter and examples focus upon school age learners rather than tertiary education, which is the context of this research.

Activity Theory is outlined here because of its dominance as a theoretical frame for mlearning, stemming largely from Sharples et al.'s (Sharples, Taylor, & Vavoula, 2005; Sharples, Josie Taylor, et al., 2007) research, but because of the operational complexity of Activity Theory (Pachler, et al., 2010), it was not considered useful by the researcher as a foundational framework for this research.

Activity Theory finds its roots in the thinking of Vygotsky (1978) and was developed further by Leont'ev (1978). According to Leont'ev human activity is defined in the development of tools to achieve goals that are then useful for social interaction. Engeström (1987) expanded and popularised Activity Theory. For Engeström, an activity system consists of, at a minimum, object, subject, mediating artifacts (signs and tools), rules, community, and division of labor.

Wali et al. (2008) use Activity Theory to define mlearning. However, their resultant definition is extremely broad: "learning that occurs as a result of pursuing learning activities that are directed towards achieving some objective in multiple contexts (physical and social)" (Wali, et al., 2008, p. 45). Wali et al. take 'context crossing' as the basis for their conceptualization of mlearning. Using Engeström's (1987) expansion of Activity Theory as a foundation, mlearning is defined as the learning activities that are mediated by the use of tools (physical or conceptual) in relation to the context of use (physical and social). Wali et al. believe "definitions of mobile learning should cover conventional devices as well as any other technology" (Wali, et al., 2008, p. 50). They want to get away from a technology focus within the definition of mlearning, to a focus upon the "continuity of learning activities in different contexts" (Wali, et al., 2008, p. 56). According to Wali et al. (2008) "It is not the technology that makes learning mobile" (p. 56). However they end up with such a broad definition of mlearning that fails to define the uniqueness of mlearning. This is similar to the problem of defining learning objects where the 'granularity' of the learning object (context dependence) is inversely proportional to its reusability

(Cochrane, 2005a, 2007a). In contrast to Wali et al.'s application of Activity Theory, the researcher argues that:

- It is the use of technology that mediates the continuity between contexts. Therefore the use of technology is crucial to fulfil Wali et al.'s definition of mlearning, rather than minimizing its impact, the unique affordances of mobile technology should be leveraged (Herrington & Herrington, 2007; Morgan, Butler, & Power, 2007; Trinder, et al., 2008).
- Mobile learning uniquely allows both physical (location) and social (communication and social presence, for example: Instant Messaging, and Twitter) context bridging (Cochrane, 2009c, 2010e; Cochrane & Bateman, 2010d; Cook, et al., 2008; Vavoula, 2007b).
- The difference between context crossing and context bridging is ubiquitous connectedness, facilitating continuation of the learning conversations (CeLeKT, 2009; Price, 2007; Rogers & Price, 2006; Sotillo, 2003; Swan, Kratcoski, & van't Hooft, 2007). This is the unique element of Wireless Mobile Devices (WMDs). Non-wireless devices cannot bridge communication across multiple contexts.

Uden (2007) makes a correlation between collaborative learning environments (CLEs) and mobile learning, arguing that Activity Theory offers a framework for context aware systems. Context aware systems reduce the need for explicit input by increasing the use of implicit input. According to Uden (2007): "Activity theory is ideal for analysing Constructivist Learning Environments (CLEs) because the assumptions of activity theory are very consonant with those of constructivism, situated learning, distributed cognition, social cognition and everyday cognition that underlie CLEs" (p. 88). Activity Theory analysis of activities is useful for analysing 'contradictions' (disruptions to the learning environment). However, this requires significant time, whereas many mlearning case studies span relatively short time frames.

> For effective use of activity theory for designing context-aware mobile applications, it is important that research time be long enough to understand the objects of activity, the changes of those objects over time and their relations to objects in other settings. There should be commitment to understanding things from the users' viewpoint. This means that there should be a phased approach to the design and evaluation of technology use, such as mobile devices for collaborative learning. (Uden, 2007, p. 100)

Uden's use of Activity Theory to design mobile learning activities is complex and time consuming. As Uden (2007) notes: "The theory helps structure analysis, but does not prescribe what to look for" (p. 90). Thus while Activity Theory is a useful theoretical framework for analysing the processes and influences involved in mlearning, that is useful for a researcher, it presents an overly complicated approach to curriculum design and integration for a typical tertiary educator. Pachler et al. (2010) criticise the relevance of Activity Theory for mlearning as Activity Theory is too object focused, rather than providing a focus upon the subject and contexts of learning. In Pachler et al.'s (2010) view, Activity Theory's "level of abstraction is too high for it to be readily operationalisable and, therefore, the model is arguably of limited value for policy makers and practitioners" (p. 163).

In an attempt to make Activity Theory more accessible, Mwanza-Simwami (2009) proposed Activity-Oriented Design Methods (AODM) "as a structured and flexible method for investigating mobile learning" (p. 116). AODM incorporates four methodological tools designed to make the use of Activity Theory as an analysis approach simpler. However AODM analysis is still time consuming, requires an understanding of the principles of activity theory, and uses decomposition (post event) “whilst providing a mechanism for making the inter-relatedness of interaction processes more explicit” (Mwanza-Simwami, 2009, p. 117). Therefore it is the researcher’s opinion that Activity Theory is not helpful for providing a framework for implementing mlearning in mainstream tertiary education where (from the researcher’s experience as an Academic Advisor) the typical lecturer is not an educational theorist expert, but rather they are context experts and pragmatic educationalists.

3.3 Mlearning Critical Success Factors

The researcher is interested in facilitating pedagogical change, and as such a review of mlearning crtical success factors is appropriate. The JISC “Effective Practice in a Digital Age” (Knight, 2009) report outlines several key principles for designing technology-enhanced learning. These can be applied to mlearning:

1. Blended learning exploits the affordances of technology to promote active participative learning in both face-to-face and online contexts.

2. Practitioners teach and learners learn in a context of increasing choice. Effective practice in a digital age includes selecting the most appropriate tools for the purpose.

3. Learners can be active makers and shapers of their own learning. They should be supported in using technologies of their own choice where appropriate.

4. Even advanced users of technology look to their tutors for guidance on how to use technology in learning. Understanding how to learn in a digital world is a vital skill.

5. When unfamiliar technologies are integrated into learning designs, the benefits need to be clearly communicated to learners.

6. Benefits arise when there is coherence between technologies and media, the learning tasks and outcomes, and subject-specific demands of a course.

7. Where technology is used, it extends the potential for learning and is not used for its own sake. (JISC, 2009a, p. 51)

According to Barker, Krull, and Mallinson (2005), the critical success factors essential for the adoption of mobile learning are:

1. *Interactivity*: refers to the amount of interaction between learners using mobile devices, and the extent to which using handhelds force learners to share information in a learning activity.
2. *Coordination*: refers to the use of mobile devices encouraging active participation by all learners and a need to coordinate activities;
3. *Negotiation and Communication*: Using handhelds allows for negotiation between learners within group activities, as a consensus needs to be reached before moving on to another activity. Communication implies that a mobile learning environment needs to open the channels of communication between learners, and with their teacher.
4. *Organisation of material*: is essential for the learner to be able to employ appropriate information-seeking behaviours.
5. *Mobility*: refers to the portability of the devices and the extent to which they enable the mobility of the learners.
6. *Motivation*: implies the extent to which the m-learning environment motivates learners to engage with their learning and encourages teachers to develop innovative ways of using the devices to complement traditional teaching methods;
7. *Collaboration*: refers to the m-learning environment promoting partnership between learners and teachers. (Barker, et al., 2005, p. 8)

Herrington, Mantei, Herrington, Olney and Ferry's (2008) nine critical success factors in establishing authentic learning environments are based upon Herrington and Oliver (2000) and include:

1. *Authentic contexts* that reflect the way the knowledge will be used in real-life
2. *Authentic activities* that are complex, ill-defined problems and investigations
3. *Access to expert performances* enabling modeling of processes

4. *Multiple roles and perspectives* providing alternative solution pathways
5. *Collaboration* allowing for the social construction of knowledge
6. *Opportunities for reflection* involving metacognition
7. *Opportunities for articulation* to enable tacit knowledge to be made explicit
8. *Coaching and scaffolding* by the teacher at critical times
9. *Authentic assessment* that reflect the way knowledge is assessed in real life. (Herrington, et al., 2008, p. 3)

Herrington et al.'s (2008) success factors emphasise the pedagogical input of the teacher beyond the classroom. Laurillard (2007) also focuses upon the critical role of the teacher in desiging appropriate mlearning pedagogical strategies:

> M-learning technologies offer exciting new opportunities for teachers to place learners in challenging active learning environments, making their own contributions, sharing ideas, exploring, investigating, experimenting, discussing, but they cannot be left unguided and unsupported. To get the best from the experience the complexity of the learning design must be rich enough to match those rich environments. (Laurillard, 2007, p174)

While each of these studies and reports emphasize different critical success factors for mlearning, in general they can be categorised into subheadings. A comparison of these critical success factors within five categories identified by the researcher (Cochrane, 2010b, 2010d; Cochrane & Bateman, 2010c, 2010e) is shown in Table 4.

Table 4: Comparison of mlearning critical success factors.

Categorised critical success factors	Authentic mLearning Herrington et al. (2008)	JISC (Knight, 2009)	Barker et al. (2005)	Conversational Framework Laurillard (2007)
1. Pedagogical integration	1. Authentic contexts 2. Authentic activities 4. Multiple roles and perspectives 6. Opportunities for reflection 9. Authentic assessment	1. Active participative learning 5. Benefits need to be clearly communicated to learners 6. Learning tasks and outcomes 7. Extends the potential for learning	1. Interactivity 2. Coordination 4. Organisation of material	Design of learning activities
2. Lecturer modeling	3. Access to expert performances	4. Look to their tutors for guidance	6. Motivation	Dialogic interaction between students and lecturer
3. Learning community	5. Collaboration	3. Learners can be active makers and shapers of their own learning. They should be supported in using technologies of their own choice where appropriate.	3. Negotiation and Communication 7. Collaboration	Continuing learning conversations
4. Appropriate choice of technology	7. Opportunities for articulation	2. Selecting the most appropriate tools for the purpose	5. Mobility	Importance of communication and collaboration technologies
5. Technological and Pedagogical Support	8. Coaching and scaffolding			

The comparison of critical success factors indicates that most research has been put into the area of pedagogical integration, with relatively little focus on the aspects of technological and pedagogical support. A sixth critical success factor identified by the researcher from the thirteen mlearning projects (see section 10.2) as sustained engagement for ontological shifts for the participants is not addressed by any of these. This is because most mlearning projects are short-term projects and do not look at the longitudinal impact of mlearning. These identified critical success factors for mlearning can be used to evaluate the four social constructivist frameworks chosen to inform the research: Communities Of Practice, the Conversational Framework, Leaner Generated Contexts, and Authentic Learning.

3.4 Communities of Practice

'Communities of Practice' (COP) is a social learning theory. The concepts were proposed by Lave and Wenger (1991), while studying the apprenticeship model of learning. Wenger (1998) later further developed the concepts, and then simplified the concepts for wider contexts: "Communities of practice are formed by people who engage in a process of collective learning in a shared domain of human endeavor" (Wenger, 2005, p. 1). Though not originally intended as a pedagogical strategy or teaching technique, rather an analytical viewpoint on learning (Lave & Wenger, 1991), the concepts of communities of practice have found popularity within educational contexts. The main differences between traditional teacher-directed (didactic) educational environments and communities of practice are: an emphasis on inventiveness with a continual evolution of ideas and direction of the community (Brown, 2006), a lack of hierarchy (Head & Dakers, 2005; Langelier, 2005), and teachers take on the role of expert mentor (Herrington, Herrington, Kervin, & Ferry, 2006) rather than delivery of content.

Wenger (2005, pp. 1-2) describes three defining characteristics of communities of practice:

- The Domain. This is the shared interest that defines the identity of the COP, and within an educational context is the focus of pedagogical integration.

- The Community. This is some form of regular group relationship built upon joint activities and discussions.
- The Practice. This involves the development of a shared repertoire of resources, involving time and sustained interaction. Within the context of education this includes modeling by the lecturer to the students.

Wenger (2005) states that “it is the combination of these three elements that constitutes a community of practice. And it is by developing these three elements in parallel that one cultivates such a community” (p. 2).

The development of the concept of communities of practice has undergone several stages (Cox, 2005), beginning with the seminal work in 1991 (Lave & Wenger, 1991), where the concept of ‘legitimate peripheral participation’ had more prominence than in later developments (Hodkinson & Hodkinson, 2004). This was followed by Wenger’s exposition of the concept in 1998 with a focus upon “personal growth and the trajectory of individuals’ participation within a group” (Li, et al., 2009, p. 1). Storberg-Walker (2008) criticises Wenger’s 1998 theory as being too abstract and therefore too difficult to operationalise. Wenger et al.’s (2002) practical how-to guide in is conversely viewed as a simplified COP model for wider consumption within the context of businesses (Li, et al., 2009). Li et al (2009) argue that the evolving nature of the COP concept “make it challenging to apply the concept or to take full advantage of the benefits that CoP groups may offer” (p. 1). They therefore recommend “focusing on optimizing specific characteristics of the concept” (Li, et al., 2009, p. 1).

Swann (2010) argues that the COP framework does not easily transfer to a tertiary education setting because the short life cycle of semester long courses does not allow for the growth and development of COPs that may span several years within the original business environment used for the basis of Wenger's (1998) theory. The concept is therefore better suited to longitudinal contexts that span significant timeframes.

Within the context of mlearning, Pachler et al. (2010) question the direct validity of COP theory for a lack of emphasis on connectivity, and having its base in a historic context prior to the emergence of mobile devices and their impact on cultural practices. However, Wenger et al. (2009; 2005) have attempted to continue evolving the COP concept with particular relevance to the impact of web 2.0 social software.

3.4.1 Creating a supportive learning community

Lave and Wenger (1991) assert that new peripheral (or partial participation) community members learn from the active members of a community, and learning occurs as they are gradually brought into an active role or full participation in the community. This partial participation is a valid form of community participation, and called 'legitimate peripheral participation': "As a place in which one moves toward more-intensive participation, peripherality is an empowering position" (Lave & Wenger, 1991, p. 36). Conversely, Lave and Wenger (1991) also note that the periphery can be a place of exclusion from full participation within the community, and thus a disempowering position, implying: "The ambiguous potentialities of legitimate peripherality reflect the concept's pivot role" (p. 36).

Attwell (2006) draws a comparison between the concept of legitimate peripheral participation and Vygotsky's (1978) zone of proximal development.

> Bridging the zone of proximal development construct with legitimate peripheral participation construct may be accomplished if one thinks of a zone in which the expert or mentor takes the learner from the

> peripheral status of knowing to a deeper status… the expert scaffolds the environment to the extent in which the learner is engaged with the discourse and participants within the zone and is drawn from a peripheral status to a more engaged status. The peripheral learner interacts with the mentor, expert learners and peers within the zone. More able learners (peers) or the mentor will work with the less able learner potentially allowing for socially constructed knowledge. (Attwell, 2006, p. 6)

The process described by Attwell of moving from a position of legitimate peripheral participation to full participation within a community of practice involves sustained activity and requires time for the ontological shifts that must occur. Communities of practice can form the basis for effective peer support groups for student learning (Lockyer, Patterson, Rowland, & Hearne, 2002). Head and Dakers (2005) describe the pedagogical changes that a COP model for learning community formation brings:

> The class ceases to be a hierarchy of command and control and becomes a collegial organisation… The teacher/pupil relationship, therefore, changes from one of power based on the holding and imparting of knowledge, to one of interdependence based on the fostering and development of learning. (Head & Dakers, 2005, p. 39)

Using these concepts as guidelines, a collaborative community of practice between the researcher, the course lecturer and the course students was used as a model (see section 4.7) for scaffolding students learning throughout all of the mlearning research projects.

3.4.2 Appropriate Choice of Supporting Technologies: Social Software and Communities of Practice

Wenger (2005) discusses the contribution that technologies can make to communities of practice, in particular web 2.0, social software tools. He describes two tensions that communities must live with but can mitigate using technology via a cycle of inventiveness:

1. Community implies an experience of togetherness that extends through space and time.
2. The relationship between communities and individuals.

The key characteristics of social software (or web 2.0) fit well with social learning theory, enabling a relatively simple approach to supporting communities of practice. Web 2.0 is about moving beyond content delivery to an interactive collaborative environment with an emphasis upon sharing, ease of use, customization and personal publishing. Thus in the educational setting, web 2.0 provides opportunities for students to be involved in the learning process, to create their own unique collaborative environments that can be shared globally. This can involve the collation of a variety of media centric web based tools and sites that can be aggregated via RSS to form virtual eportfolios.

> This emerging class of flexible, boundary-spanning tools has been called social software by its proponents. The label points to the user's ownership of their software-mediated experience and to the ways that the software bridges between the individual and the group. Easy publication and easy group formation, driven by individuals, are key phrases in this new frame for online collaborative technologies. (Wenger, et al., 2005, p. 7)

Wenger et al.'s (2005) exploration of the use of web 2.0 tools to enhance communities of practice paralleled the early development of the researcher's research methodology. But Wenger's largest contribution to the mobile web 2.0 research project was the simultaneous development of the concept and role of the Technology Steward (Wenger, et al., 2005, p. 3) within communities of practice. Thus Wenger's later (2002 onwards) rather than earlier (1991 to 1998) exploration of communities of practice has been more influential on the research methodology of this thesis. The use of communities of practice to scaffold and support lecturer and student appropriation of mobile web 2.0 via the role of the technology steward were the core concepts appropriated by the researcher for this thesis project.

3.4.3 Technical and Pedagogical Support: 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. The technology steward thus forms a pivotal role in the successful integration of technology into the group's practice. As the research project has developed, and in particular with the development of an intentional community of practice model to support the pedagogical and technological integration of WMDs into each project, so has the understanding of the crucial role of the researcher as the technology steward in supporting these projects.

Wenger has continued to develop his understanding of this key role within COPs in the twenty first century technological environment, to the point where an entire book was published (Wenger, et al., 2009) devoted to exploring this crucial role within communities of practice. This conceptual development was made explicit in the 2009 book "Digital Habitats: stewarding technology for communities" as follows:

> Since the first report was produced, we found that interaction in digital habitats had advanced. Technology was being incorporated more deeply and broadly into the regular life of communities. The boundaries between tool selection, configuration, facilitation, and design were increasingly blurred. Even the questions people asked

> about technologies had evolved. Communities' conversations were becoming the vehicle for the evolution and even the development of technology. Community and technology were evolving in interwoven ways even more than before. The market - both proprietary and open-source - and the technologies in use were changing our view of community. They seemed to be transforming the very concept of community. (Wenger, et al., 2009, p. xii)

Wenger et al. (2009) see technology stewardship within communities of practice as an emergent role that is clearly distinguished from traditional information technology (IT) support. The rise in the importance of this role in communities of practice has led to a refined definition from that given in 2005 (Wenger, et al., 2005, p. 3):

> Technology stewards are people with enough experience of the workings of a community to understand its technology needs, and enough experience with or interest in technology to take leadership in addressing those needs. Stewarding typically includes selecting and configuring technology, as well as supporting its use in the practice of the community. (Wenger, et al., 2009, p. 25)

The role of the Technology Steward was appropriated by the researcher within the context of communities of practice for lecturer professional development in preparation for implementing mlearning with their students. This model was then used to create communities of practice involving the researcher (again as the technology steward), the course lecturers and their students for scaffolding their learning during the implementation of each mlearning project. These were effectively 'intentional' communities of practice (Langelier, 2005), focused on the pedagogical and technical support of the mlearning projects.

3.4.4 Pedagogical Integration: Intentional Communities of Practice

Wenger's (2005) definition of communities of practice "allows for, but does not assume, intentionality" (p. 1). While communities of practice often form organically and spontaneously, they can also be created intentionally and cultivated for specific purposes. Intentional communities of practice share the same characteristics as organic communities of practice, but have at their core a plan, as described by Langelier (2005):

> Certain virtual communities of practice emerge spontaneously and effortlessly from the organization, while the organization intentionally creates other communities… In this instance, the organization defines and controls the community's objectives, initial activities and support and leaves it up to the community to organize itself and elaborate its own rules… Knowledge management is not left to the chance spontaneous emergence of "natural" communities but is, to the contrary, a deliberate, planned approach. (Langelier, 2005, p. 31)

This quotation comes from the CEFIRO report on intentional communities of practice (Langelier, 2005) to which Wenger et al. (2005) contributed chapter 5 entitled "Technology for communities". The concept of intentional communities of practice has found many applications, often forming juxtaposition between the organic nature of COPs and a specific foundational goal. For example, Floyd (2008) appropriates intentional COPs to describe a vital church congregation. Head and Drakers (2005) argue for the use of intentional COPs to form the basis for a new approach to technology education. The concept of intentional communities of practice is similar to semi-formal learning communities (Kukulska-Hulme & Pettit, 2008) but was more longitudinal throughout the length of the mlearning projects described herein. The concept was foundational in developing a support strategy for the research. Intentional COPs formed the hub of the collaborative mlearning projects throughout the research for this thesis, linking the researcher as the 'technology steward', the course lecturers, and the students on each of the courses.

3.5 Conversational Framework

3.5.1 Lecturer Modeling: Dialogic Interaction

Diana Laurillard (1993) developed the conversational framework of learning, based upon a Socratic conversation between student and teacher (Figure 4). The conversational framework conceptualises learning as an interactive conversation between the lecturer and the student, with feedback between the lecturer and student creating cycles of adaptation and reflection of both the student and lecturer's conceptions of the learner's understanding. Figure 4 outlines the 2001 version of Laurillard's conversational framework.

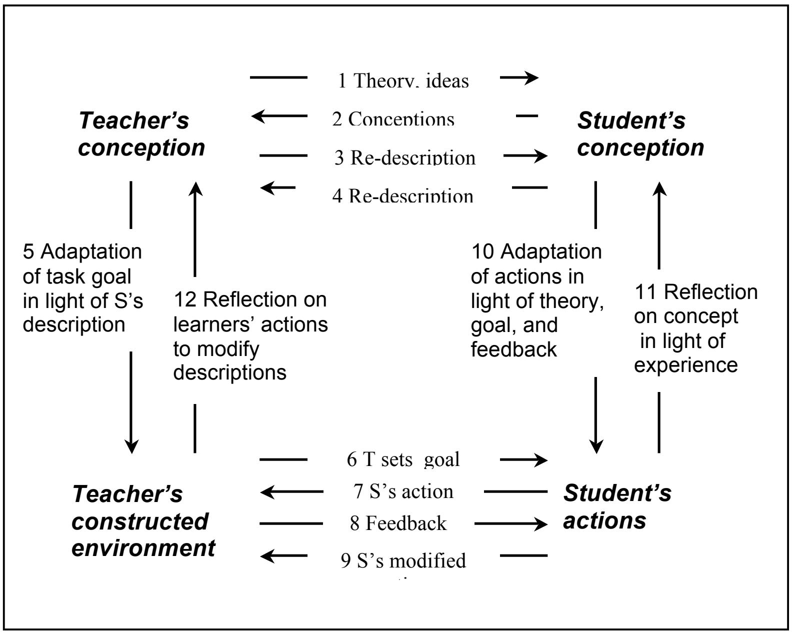


Figure 4: The conversational framework. (Laurillard, 2001, p. 102)

The dialogue between the lecturer and the student is grounded in the ability of the lecturer to model and guide the learning environment. According to Laurillard's conversational framework, technologies that enhance communication between the student and teacher can thus enhance learning. Laurillard updated the application of the framework to include Internet based technologies in the 2001 second edition of her book (Laurillard, 2001) answering criticisms of the relevance of the framework to the Internet age since the publication of first edition.

3.5.2 Creating a Supportive Learning Community

Laurillard categorises this framework as co-operative and democratic, contrasting it with the prescriptive nature of instructivist psychology and noting that the only prescriptive element of her framework is at the level of process, in setting out how the dialogue should be conducted. Laurillard sees multimedia as useful as a means of facilitating and enhancing the conversational framework. Communicative multimedia by itself does not adequately fulfil the key elements in the conversational framework of learning. It is how these multimedia elements are incorporated and implemented in the learning situation that makes them interactive, adaptive and able to promote student reflection. However, educational researchers such as Kennedy and McNaught (1997) have found multimedia significantly enhances learning in many other ways and dimensions. These include: stimulating student interest, stimulating student interactivity with the content and with tutors, and allowing students to work at their own pace and in their own time. Draper (1997) critiques the conversational framework for it’s lack of acknowledgement of the learning choices made by students beyond the formal learning environment, and also for Laurillard’s critique of the value of traditional lectures. Laurillard’s (2007) analysis of the applicability of the conversational framework to mlearning and the ability of mobile devices to continue learning conversations beyond the classroom provides a strong case for the relevance of the conversational framework to informal learning environments.

3.5.3 Appropriate Choice of Supporting Technologies

Laurillard's model has been popular as a framework for informing social constructivist learning environments mediated by a variety of technologies. Sharples (2005) uses Laurillard's conversation model as a basis to describe the potential of mobile devices for enabling 'conversations in context'. "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, p. 152). Sharples superimposed the conversational framework upon Engestrom's Activity Theory model, while removing the teacher from the conversational model to represent informal learning. In response, Laurillard (2007) evaluated the applicability of her conversational framework of learning to mobile technologies, reappropriating the conversational framework on her own terms in contrast to Sharples' application of the Conversational Framework.

Laurillard (2007) also debates what pedagogical characteristics are intrinsic to mobile technologies, highlighting the following unique affordances:

- Learner generated contexts
- Location awareness
- Personalization and ownership
- Social space *(social presence – Instant Messaging, txt)*
- Motivation
    - Control
    - Ownership
    - Fun
    - Communication

- Learning-in-context
- Continuity between contexts

Laurillard discusses how mobile technologies support learning. “The intrinsic nature of mobile technologies is to offer digitally-facilitated site-specific learning, which is motivating because of the degree of ownership and control” (Laurillard, 2007, p. 157). According to Laurillard, it is the integration of a wide range of learning activities offered by mobile technologies that sets them apart from other forms of e-learning (Laurillard, 2007, p. 159).

3.5.4 Pedagogical Integration: Mlearning Facilitating Learning Conversations

Laurillard (2007) then investigates the question “Does mobile learning support the pedagogical requirements defined by the conversational framework?” (p. 163), illustrating that the conversational framework has relevance for mlearning. A key element in the conversational framework is the dialogue between teacher and student. In contrast to Sharples et al. (2006), Laurillard emphasizes the teacher’s input in mobile environments through good pedagogic design that facilities continuity between the face-to-face and remote peer learning contexts.

> M-learning technologies offer exciting new opportunities for teachers to place learners in challenging active learning environments, making their own contributions, sharing ideas, exploring, investigating, experimenting, discussing, but they cannot be left unguided and unsupported. To get the best from the experience the complexity of the learning design must be rich enough to match those rich environments. (Laurillard, 2007, p. 174)

Laurillard gives an example breakdown of how mlearning enhances learning designs as understood by the conversational framework: “mobile devices *digitally facilitate* the link between students and data while they are in the *site-specific* practice environment" (Laurillard, 2007, p. 166). MLearning also facilitates collaboration and competition, and student contribution to a product, maintaining student ownership.

Laurillard defines mlearning within the context of the conversational framework as: "M-Learning, being the digital support of adaptive, investigative, communicative, collaborative, and productive learning activities in remote locations, proposes a wide variety of environments in which the teacher can operate" (Laurillard, 2007, p. 173). This supported the researcher's evolving sense of the key critical success factors of mlearning, one of which was observed to be the level of pedagogical integration and lecturer modeling of mlearning.

A similar conclusion is reached by Duncan-Howell and Lee (2007) in their review of mlearning research. They provide an overview of current research and implementation of mobile learning in tertiary education and conclude that: "The key to success is the ability of educators to design and develop pedagogically sound opportunities and environments that enhances learning" (Duncan-Howell & Lee, 2007, p. 223).

The conversational model was used to inform the pedagogical use of the communication and collaboration affordances of mobile web 2.0 in the research methodology, rather than a focus upon content delivery to small-screen devices.

3.6 Learner-Generated Contexts

Learner-Generated Contexts (LGC) has been proposed as a developing framework for supporting the effective use of technology to support learning (Luckin, et al., 2008; Luckin, et al., 2010). The working definition of a Learner-Generated Context is:

> A context created by people interacting together with a common, self-defined learning goal. The key aspect of Learner-Generated Contexts is that they are generated through the enterprise of those who would previously have been consumers in a context created for them.
> (Luckin, et al., 2010)

In this section the researcher explores the implications of learner-generated content and learner-generated contexts for mobile web 2.0. The concept of 'Generation C' or learner-generated content and learner-generated contexts was useful for framing the research project around the unique affordances of WMDs.

Kress and Pachler (2007) describe web 2.0 as a "fundamental shift in agency from broadcast to content generation, a decentralization of resource provision and, … an enhanced organization and categorization of content with an emphasis on 'deeplinking'" (Kress & Pachler, 2007, p. 11). The "new breed of learners" who appropriate web 2.0 are referred to by Bruns (2007) as 'Generation C': "a loose grouping of participants who share a set of common aims and practices around user-led content creation communities" (Bruns, 2007, p. 2) or 'produsers' for short. These learners are characterized by their willingness and ability to create their own content (for example: record and upload original YouTube videos, create and share online photo albums, record and share Podcast shows). However there is often a general disconnect between students' social use of web 2.0 tools and integration of web 2.0 within the formal learning environment. As the researcher's surveys of mlearning project student participants indicated (2006 to 2009), the majority of students are consumers of web 2.0 content rather than producers. Kress and Pachler (2007) explore these ideas within the context of mobile learning. Kress and Pachler see one mobile learning challenge around the "physicality of the devices: due to their small size and the amount of data that can be displayed at any one time and the ease with which it can be manipulated is limited" (Kress & Pachler, 2007, p. 12).

According to Kress and Pachler, the characteristics of mobile devices are:

- Flexibility and portability
- Multifunctionality and technical convergence
- Multimodality
- Nonlinearity
- Interactivity and communicative potential

They also explore the social consequences of mobile use:

1. Mobile devices become a prosthesis for some users
2. Mobile devices have impact on the notions of the self and society

However, new mobile devices are overcoming their traditionally associated physical barriers of small screen size and slow text entry. For example: the Nokia N95 smartphone introduced video output to large screen display devices. The User Interface (UI) of the iPhone and iPod touch revolutionized the small screen experience, and remote control and screen display software also overcomes these limitations (for example: ImageExpo is an example of VNC based screensharing applications now available for mobile devices for large group demonstrations). Finally, today's smartphones have the ability to share mobile created content with desktop and laptop computers via synchronization software, beaming and web hosted services (for example: Google Documents).

While Bruns discusses the concept of learner-generated content, or generation 'C', Cook et al. (2007) focus on learner-generated contexts enabled by mobile devices. The focus then becomes the mobility of the learner allowing any environment to become a ‘site of learning’.

Sharples and Brown (2009) identify two different interpretations of ‘context’:

1. A ‘shell’ view of context
    a. Context is “that which surrounds us”, for example: Cole (1996).
    b. Defines learning as knowledge acquisition
2. An ‘interaction’ view of context
    a. Context is created by the constructive interaction between people and technology, or social knowledge construction, for example: Dourish (2004).

The interaction view of context is the focus of this research. Price (2007) builds upon this core attribute of mobility to describe the ability of mobile technologies to link, interact and enhance learning experiences in the physical world as ‘augmentation’. Thus Price argues mobile devices support:

1. Experiential and discovery learning (Bruner, 1973)
2. Construction activities (Papert, 1980)
3. Collaborative learning (Pea, 1994)
4. Computational offloading (Larkin & Simon, 1987)
5. Digital representations (Rogers & Price, 2006)
6. Re-representation and reorganization (Levene & Peterson, 2002)
7. Interpretation and transformation of information (Schomberg, 1986) (Price, 2007, pp. 43-44).

Price (2007, p. 48) identifies four key themes for the impact of mobile devices on learning:

1. Integrating knowledge
2. Constructing knowledge
3. Collaborative learning
4. Interaction and control

One example of this is the use of QR Codes (Elias, 2009; Kaywa, 2005) to represent information encoded into a two-dimensional code that can be decoded using a cameraphone. In summary, while espousing the potential benefits of mobile devices in enhancing learning, Price (2007) acknowledges the limitations of carrying out longitudinal research in this area. Hence the proliferation of “large numbers of disparate case studies” (p. 47) have made the establishment of transferable mobile learning principles problematic.

Cook et al. (2007) “propose that learner generated context (denoted by Generation ‘CX’) and not ‘merely’ the generation of content is a more generic way to conceptualise pedagogically effective ways to design learning activities that embed *[mobile]* digital interactions” (p. 55). The use of mobile devices is justified by referring to Green and Hannon (2007): “the use of digital technology has been completely normalized by this generation, and it is now fully integrated into their daily lives…”. Cook et al. (2007) therefore investigated the question: “how should learning activities using mobile technologies be designed to support innovative educational practice?” (p. 55).

Cook et al. (2007) describe a case study where students were supplied with a Nokia N91 smartphone each for a particular project within their pre-service teacher education course. They investigated the link between learners' informal private space and formal education environments using mobile technology. However, in response to the question "Was there evidence of learner generated contexts?" (Cook, et al., 2007, p. 59) responses focused more on learner-generated content. Identified critical incidents in the study included: two latecomers to the project "did not use the smart phone and scored poorly in the assignment" (Cook, et al., 2007, p. 72). They conclude: "our results have shown that the state-of-the-art technology can engage and motivate" (Cook, et al., 2007, p. 72), but the alignment of the project goal and outcomes appears somewhat tenuous in this example.

More recently Cook has appropriated concepts from Luckin's (2008) Ecology of Resources (EOR) model to extend his earlier work on learner generated contexts. For Cook, the context of learning is informal learning, where the learner defines the learning goals: "informal learning is a natural activity by a self-motivated learner 'under the radar' of a tutor, individually or in a group, intentionally or tacitly, in response to an immediate or recent situation or perceived need. Or serendipitously with the learner mostly being (meta-cognitively) unaware of what is being learnt" (Cook, et al., 2008, p. 4).

The London Mobile Learning Group (LMLG), of which Cook is a core member, continues to develop their theoretical foundations for mlearning, including the publication of a book drawing together their thoughts (Pachler, et al., 2010). While Cook et al. have added significant theoretical discourse that broadens the base of mlearning research; it is debatable that this is based on much personal empirical evidence, with the basis of these discourses appearing to be small, short-term case studies (Cook, et al., 2007). There appears to be a gap between mlearning theorists and mlearning practitioners. This is a gap this research attempts to partially fill, appropriating the concept of student-generated contexts across multiple iterations (2007-2009) of mlearning design and implementation.

3.6.1 Pedagogical Integration: The Pedagogy-Andragogy-Heutagogy Continuum

Focusing explicitly on empowering independent learners, Luckin et al. (2008) proposed the concept of Learner-Generated Contexts (LGC) as a potential framework for technology based learning based on the Vygotskian concept of Obuchenie. Obuchenie blurs the distinction between teaching and learning, creating a two-way dyadic interaction within the Zone of Peripheral Development. Though not limited to mobile learning, the concept focuses upon learning within learners' own environments that new technologies facilitate. Luckin et al. (2008) see a reconceptualisation of the level of influence the teacher plays in these contexts. They attempt to breakdown the hierarchical distinctions between pedagogy (teacher-directed, school education), andragogy (student-directed, adult education) and heutagogy (self-determined, doctoral research), illustrated in Table 5, and create a PAH continuum (Pedagogy – Andragogy – Heutagogy) that bridges these distinctions and reconceptualises the interactions between the student and the teacher in learning, particularly in informal learning environments.

Table 5: The PAH continuum.

	Pedagogy	**Andragogy**	**Heutagogy**
Locus of Control	Teacher	Learner	Learner
Educational sector	Schools	Adult education	Doctoral research
Cognition Level	Cognitive	Metacognitive	Epistemic
Knowledge Production Context	Subject understanding	Process negotiation	Context shaping

From "Learner Generated Contexts: a framework to support the effective use of technology to support learning," by Luckin et al. (2008, p. 10)

The PAH continuum maps well with the progression of mobile web 2.0 course integration from web 2.0 appropriation (JISC, 2007, 2009a), to student mobile facilitated content creation (Bruns, 2007; JISC, 2009b), and finally the context awareness and bridging affordances of mlearning (Luckin, et al., 2008; Vavoula, 2007a) where students begin to negotiate and define new learning contexts themselves.

3.6.2 Lecturer Modeling: Obuchenie

Luckin et al. (2010) propose the Obuchenie context model as an integration of PAH with the Ecology Of Resources (EOR) model (Luckin, 2008) to reinterpret these within the context of a flexible "democratic, socially-constructed, community-based defense against the traditional levers of control or colonization by the organization" (p. 80).

According to Luckin et al. (2008):

> A context can be described as a situation defined through the relationships and interactions between the elements within that situation over time. For a learner, a context is a situation defined through interactions in and with the world that are themselves historically situated and culturally idiosyncratic. (p. 4)

The EOR comes out of Activity Theory, and defines context as "a set of inter-related resource elements, including people and objects, the interactions between which define a particular context" (Luckin, et al., 2008, p. 5). Their focus is upon learner choice. They see other current pedagogical models limitations because they are "not communicative and learner-centric, but instrumental and organization-centric" (Luckin, et al., 2008, p. 6). Their view is that the limitation of the Conversational Framework is that it does not "transform practice" (Luckin, et al., 2008, p. 6). They see design as an industrial process that is specifically oriented towards the reduction of choice. Therefore they want to minimise the teacher's influence and maximise the learners' choices. Creating role shifts that can be empowering but may also be disruptive.

The Achilles heel of this conceptualisation of learner generated contexts based on the PAH continuum and an Obuchenie model is that the approach is built upon the assumption that the students involved in the learning are "self-motivated" learners (Cook, 2007b), and is based almost exclusively within informal learning contexts (Cook, et al., 2008). Student participants in Cook et al.'s (2008) mlearning trials were pre-service teachers, who are usually highly motivated learners.

> Informal learning is a natural activity by a self-motivated learner 'under the radar' of a tutor, individually or in a group, intentionally or tacitly, in response to an immediate or recent situation or perceived need. Or serendipitously with the learner mostly being (meta-cognitively) unaware of what is being learnt. (Cook, et al., 2008, p. 4)

While the researcher is not advocating a radical reconceptualising of educational pedagogy on the scale that is proposed by Luckin et al. (2008), I see similarities and useful alignment of the pedagogical approaches chosen for this research with pedagogy2.0, authentic learning and some of the PAH continuum principles, in particular the concept of scaffolding and staging the PAH continuum as a framework for transforming pedagogy has been influential on the research project. The key point of difference is in the role that the researcher assigns to the lecturer within the formal and informal learning environments. I see the input and facilitation of the lecturer as a critical success factor in implementing mobile web 2.0 technologies, and would agree with Laurillard's position that states "M-learning, being the digital support of adaptive, investigative, communicative, collaborative, and productive learning activities in remote locations, proposes a wide variety of environments in which the teacher can operate", thus mlearning supports "the formal learning process by maintaining continuity between the teacher- directed f2f context and the learner's remote peer learning context" (Laurillard, 2007, p. 172).

The researcher contends that mlearning technologies provide the ability to facilitate learning conversations between students and lecturers, between student peers, students and subject experts, and students and authentic environments across multiple contexts. Fisher and Baird (2006), Herrington et al. (2009b), and Pachler et al. (2010) take a similar approach to the researcher's, aligning social constructivism with emerging mobile web 2.0 services. While web 2.0 tools are characterised by user-generated content and social networking, mobile devices add the extra dimension of user-generated contexts. "The intrinsic nature of mobile technologies is to offer digitally-facilitated site-specific learning, which is motivating because of the degree of ownership and control" (Laurillard, 2007, p. 157).

3.7 Authentic Learning

Authentic Learning (Herrington & Oliver, 2000) is based on constructivist learning paradigms, and specifically on situated learning theory (Lave & Wenger, 1991). Beginning with the application of situated learning to instructional design of multimedia (Herrington & Oliver, 1995, 2000), Herrington et al. have championed the development of authentic learning as a general framework for elearning (Herrington & Herrington, 2006a, 2006b; Herrington, 2006; Herrington & Kervin, 2007; Herrington, Oliver, & Reeves, 2003; Herrington, Reeves, & Oliver, 2006; Herrington, Reeves, & Oliver, 2009), and then investigated the application of mlearning as a foundation for mlearning (Herrington, 2008; Herrington & Herrington, 2007; Herrington, Herrington, & Mantei, 2009; Herrington, Herrington, Mantei, Olney, & Ferry, 2009a; Herrington, Herrington, et al., 2009b; Herrington, et al., 2008). The tenets of authentic learning resonate closely with the researcher's approach to designing mobile web 2.0 learning environments. The application of authentic learning to mlearning was explored contemporaneously (Herrington & Herrington, 2007) to that of the researcher's own mlearning research. Thus authentic learning was not used as a foundation for this research, but was used primarily in the analysis of the research, providing a source of comparative findings and principles for mlearning implementation.

Herrington and Herrington (2006b) describe authentic learning environments as: "motivating and challenging activities that require collaboration and support. The tasks the students do reflect the tasks seen in real professions and workplaces, and the problems they solve are complex and sustained, requiring intensive effort" (Herrington & Herrington, 2006b, p. 2). "Authentic learning situates students in learning contexts where they encounter activities that involve problems and investigations reflective of those they are likely to face in their real world professional contexts" (Herrington, et al., 2008, p. 421). The characteristics of authentic learning include:

> Problems are set within an authentic and realistic context, they are ill-defined and complex, they require a significant investment of time and intellectual resources, problems require examination from multiple perspectives, they require collaboration and reflection, they are integrated with assessment, and supported by scaffolding. (Herrington & Herrington, 2006b, p. 5)

Authentic learning is defined in contrast to the typical behaviorist approach found in university teaching and learning. "Typically, university education has been a place to learn theoretical knowledge devoid of context" (Herrington & Herrington, 2006b, p. 2).

Herrington and Oliver (2000) identify nine critical characteristics of authentic learning:

> 1. *Authentic contexts* that reflect the way the knowledge will be used in real-life
> 2. *Authentic activities* that are complex, ill-defined problems and investigations
> 3. *Access to expert performances* enabling modeling of processes
> 4. *Multiple roles and perspectives* providing alternative solution pathways
> 5. *Collaboration* allowing for the social construction of knowledge
> 6. *Opportunities for reflection* involving metacognition
> 7. *Opportunities for articulation* to enable tacit knowledge to be made explicit
> 8. *Coaching and scaffolding* by the teacher at critical times
> 9. *Authentic assessment* that reflect the way knowledge is assessed in real life. (Herrington, et al., 2008, p. 3)

The main criticisms of authentic learning are the same as those of situated learning (Brown, et al., 1989; Collins, et al., 1989) upon which it is based. Wineburg (1989) criticized situated learning for claims of being a new approach to teaching and learning without contextualizing it within similar past approaches. Tripp (1993) argued that situated learning could not be transferred to a classroom environment, and that transferability of knowledge requires abstraction. Laurillard (1993, 2001) also argued that experiential (direct) learning requires abstracted (mediated) academic knowledge in order to create connections between the knowledge gained from experience and wider contexts. However, Herrington and Herrington argue that, "The *cognitive authenticity* rather than the *physical authenticity* is of prime importance in the design of authentic learning environments" (2006b, p. 3). Other issues include the complexity of assessing authentic learning, and its applicability to knowledge-based disciplines such as mathematics. Accordingly authentic learning research has focused on defining tasks and principles for implementation that can be used across a variety of learning contexts (Herrington & Herrington, 2006a; Herrington, 2006; Herrington

& Kervin, 2007; Herrington, et al., 2003; Herrington, et al., 2006; Herrington, Reeves, & Oliver, 2007; Herrington, T. Reeves, et al., 2009).

In the researcher's view, the ability of WMDs (mlearning) to bridge learning contexts and facilitate student-generated contexts provides a powerful way to address the critics of authentic learning who contend that situated learning cannot authentically occur in the classroom. WMDs can facilitate the design of pedagogical activities that enable students to continue learning conversations and experiences both in and beyond the classroom.

Herrington and Herrington (2007) proposed authentic learning as a suitable theoretical paradigm for informing mlearning, and used the concepts of authentic learning to form the pedagogical basis for mlearning projects developed at the University of Wollongong, mapping the nine critical characteristics of authentic learning to the design of mlearning scenarios. Herrington and Herrington (2007) argue "that the advances in philosophical and practical developments in education have created justifiable conditions for the pedagogical use of mobile technologies based on authentic learning" (p. 1). Table 6 was created by Herrington and Herrington (2007) to map these pedagogical developments:

Table 6: Shift in philosophical, theoretical and professional dimensions of learning.

Dimension	Moving from	Moving to
Philosophy	Instructivist	Constructivist
Theory	Behaviorist, cognitivist	Situated, socio-constructivist, andragogical
Course design	Bounded scope and sequence	Open-ended learning environment, flexible content
Time and place	Fixed in educational institutions	Distributed, to suit the contexts of the learners
Knowledge base	'Objective' knowledge, largely determined by experts	Knowledge built and shared among the community
Tasks	Decontextualized, concise, self-contained	Authentic, reflective, complex and sustained
Resources	Fixed, chosen by teacher	Open, chosen by learners with access to search tools
Support	Teacher	Community of learners,
Mode	Individual, competitive	Collaborative, networked
Technology tools	Fixed, located in learning spaces	Mobile, portable, ubiquitous, available
Knowledge outcomes	Facts, skills, information	Conceptual understanding, higher order learning
Products	Academic essays, exercises, or no tangible product	Authentic artifacts and digital products
Assessment	Standardized tests, examinations	Performance-based, integrated and authentic assessment
Transfer of knowledge	Stable knowledge adapted to different contexts	New and changing knowledge acquired when required
Professional learning	Courses, group events, workshops	Personal, just-in-time, community-based

From "Authentic mobile learning in higher education," by Herrington and Herrington, AARE 2007, International Educational Research Conference: Fremantle. (2007, p. 2)

Herrington and Herrington (2007) observed that most educational uses of mobile devices have focused on administrative (usually using SMS text messaging), reference, or interactive response functions. They report that Pattern, Arnedillo-Sanchez and Tangney (2006) suggest "the theoretical underpinnings of these activities appear to be either non-existent or principally behaviourist in nature" (Herrington & Herrington, 2007, p. 3).

> Their (*mobile technologies*) adoption is following a typical pattern where educators revert to old pedagogies as they come to terms with

> the capabilities of new technologies… (Herrington & Herrington, 2007, p. 4)

In contrast to this pedagogically regressive response to new technologies, Herrington and Herrington (2007) argue that using newer learning theories to underpin mlearning will make better use of the affordances of mobile technologies in educational settings, such as:

1. Authentic Learning frameworks (based on situated learning theory).
2. Communities of Practice
3. Distributed Intelligence (Pea, 1994)
4. Distributed Cognition
5. Connectivism (Siemens, 2004)
6. Activity Theory (Sharples, et al., 2007)

Herrington et al. (2008) illustrated the application of authentic learning to mlearning scenario design during mlearning research undertaken at the University of Wollongong over a two-year period. This mlearning research consisted of a series of six-week long mlearning projects using Palm Treo680 smartphones and iPods, funded by an Australian government grant. The projects made the link between the multimedia capturing capabilities of mobile phones and web 2.0 sharing, and thus were very useful to compare with the process and outcomes of the mlearning projects described in this thesis. The main difference between these two mlearning research approaches was the relative length of the projects, and the choice of mobile devices. The Unitec mlearning research grew into five longitudinal case studies between one year and four years in duration with multiple action research cycles (projects), and involved a continually changing range of mobile devices (keeping up to date with current technology), whereas the University of Wollongong projects were of short-term duration with choices of mobile devices that have quickly become out-dated. However, the theoretical basis and structure of the Wollongong mlearning research was very helpful in informing the 2009 Unitec projects. (The researcher was unaware of the Wollongong mlearning research previous to the end of 2008).

The structure of the Wollongong mlearning research was similar to the approach used in this research, explicitly articulated by a four-stage implementation model over two years that involved an initial investigation of mlearning affordances followed by mlearning professional development leading to the implementation of mlearning projects investigating mlearning strategies. The culmination of the Wollongong mlearning research was the development and publication of mlearning principles based upon this process (Herrington, et al., 2008, p. 422). "Design-Based Research" principles were used to establish these mlearning design principles, which is a similar methodology to action research, with the goal of the research to establish and publish mlearning design principles fulfilled in the summative book "New Technologies, new pedagogies: Mobile learning in higher education" (Herrington, Herrington, et al., 2009b). The mlearning principles derived from the Wollongong project are (Herrington, et al., 2009, p. 134):

1. Real world relevance: Use mobile learning in authentic contexts
2. Mobile contexts: Use mobile learning in contexts where learners are mobile
3. Explore: Provide time for exploration of mobile technologies
4. Blended: Blend mobile and non mobile technologies
5. Whenever: Use mobile learning spontaneously
6. Wherever: Use mobile learning in non traditional learning spaces

7. Whomsoever: Use mobile learning both individually and collaboratively
8. Affordances: Exploit the affordances of mobile technologies
9. Personalise: Employ the learners' own mobile devices
10. Mediation: Use mobile learning to mediate knowledge construction.
11. Produse: Use mobile learning to produce and consume knowledge.

The conclusion drawn at the end of the Wollongong mlearning research was:

> While much has been learnt about the capabilities of the devices and appropriate designs for teaching and learning through this project, these 'first generation' studies may well be insufficient to prompt the widespread uptake of mobile learning in higher education institutions (Traxler, 2005). According to Traxler we are now at a point where we should be looking more strategically at the implementation of mobile learning in higher education on a broader scale arguing that 'mobile learning will require 'second-generation' pilots or large-scale trials across institutions and across subjects if its wider potential is to be realised'. (Herrington, et al., 2009, p. 137)

Thus there is an identified need for longitudinal mlearning research such as that reported in this thesis by the researcher.

3.7.1 Identifying critical success factors

The nine critical characteristics of authentic learning and the mlearning principles derived from the Wollongong project provide support for the researcher's identified critical success factors for social constructivist based mlearning, as summarised in the following points.

- The level of pedagogical integration.

The focus of authentic learning upon authentic contexts, activities, and assessment is achieved by expert planned pedagogical integration (Herrington, 2006; Herrington & Kervin, 2007; Herrington, et al., 2006). This also involves exposure to multiple roles and perspectives, and opportunities for student reflection that are facilitated by their teachers. Authentic mlearning will involve student produsage (Herrington, et al., 2009) within mobile contexts, that is student-generated content (Bruns, 2008) and student-generated contexts (Luckin, et al., 2010).

- Lecturer Modeling

A core aspect of authentic learning involves access to expert performances for modeling the situated use of knowledge to students. Mlearning facilitates knowledge mediation by expert teachers and practitioners involving students in knowledge construction.

- Creating a Supportive Learning Community

Authentic learning environments involve students in collaborative projects and emphasizes the importance of coaching and scaffolding students within the learning environment.

- Appropriate Choice of Technologies

Similar to the concepts of student-generated content and student-generated contexts, appropriate choices of mediating technologies that exploit the unique affordances of mlearning provide opportunities for student articulation, or produsage within multiple contexts, using student-owned devices.

- Technological and Pedagogical Support

This was not an explicit focus of either authentic learning or the derived mlearning principles.

3.8 Synthesis: Comparison of mLearning Critical Success Factors

The contribution of the four chosen pedagogical frameworks investigated in sections 3.4 to 3.7 (Communities of Practice, the Conversational Framework, Learner-Generated Contexts, and Authentic Learning) to the identification and understanding of critical mlearning success factors builds upon those already indicated in Table 4, and is summarized in Table 7.

Table 7: Comparison of mlearning critical success factors.

Categorised critical success factors	Authentic mLearning Herrington et al. (2008) Section 3.7	mLearning Design Principles Herrington et al. (2009) Section 3.7	Communities Of Practice Wenger et al. (2005, 2009) Section 3.4	Learner Generated Contexts Luckin et al. (2008, 2010) Section 3.6	Conversational Framework Laurillard (2007) Section 3.5
1. Pedagogical integration	1. Authentic contexts 2. Authentic activities 4. Multiple roles and perspectives 6. Opportunities for reflection 9. Authentic assessment	1. Real world relevance 2. Mobile contexts 4. Blended 5. Whenever 6. Wherever 11. Produse	Intentionality Domain	PAH continuum EOR Student generated	Design of learning activities
2. Lecturer modeling	3. Access to expert performances	10. Mediation	The Practice	Obuchenie – teachers as learners and students as teachers	Dialogic interaction between students and lecturer
3. Learning community	5. Collaboration	3. Explore 7. Whomsoever	Shared enterprise and Legitimate Peripheral Participation (LPP)	Assumed – focus is on providing the tools to enable learner-centered experiences	Continuing learning conversations
4. Appropriate choice of technology	7. Opportunities for articulation	8. Affordances 9. Personalise	Web 2.0 supporting COP	Student owned	Importance of communication and collaboration technologies
5. Technological & Pedagogical Support	8. Coaching & scaffolding		The Technology Steward		

The comparison of the contributions of the four chosen pedagogical frameworks to mlearning critical success factors shows a similar pattern to that found in Table 4. Table 7 indicates that most of the focus of these pedagogical frameworks has been put into the area of pedagogical integration, with relatively little focus on the aspects of technological and pedagogical support around the introduction of technology. Wenger et al's (2009; 2005) development of the role of the technology steward to support the pedagogical integration of technology became a crucial element of the supporting communities of practice surrounding each mlearning project. All four frameworks emphasize the critical element of starting with pedagogical design of learning activities and assessment (pedagogical integration). Lecturer modeling, the establishment of a supportive learning community, and the appropriate choice of technologies are addressed by all four frameworks. A sixth critical success factor identified by the researcher from the thirteen mlearning projects (see section 10.2) as sustained engagement for ontological shifts for the participants is not addressed by any of these. These critical success factors informed the iterative development of the thirteen mlearning projects within the context of five mlearning case studies that formed the basis of the research.

3.9 Chapter Summary

The chapter began by identifying the lack of a widely recognised theory of mobile learning, establishing the need to appropriate existing pedagogical frameworks for guiding the design and implementation of mlearning. An investigation of pedagogical frameworks based upon social constructivsm led to choosing four foundational pedagogical frameworks to inform mlearning design and implementation: Communities of Practice, the Conversational Framework, Learner-Generated Contexts, and Authentic Learning. These frameworks were then explored for their implications authenticating the identification of critical success factors to guide the implementation of the mlearning case studies.

4 METHODOLOGY

This chapter outlines the development and implementation of the research case studies. The chapter outlines the research method, introduces the research questions and the research participants. The chapter then explores the development of the core pedagogical and technological support model used, and outlines the general approach taken to the case studies. Following this, the chapter outlines the resource choices and management process used.

The researcher believes that the goal of research is more than simply gaining knowledge. Knowledge brings responsibility to disseminate this knowledge and bring about beneficial change to the community involved. Communities are made up of groups of people with unique strengths and needs. The rich data that comes from qualitative research is needed in order to understand communities, and to provide beneficial insights for them. Qualitative research is valuable in the field of educational research, providing rich data for educational situations (Hoepfl, 1997). Action research is useful for facilitating change for communities. Therefore a qualitative research methodology, and in particular action research, was chosen by the researcher.

The research also involved the use of some quantitative data collection instruments used to generate mixed mode data for triangulating and guiding the qualitative reflections and analysis, as recommended by Sharples (2009b), and Vavoula, Pachler and Kukulska-Hulme (2009).

The research timeline was:

1. Research proposal development (2006).
2. Research proposal confirmation (September/October 2006).

3. Action Research Projects (2007 – 2009).
4. Final evaluation/analysis of research project results (2009).
5. Institutional eLearning strategy development (2009).
6. Thesis write up (2009 to 2010).
7. Thesis submission (2010).
8. Implementation of Institutional eLearning strategy (2010-2012).

4.1 Action Research

The core research methodology chosen for the research was action research. Action research is a qualitative methodology, and involves cycles of implementation and reflection, with the research questions often evolving over time. According to Denzin and Lincoln (2005), the qualitative researcher uses bricolage creating a montage of tools and techniques to capture and analyse rich data. Action research, as a qualitative research methodology, is inherently multi-method in focus, and often uses triangulation of multiple data gathering techniques to validate the results and interpretations given to the results. Action research "deals with real-life problems in context... It creates mutual learning opportunities for researchers and participants, it produces tangible results" (Greenwood & Levin, 2005, p. 60).

Action research is a research methodology that has proven popular in education, particularly for educators wanting to bring about positive change in specific learning contexts because of its practical, problem-solving emphasis, and because practitioners (sometimes with researchers from outside the institution) carry out the research that is directed towards greater understanding and improvement of practice over a period of time (Bell, 1999). The researcher's belief is that knowledge should not merely be pursued for its own sake or that of the researcher alone, as knowledge brings responsibility – responsibility to the community that the researcher is part of or learning about, involving a responsibility to communicate this knowledge and bring about positive change within society. Producing beneficial change for the research participants and stakeholders (including the community in which the research is based) is one of the goals of action research (Ellis & Kiely, 2000; Greenwood & Levin, 2005; Holian, 1999; Wadsworth, 1998). Swantz characterised participatory action research by:

> Participation and action made research contextual. The roles of the researchers and the researched interchanged in the course of communication through which there *is* a mutual development of knowledge and learning to understand people's problems. (Swantz, 2008, p. 33)

Therefore the research was qualitative in nature, and initially used small numbers of participants evaluating the integration of WMDs, followed by larger scale iterations. The research was conducted over a three-year period, and used action research as its methodology (Dick, 1997; Ellis & Kiely, 2000; Holian, 1999). The research implementation was initially envisioned to involve one research cycle per semester, however in practice (and after evaluating two test projects in 2006) it was found that longer time-frames were required for the development of supportive learning communities and the ontological shifts that many of the participants experienced. Thus each research project typically extended over an educational year. The mid-semester and mid-year breaks formed natural points of reflection and cycles within each project (Figure 5).

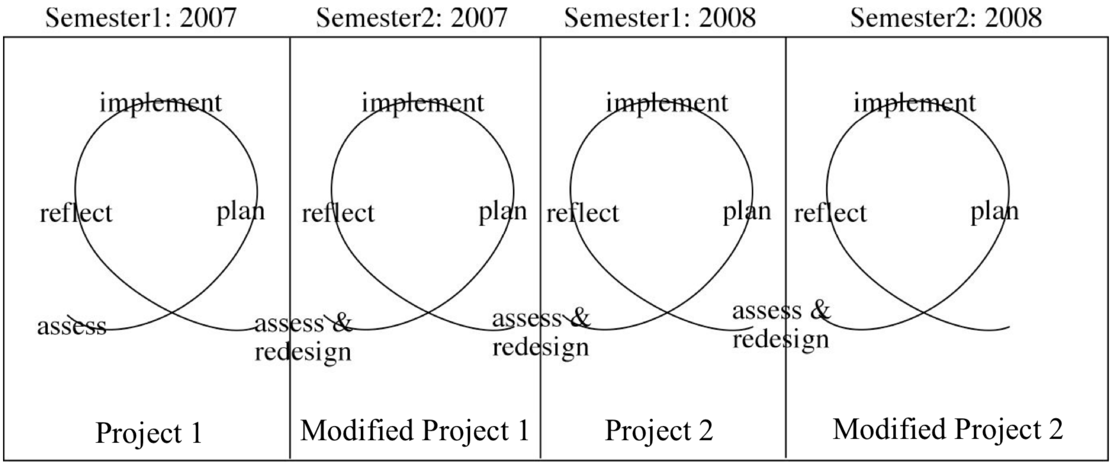


Figure 5: Action research cycles.

The action research cycles provided time for reflection and feedback between researching and developing the implementation of WMDs within each of the tertiary courses chosen. This reflection and feedback provided rich data on the success of the implementation and integration of the WMDs and areas needing modification, informing the subsequent mlearning projects. Each project cycle included: assessing the course needs, planning the integration of WMD hardware and web 2.0 tools, implementation, reflection, and modification of the pedagogical strategies employed for the following project.

Implementing five different case studies involving thirteen research projects over three years allowed the researcher to keep track of changes and progress in the development of WMD hardware and web 2.0, and the impact of these changes over an extended time-frame.

An action research methodology also allowed the research to keep up to date, as each research cycle allowed for reflection and modification for the next cycle. This allowed the incorporation of new mobile hardware and software as it became available in this very quickly changing field, and the refinement of the research questions as a result.

4.1.1 Participatory Action research

The research involved a partnership between the researcher, the course lecturers, and the students involved in each successive mlearning project. The researcher's role was that of the primary collector of data, and the technology steward (Wenger, et al., 2005) within the communities of practice developed for each project. The research approach was thus participatory action research (Wadsworth, 1998).

Wadsworth (1998) identifies the key characteristics of participatory action research: the researcher is a participant, the researcher is the main research instrument, it is cyclical in nature, involves action followed by reflection followed by informed action, and is concerned with producing change. This change is ongoing throughout the process, and the research is interested in input from participants and stakeholders. This allows for the continual development and improvement of the projects based on the feedback from participants at regular points in the projects. These reflective points were focused around the semester breaks, before which participant feedback was gathered via surveys and focus group discussions. Following this the researcher and the course lecturers spent significant time together critiquing the project implementation and modifying it for the following semester period. Each action research project involved a series of research cycles that occurred throughout the project providing continuous feedback, reflection and modification of the research approach. Feedback was facilitated by the following:

- Weekly face-to-face technology support sessions, facilitated by the researcher.

- Instant Messaging – between students and academics, students and technology steward/researcher, and academics and technology steward/researcher.
- RSS feeds from forums set up on the learning management system (Moodle and Blackboard).
- RSS feeds from student Blogs and online media hosting services.

The research investigated the pedagogical issues of utilizing mobile wireless devices in tertiary education. The aim was to improve pedagogy and positively enhance students' learning. The study situated itself firmly in the discursive and student-centred pedagogies rather than didactic and teacher centred pedagogies. The emphasis was upon 'what the student does' – getting the students involved in the discovery of learning, rather than being merely receptors for course content. Communication is a key in this, as defined in the chosen underpinning pedagogical frameworks, for example: Laurillard's conversational framework of learning (Laurillard, 2001; Sharples, 2005). Another key issue in successful tertiary education is the alignment of teaching and learning activities with the course assessment and outcomes. Biggs (2003) coined this 'constructive alignment'. This concept helped guide the development of appropriate assessment strategies for each project. Also, as outlined previously, the theories of social constructivism, communities of practice, and the conversational framework, informed the design of the research project.

Taking on-board these concepts, the main focus of this research was on the support and enhancement of both formal (face to face) and informal (beyond the classroom) teaching and learning by using the mobile wireless devices as a means to leverage the potential of current and emerging collaborative and reflective e-learning tools (for example: blogs, wikis, RSS, instant messaging, podcasting, social book marking). The e-learning activities developed to make use of the WMDs in the various projects therefore focused upon the use of web 2.0 tools. Each project was designed to stage and scaffold mlearning integration as appropriate to the level of the course, starting with establishing a learning community culture involving both the students and the lecturers and facilitation of a progression of teaching and learning paradigms from pedagogy to heutagogy (PAH) (Luckin, et al., 2008; Luckin, et al., 2010) following the first year to third year of a course (see Table 45). The PAH continuum mapped with the progression of mobile web 2.0 course integration from web 2.0 appropriation (JISC, 2007, 2009a) in a first year course (see for example Table 14 and Table 17) to student mobile facilitated content creation (Bruns, 2007; JISC, 2009b) in a second year course (see for example Table 16 and Table 19), and finally the facilitation of student-generated contexts and the context bridging affordances of mlearning (Luckin, et al., 2008; Vavoula, 2007a) leveraged in the third year course projects (see for example Table 10 and Table 15).

4.2 The Research Questions

The research questions reflect the researcher's goal of enhancing students' learning environments with tools that facilitate social constructivist pedagogy. The choice and integration of technology into a learning environment should firstly be based upon sound pedagogical foundations. The underlying foundation chosen for the following examples is social constructivism, facilitating a student-centred learning environment. Communication (student to student, student to teacher, and student to resources) as emphasised in Laurillard's conversational framework of learning, and student content creation were identified by the researcher as key elements in establishing a social constructivist learning environment. Mobile web 2.0 technologies were then identified as potential tools to facilitate this. Web 2.0 social software provides a close fit with the tenets of social constructivism, providing easy to use, interactive, collaborative content creation and sharing tools that are accessible worldwide in an online environment that can enhance both face-to-face and distance learning. The research questions were designed to explore these assumptions.

1. What are the key factors in integrating Wireless Mobile Devices (WMDs) within tertiary education courses?
2. What challenges/advantages to established pedagogies do these disruptive technologies present?
3. To what extent can these WMDs be utilized to support learner interactivity, collaboration, communication, reflection and interest, and thus provide pedagogically rich learning environments that engage and motivate the learner?
4. To what extent can WMDs be used to harness the potential of current and emerging social constructivist elearning tools?

4.3 Design of the Research Instruments

The research was qualitative, and was aimed at bringing about positive change for the professional development of lecturers, and educational engagement of students within the researcher's institution. The data collection instruments were thus focused upon qualitative reflection and feedback from the participants. However a mix of quantitative survey questions were also used to provide multimode triangulation data (Sharples, 2009b; Vavoula, et al., 2009) on the impact of the mlearning interventions on the participants' teaching and learning experiences. All of the data collection and guideline instruments were pre-tested and modified via two pre trials at Unitec during 2006.

The core data gathering tools used in this research consisted of:

1. Pre-project surveys of lecturers and students, to establish current practice, expertise and experience.
2. Post-project surveys and focus groups, to measure the impact of the wireless mobile computing environment, and identify emergent themes.
3. Lecturer and student reflections via their own blogs and eportfolios during the project, collated via RSS feeds. The research used the technologies that were an integral part of the projects, such as participant blog posts, peer blog comments, and VODCast reflections to capture data on the progression and impact of mobile web 2.0 on the participants' learning experience.

4.3.1 Primary Data Collection Processes.

This section outlines the primary data collection tools and processes used in the research.

1. Initial feasibility study and needs analysis with lecturers

A short survey (attached in Appendix 13.5) was deployed to lecturers at the start of each mlearning project to establish their previous experience with mobile and web 2.0 tools. The survey was designed to encourage participating lecturers to reflect upon their current pedagogical practice and how they initially perceived the potential of WMDs and social software to enhance their courses and their students' learning experiences. The survey helped identify any potential barriers to mlearning within the context of each project, and formed a starting point from where the researcher could generate discussion around the unique contexts of each course that could be enhanced by the integration of mlearning.

2. At the start of each project all participating students completed a survey (attached in Appendix 13.7) of their prior group work experience, and their prior mobile and web 2.0 experience.

The data collection surveys of previous mlearning studies and the JISC (2005a, 2005b, 2005c, 2005d, 2005e) mlearning implementation guidelines were used to inform the design of the research questions and surveys. In particular, questions from two earlier studies were used as guides (Keegan, 2005b; Rawlinson & Bartel, 2006). The initial student survey consisted of a set of questions designed to evaluate the participants' prior mobile web 2.0 experiences, technology capability, and preconceptions about WMDs and social software. The survey provided data to compare against the participants' responses in the end of project survey, providing a benchmark on the impact to participants' learning and quality of experiences throughout the project. The survey was kept short, consisting of twelve questions. The questions were a combination of yes/no, multiple choice, and likert scale questions, with opportunity for qualitative responses at the end of the survey. Responses were collated using Excel spreadsheets, graphs, and any qualitative comments collated to identify themes.

3. At end of each project all participating students and lecturers completed a final survey form (attached in Appendix 13.8).

Questions from two earlier studies (Keegan, 2005b; Rawlinson & Bartel, 2006) were used as guides for the type and scope of questions asked in the survey. The survey consisted of a set of nineteen questions designed to evaluate the changes in responses between the initial survey and the end of project responses, providing a measure of the impact of the WMD project on participants' experiences, technology capability, and conceptions about WMDs and social software. The survey provided data to measure the participants learning and quality of experiences throughout the project. Responses were collated using Excel spreadsheets and graphs for comparison to the initial survey responses.

4. Focus groups were convened at the end of each project and a set of guiding questions were used to generate discussion and feedback around the mlearning project.

Twelve questions were used to guide the reflections of the focus groups. The focus group questions are attached in Appendix 13.9. The questions identified participants' reflections upon the collaborative, communicative, and connectivity affordances of the WMDs, and their thoughts on the integration of the WMDs into their course, and thus helping to identify how (from the participants' perspectives) the WMD integration facilitated a social constructivist learning and teaching environment. The focus groups consisted of representatives from each project group, usually involving a sample of five students, and one or two lecturers. Utilizing feedback from the two main stakeholder groups provided a good indication on the impact of the WMDs on learning. Involving representative lecturers from Unitec in the evaluation process provided an element of peer review into the research and also provided feedback on the pedagogical usefulness of the WMDs. The feedback gained from the focus groups was used to enhance that gained through written evaluations and observations, and also provided opportunity for further clarification of any issues. Following collation of the data from the focus group, the researcher met with the participating lecturers, and implications were discussed for developing learning activities utilizing WMDs and web 2.0 tools during any following project. Feedback was also compared to earlier projects. The post project focus group provided qualitative feedback to inform reflections and analysis of the project and identify any changes needed for following projects. The face-to-face environment of the focus group allowed the researcher to attempt to draw out reflective comments and critiques from the participants on any identified issues.

5. Reflective Journals.

A key activity in each project was the creation and maintenance of a reflective Blog by each participant, including all lecturers and students involved in each project (See Table 9 to Table 21 outlining the participants). The Blog host utilized for each project was negotiated with the lecturers before the beginning of each project, and a decision made based on the integration with the chosen WMDs and focus of each project. The researcher used RSS to subscribe to all of the participants' blogs and web 2.0 media sites, following their thoughts and progress throughout the project. The researcher also modeled the use of formative feedback on students' blog posts for the lecturers. This also formed a channel for technical support from the researcher as the technology steward for the projects, with students and lecturers often using blog comments and instant messaging to ask questions related to the projects from the researcher. These tools formed a core part of the learning community supporting each mlearning project.

In addition to a public reflective blog, the researcher kept a private reflective journal. The researcher's journal detailed key events and critical incidents occurring within each project, and a summary of each COP session with each different project. A Word document journal template was created for recording the researcher's thoughts, events, and ideas throughout the time-span of the projects (see Appendix 13.10 for the journal template used). The template was designed to facilitate reflection and keep the comments focused on the pedagogical implications and outcomes of key events and experiences from the researcher's perspective.

4.3.2 Triangulation Data Collection Processes.

Several processes were used to triangulate the data collected from participants via the formal surveys and focus groups. These are outlined in this section.

1. Usage statistics from the institution's Learning Management System (LMS) activity.

All lecturers and students involved in each project (See Table 9 to Table 21 outlining the participants of each project) were supported by either a Moodle (http://moodle.unitec.ac.nz) or Blackboard (http://bb.unitec.ac.nz) course, used for hosting tutorials on the use of the mobile web 2.0 tools used in the projects. Moodle or Blackboard user activity logs were kept for each project. These logs provided data showing what aspects of the Moodle support course were utilised, frequency of posting to discussion forums and other online interactions between lecturers and students, and between students. These were useful for indicating any students or lecturers who were not regularly participating in the project for any reason. The online forums also provided support avenues and tutorials for the projects.

2. Eportfolio content and collaborative networking by participants

All lecturers and students involved in each project (See Table 9 to Table 21 outlining the participants) maintained an eportfolio facilitating monitoring of user activity for each project. RSS feeds provided data showing what aspects of the eportfolio were utilised: file sharing, the creation of group work spaces, the frequency of posting to discussion forums, and other online interactions between lecturers and students, and between students.

3. Informal participant surveys

Occasional feedback was elicited from participants using both paper-based surveys and online via Surveymonkey (http://www.surveymonkey.com), usually around the mid-point of each project, or soon after mid semester breaks. This feedback was used to identify any specific support or implementation issues raised by the participants that could be quickly addressed during the project itself.

4. Participant VODCast

Participants were asked to reflect on the impact of the mobile web 2.0 technologies on their learning (and teaching), recording these reflections as video podcasts (VODCast), and uploading these VODCast to either their Blog, or YouTube. These were then later collated and transcribed by the researcher, providing a wealth of data for analysis. The use of rich media and participant reflections via VODCast provided rich qualitative data for analysis, and the use of multi-format, longitudinal, and participant-generated data aligns with Vavoula et al.'s (2009) recommendations for evaluating mlearning:

- Research should be in tune with new thinking about learning
- Research should consider the impact of context and be longitudinal, covering formal and informal environments
- Research should consider different types of data and analysis
- Research should involve learners as co-designers or co-researchers.

(Vavoula, et al., 2009)

4.3.3 Project Implementation Guidelines.

1. Project timelines and key goals.

A general project plan outline was produced by the researcher for each year of the research, with specific project plans involving informal discussions over a number of weeks between the researcher and the key lecturers in each project (see for example the Mobile learning project Outline 2008 http://docs.google.com/View?id=dchr4rgg_101wvprwjd, and the Mlearning Project 2009 Outline http://docs.google.com/View?id=dchr4rgg_95hjvbzkgs). Project planning and course integration formed one of the core goals of the pre-project lecturer Communities of Practice.

2. Project Plan.

Integration into the curriculum and assessment involved the pedagogical design of authentic WMD use and activities. While formal planning tools were available (for example the JISC e-learning activity planner (JISC, 2005b), and practitioner planner (JISC, 2005e)), in practice it was found that the project plan usually involved informal discussions over a number of weeks with the key lecturers in each project. This planning formed a focus for the pre-project lecturer Communities of Practice. A consultative approach with lecturers was taken to develop contextualized assessments and activities that enhanced the course by planned integration of the use of WMDs and social software within each course.

3. Participant information (explanatory statement) (Monash University, 2003b) and consent forms (Monash University, 2003a) were created based on the Monash University templates.

These documents (attached in Appendix 13.1 to 13.4) provided key information on the research for the participants, including: outlines of the research projects, what was expected of the participants, and a form for gaining their informed consent to participate in the research projects.

4. Institutional research permission form (Monash University, 2003c).

This form (attached in Appendix 13.11) was used for gaining permission from Unitec's CEO for the research projects.

5. Acceptable use policy for students

This document (attached in Appendix 13.6) outlined guidelines for participants' use of the institution's networks, hardware, and software during the project. Every participant signed the form to confirm they would look after loaned equipment and return it in working order.

4.4 Participants

The following sections outline the process of participant selection, and an outline of the participants involved in each of the mlearning projects from 2006 to 2009.

4.4.1 Selection of Participants

Unitec lecturer participants were comprised of lecturers wishing to explore the use of technologies to enhance their course and student learning. Potential lecturers and courses were identified by their participation and response to professional development workshops run by the Centre for Teaching and Learning Innovation (CTLI) at Unitec where the researcher was an Academic Advisor in learning technologies. Invitations were initiated either by the researcher to identified potential lecturers, or in response to request for participation by lecturers themselves (In response to CTLI workshops). An initial face-to-face meeting with the key lecturers of a course was held with the researcher to outline the research project and its potential fit and benefit with the course. This was followed by distributing the explanatory statement (Appendix 13.4) to the lecturers, and the research consent form (Appendix 13.2). An initial survey was created for the lecturers to gauge the potential benefit of the research project for a particular course (Appendix 13.5). The lecturer then invited colleagues teaching on the same course to form a Community Of Practice investigating the use and integration of mobile web 2.0 tools into the curriculum. The researcher then worked with the lecturers of the course as a participant within the COP, taking on the role of the 'technology steward' (Wenger, et al., 2009; Wenger, et al., 2005). Participating lecturers' expected commitments were outlined in their research consent forms. Lecturer requirements included:

- Integrating the use of a Wireless Mobile Device (WMD) and web 2.0 into the delivery and assessment of a semester length course that they teach.
- Taking part in a focus group discussion.
- Allowing the discussion to be audiotaped and/or videotaped.
- Attending a weekly Community Of Practice to learn about the WMD and web 2.0 software.
- Making regular reflections on a blog.
- Completion of an initial feasibility survey about the WMD project.

Unitec student participants were comprised of students in courses taught by participating lecturers. Participating students volunteered to participate, but were first selected by the lecturers on the basis of the students ability to learn how to use the proposed WMD, and the benefits students would receive in participating. For example: increased access to communications tools, resources and development of critical/reflective thinking. An outline (written and verbal) of how the project was integrated into the course delivery and assessment was provided and explained (This was specific to each separate project). An acceptable use policy (Appendix 13.6) outlining the participants' responsibility for loaned wireless mobile devices (if applicable) and use of the Unitec wireless network was provided for participating students to sign. The commitments expected of participating students were outlined in their research consent forms. The project was integrated into their existing programme, and they were expected to be interacting with the wireless mobile device daily as part of their course over the semester. The initial survey took about fifteen minutes to complete, while the post-project survey took about forty-five minutes to complete, and the focus group took the form of structured questions and discussion for about an hour. There was also a planned weekly one-hour community of practice supporting how to use the software and wireless mobile device involved. Student requirements included:

- Taking part in a focus group discussion.
- Allowing the discussion to be audiotaped and/or videotaped.
- Attending a weekly Community Of Practice to learn about the WMD and software.
- Make regular reflections on a blog.
- Completion of two questionnaires about the WMD project.

Table 8 to Table 21 provide a comparative outline of the mobile web 2.0 projects conducted between 2006 and 2009. Each project used a Learning Management System (LMS) to provide scaffolding and support for both tutors and students (either Blackboard or Moodle). Each project also used a different wireless mobile device, as available and appropriate to the requirements of the course, and each project had a specific timeline that was negotiated between the course lecturers and the researcher. Figure 6 provides an overview of the WMD projects from the 2006 pre trials to the 2009 research projects. An updated version including the 2010 post-research projects can be found at http://picasaweb.google.com/lh/photo/AkJiDAgsmIuvCeVnxkk0Gw?feat=directlink.

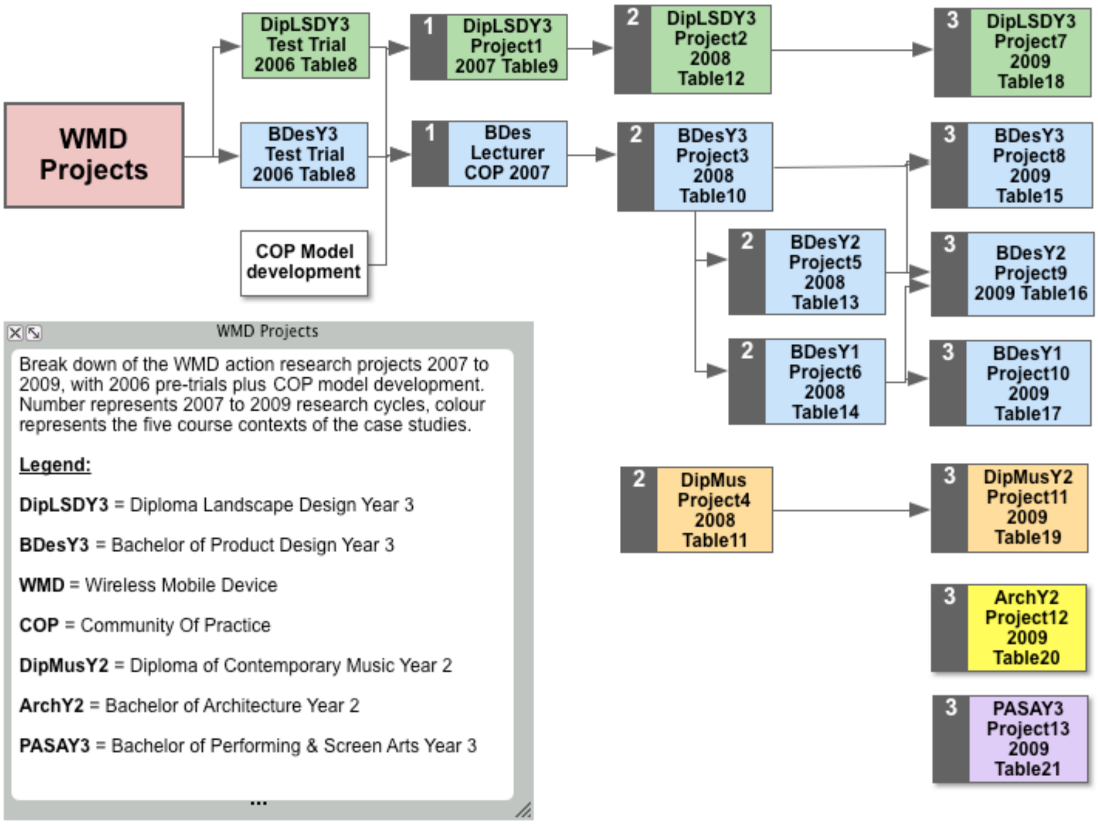


Figure 6: Outline of WMD Projects 2006 to 2009.

4.4.2 Test Trial Participants 2006

The initial 2006 trials utilized WiFi capable PDAs, and while they were informal trials, they were precursors to the formal projects in 2007 and following. The 2006 trials (Table 8) were used to test the development of the research instruments, and were formative in establishing initial implementation ideas. A preview version of the ethics consent form was used for the 2006 participants to sign, and this was included in the full ethics application that was approved January 2007 by the Monash ethics committee.

Table 8: WMD Trials 2006.

Trial	Course	Participants	WMD	Social Software	Summary
Trial 1	Diploma of Landscape Design, Unitec	18 students, 2 Lecturers, researcher.	Palm TX with folding wireless keyboard for text entry	Moodle Splashblog.com Litefeeds.com Blogger.com Letmeparty.com AIM, MSN	Use of WiFi PDA to create reflective Blogs. Group members subscribe to each other's blogs and to a central course blog using an RSS reading Java application. Deliver basic course content via Moodle, and encourage students to experiment with capabilities.
Trial 2	Year Two, Bachelor of Product Design, School of Design, Unitec	18 students, 2 Lecturers, researcher.	Palm TX paired with a Bluetooth 3G mobile phone	Moodle, Elgg Splashblog.com Blogger.com Litefeeds.com Letmeparty.com AIM, MSN	Use a combination of a WiFi PDA paired with a Bluetooth enabled 3G-cell phone, for anywhere, anytime connectivity to social software tools. Students establish reflective blogs, subscribe to each other's blog via RSS, and upload photos to splashblog.com.

4.4.3 Project Participants 2007.

Table 9: Outline of Diploma of Landscape Design 2007 mobile web 2.0 project.

Course: Diploma Landscape Design 2007, elective project	
Participants	• 8 students (three teams) –The average age of the students was 28 (19 to 49), and the gender mix was 5 female students and 3 male students. • 1 Course Tutor • Technology Steward (Thom Cochrane – CTLI)
Mobile Technology	Nokia N80 WiFi and 3G smartphone, prepay voice and data SIM provided, participants responsible for voice and data costs.
Pedagogical Model	From Pedagogy to Andragogy
Pedagogical Focus	Design and build a group exhibition garden for the Ellerslie Flower Show
Community of Practice	Focused on beginning and middle of the project, with 4 sessions at the beginning of the trial and 4 sessions mid trial with the introduction of the N80.
Support LMS	Moodle
Deliverables	A reflective blog of the design and build process. (Initially Wordpress, then moved to Vox in July 2007) A portfolio (either electronic using VOX or print-based).
Timeframe	March 2007 to November 2007, with N80 mobile introduced in July 2007.
Project Outline	https://docs.google.com/fileview?id=0B9kx7n-UKqvBZDM2M2Q4MTEtOWU3Ni00MjQ4LTk5ZGEtZGUzYjM1MzUxYmZj&hl=en_GB

4.4.4 Project Participants 2008.

Table 10: Outline of Bachelor of Product Design 2008, third year class, mobile web 2.0 project.

Course: Bachelor of Product Design, third year class, 2008	
Participants	• 9 students – The average age of the students was 24 (19 to 33), and all were male students. • 2 Course Tutors • Technology Steward (Thom Cochrane – CTLI)
Mobile Technology	Nokia N80 WiFi smartphone (upgraded to N95 in Semester2), Bluetooth folding keyboard, participants supplied with a 1GB/month 3G data allowance.
Pedagogical Model	From Andragogy to Heutagogy
Pedagogical Focus	Documenting the research and design of three products throughout the year, including working with a client company in small design teams
Community of Practice	Weekly throughout the entire course
Support LMS	Moodle
Deliverables	An online Blog/eportfolio documenting and showcasing your design processes and forming the basis of a collaborative hub with worldwide peers and potential employers/clients.
Timeframe	February 2008 through to November 2008, expanding to the entire course 2009.
Youtube Videos	• Third Year Project Overview http://www.youtube.com/watch?v=8Eh5ktXMji8 • Student Feedback http://www.youtube.com/watch?v=d44q77cz7H4
Project Outlines	Project Outline: http://docs.google.com/View?id=dchr4rgg_22hckp9zc9 Example Course Outline: http://docs.google.com/View?id=dchr4rgg_15fxjk7jcj

Table 11: Outline of Diploma of Contemporary Music 2008 mobile web 2.0 project.

Course: Diploma of Contemporary Music, elective class, 2008	
Participants	• 11 students – The average age of the students was 22 (17 to 32), and the gender mix was 6 female students and 5 male students. • 2 Course Tutors • Technology Steward (Thom Cochrane – CTLI)
Mobile Technology	iPod Touch WiFi PDA, upgraded to iPhone, participants supplied with a 200MB/month 3G data in Semester2.
Pedagogical Model	From Pedagogy to Andragogy
Pedagogical Focus	A group investigation of the potential of the iPod and iPhone to enhance the Contemporary Music programme
Community of Practice	Weekly throughout the entire course
Support LMS	Blackboard with added Campuspack for Podcasting, RSS, Wiki's , and Blogs
Deliverables	A regular Blog entry documenting participants experiences A regular Podcast show episode
Timeframe	February 2008 through to November 2008, continuing in 2009.
YouTube Videos	Project Overview http://www.youtube.com/watch?v=0It5XUfvOjQ
Project Outline	Google Docs Link

Table 12: Outline of Diploma of Landscape Design 2008 mobile web 2.0 project.

Course: Diploma Landscape Design 2008, elective overseas field trip	
Participants	• 6 students – The average age of the students was 55 (42 to 69), and the gender mix was 3 female students and 1 male students. • 2 Course Tutors • Technology Steward (Thom Cochrane – CTLI)
Mobile Technology	Sonyericsson P1i WiFi smartphone, Bluetooth folding keyboard, participants supplied with a 1GB/month 3G data allowance.
Community of Practice	Focused on the beginning of the project with four introductory sessions, then a further four sessions in August/September before the trip to Japan.
Support LMS	Moodle
Pedagogical Model	From Pedagogy to Andragogy
Pedagogical Focus	Creation of an eportfolio preparing, researching cultural background, and recording and then exhibiting an investigative trip to Japan
Deliverables	A Vox eportfolio and blog.
Timeframe	April 2008 to October 2008
YouTube Videos	Participant Reflections http://www.youtube.com/watch?v=c8IZSVtaMmM
Project Outline	Project Outline https://docs.google.com/document/d/11fLXzoSvtbvKA1RDKpU-xaeTChA9gSeCLTQpHxZnscQ/edit?hl=en_GB Course Outline https://docs.google.com/document/d/1rsc8w1kBg3My6qyW9_MNd3Aw_rag6UULHRYj9Mbg7tI/edit?hl=en_GB

Table 13: Outline of Bachelor of Product Design second year class 2008 mobile project.

Course: Bachelor of Product Design, second year class, 2008	
Participants	• 6 students – The average age of the students was 29 (19 to 41), and the gender mix was 3 female students and 3 male students. • 1 Course Lecturer (Did not participate in the project) • Technology Steward (Thom Cochrane – CTLI)
Mobile Technology	Nokia N95 WiFi smartphone, Bluetooth folding keyboard, participants supplied with a 1GB/month 3G data allowance.
Pedagogical Model	From Pedagogy to Andragogy
Pedagogical Focus	An informal group investigation of the potential of mobile technologies and moblogging to enhance the Product design second year programme.
Community of Practice	Weekly throughout the second semester, during students lunch hour.
Support LMS	Moodle
Deliverables	No programme or assessable deliverables required, however a reflective personal regular Blog entry documenting participants' mlearning experiences and enhancing their class project was expected of the participants.
Timeframe	July 2008 through to November 2008.
YouTube Videos	Student Reflections http://www.youtube.com/watch?v=6jwAFXBZAz0

Table 14: Outline of Bachelor of Product Design first year class 2008 mobile project.

Course: Bachelor of Product Design, first year class, 2008	
Participants	• 10 students – The average age of the students was 25 (19 to 39), and the gender mix was 1 female student and 9 male students. • 1 Course Lecturer • Technology Steward (Thom Cochrane – CTLI)
Mobile Technology	iPhone 3G, participants supplied with a 200MB/month 3G data allowance.
Pedagogical Model	Pedagogy
Pedagogical Focus	Creation of student design teams to research and design a new ergonomic garden trowel. The research was to be documented using a group VOX blog/eportfolio.
Community of Practice	Focused on the Ergonomics paper within the second semester of the course with the first hour of the weekly class devoted to the moblogging project.
Support LMS	Blackboard
Deliverables	An assessed Vox eportfolio and group blog.
Timeframe	August 2008 to November 2008
Project Outline	https://docs.google.com/document/d/1m7sJx5sFOuCiO9hdHaIEdwgJmp1-5zFMrLoZCtpYs-M/edit?hl=en_GB
YouTube Videos	Student Reflections http://www.youtube.com/watch?v=8QUfw9_sFmo

4.4.5 Project Participants 2009.

Table 15: Outline of Bachelor of Product Design third year 2009 mobile project.

Course: Bachelor of Product Design, third year class, 2009	
Participants	• 24 students • 2 Course Lecturers • Technology Steward (Thom Cochrane – CTLI)
Mobile Technology	Nokia N95 WiFi smartphone (to be upgraded to N97 in Semester2), Bluetooth folding keyboard, participants responsible for 3G data, voice & txt costs.
Pedagogical Model	From Andragogy to Heutagogy
Pedagogical Focus	The third year course is based around a Studio Design model where students undertake three design projects throughout the year, one of which is substantial. The project involves documenting the research and design of these products throughout the year, including working with a client company in small design teams. The first project was a collaborative project with UATI and Landscape Design students. The mobile web 2.0 technologies were also used to establish a weekly 'nomadic' studio session with staff and students focusing on context bridging and full integration of moblogging into course projects.
Community of Practice	Weekly throughout the entire course
Support LMS	Moodle
Deliverables	An assessed online Blog/eportfolio documenting and showcasing students' design processes and forming the basis of a collaborative hub with worldwide peers and potential employers/clients. And the weekly use of instant messaging, microblogging, and VODCasts during the 'nomadic' studio session.
YouTube Links	Semester1 Project Overview http://www.youtube.com/watch?v=uDO0Er7tL54
Blog Links	Shac09 Ning Social Network http://shac09.ning.com/
Course Project Outlines	· Shac09 Project Brief http://docs.google.com/View?id=dchr4rgg_44f4v8kccx · NPC Project Semester2 http://docs.google.com/View?id=dv83r4v_8ddxfbkfg
Timeframe	March 2009 through to November 2009.

Table 16: Outline of Bachelor of Product Design second year mobile project.

Course: Bachelor of Product Design, second year class, 2009	
Participants	• 15 students • 1 Course Lecturer • Technology Steward (Thom Cochrane – CTLI)
Mobile Technology	Nokia XpressMusic 5800 WiFi smartphone, participants responsible for 3G data, voice and txt costs.
Pedagogical Model	From Pedagogy to Andragogy
Pedagogical Focus	Building on the students' first year mobile web 2.0 experience, integrating moblogging, social networking, and student-generated content into the course, facilitating collaboration and peer critique.
Community of Practice	Weekly throughout the second semester, during students lunch hour.
Support LMS	Moodle
Deliverables	An assessed online Blog/eportfolio documenting and showcasing students' design processes and forming the basis of collaborative critique and show-casing with worldwide peers and potential employers/clients. Ning is used as a teacher-facilitated collaborative hub for all the projects. Second semester projects focused on sharing and critiquing projects using Google Docs and Vox Group blogs, using the smartphone to capture and share project progress and presentations.
YouTube Links	Group Blog video presentations http://pd-mantec-unitec.groups.Vox.com/library/videos/
Blog Links	Gown Project Ning Social Network http://gowndesign.ning.com/
Course Project Outlines	· Gown Design Project http://docs.google.com/View?id=dchr4rgg_47cwtgcwcf · ManTech Project http://docs.google.com/View?id=dv83r4v_33f89b4fhm
Timeframe	March 2009 through to November 2009.

Table 17: Outline of Bachelor of Product Design first year mobile project.

Course: Bachelor of Product Design, first year class, 2009	
Participants	• 15 students – The average age of the students was 25 (19 to 39), and the gender mix was 4 female student and 11 male students. • 1 Course Lecturer • Technology Steward (Thom Cochrane – CTLI)
Mobile Technology	Semester1: Dell Mini9 3G netbook. Semester2: Nokia XpressMusic 5800 WiFi smartphone, participants responsible for 3G data, voice and txt costs.
Pedagogical Model	Pedagogy
Pedagogical Focus	Integrating blogging, followed by moblogging into the course. Scaffolding the introduction of web 2.0 and mobile web 2.0 tools into the students learning experience to facilitate the beginnings of their online eportfolio and introduction to the educational use of social networking for collaboration.
Community of Practice	An assessed online Blog/eportfolio documenting and showcasing students' design processes and forming the basis of the beginnings of a collaborative hub with worldwide peers and potential employers/clients.
Support LMS	Moodle
Deliverables	An assessed Vox eportfolio and group blog.
YouTube Links	Introduction of First Year Project http://www.youtube.com/watch?v=Z6wN36H4TNo
Blog Links	Example student blog Group http://historicallyfuturisticdesign.groups.Vox.com/
Course Project Outlines	· PIC2 Project1 http://docs.google.com/View?id=dchr4rgg_55r5gntvf7 · PIC2 Project2 http://docs.google.com/View?id=dchr4rgg_57c3xj5qg7
Timeframe	April 2008 to November 2008

Table 18: Outline of Diploma of Landscape Design second year 2009 mobile project.

Course: Diploma Landscape Design, second year class, 2009	
Participants	• 20 students • 2 Course Lecturers • Technology Steward (Thom Cochrane – CTLI)
Mobile Technology	Semester1: Dell Mini9 3G netbook, Semester2: Three students elected to additionally use the Nokia XpressMusic 5800 WiFi smartphone, participants responsible for 3G data, voice and txt costs.
Pedagogical Model	From Pedagogy to Andragogy
Pedagogical Focus	A collaborative project with UATI, Product Design and Landscape Design students. Production of a reflective design process blog and eportfolio using Ning. The social networking features of Ning were also used to establish communication, collaboration, and sharing between the three groups of staff and students. Semester 2: A group design project facilitated using Ning social network. Mobile focus on documenting a Flowershow team design and build project.
Community of Practice	Weekly throughout the entire course
Support LMS	Moodle
Deliverables	An assessed online Blog/eportfolio documenting and showcasing students' design processes and forming the basis of a collaborative hub with worldwide peers and potential employers/clients.
Video Links	• Community Of Practice http://www.youtube.com/watch?v=znGpF1SXx9k • Project Introduction http://www.youtube.com/watch?v=Wlfhyw_Pq5M • Lecturer1 Reflections http://pennycliffin.vox.com/library/post/minisymposium.html
Blog Links	Group project social network sites (Ning) 1. http://shac09.ning.com/ 2. http://poolblog.ning.com/
Course Project Outlines	• Shac09 Project Outline http://docs.google.com/View?id=dchr4rgg_64gftqgvd9 • Pool Design Project Ning http://poolblog.ning.com/forum/topics/architecture-discussion
Timeframe	March 2009 through to November 2009.

Table 19: Outline of Diploma of Contemporary Music 2009 mobile project.

Course: Diploma of Contemporary Music, 5011 and 4006 Courses, 2009.	
Participants	• 24 students • 2 Course Lecturers • Technology Steward (Thom Cochrane – CTLI)
Mobile Technology	12 students using iPhone, participants responsible for 3G data, voice & txt costs. 12 students using iPod Touch – during Semester2.
Pedagogical Model	From Pedagogy to Andragogy
Pedagogical Focus	1. (5011) An investigation of the current and future uses of web 2.0 technologies in music production and distribution. Students' research and report on various technologies using a weekly podcast/VODCast that is peer critiqued by the other students' ion the course. 2. (4006) Recording and critique of student performances.
Community of Practice	Weekly throughout the entire course
Support LMS	Blackboard plus an institutionally hosted wiki
Deliverables	An assessed online Blog/eportfolio documenting and showcasing students' design processes and forming the basis of a collaborative hub with worldwide peers and potential employers/clients. And the weekly use of instant messaging, microblogging, and VODCasts.
YouTube Links	• Project Summary http://www.youtube.com/watch?v=hLNNTK1_wGQ • Lecturer2 Reflections http://www.youtube.com/watch?v=o9p4i23CsPE • Student Reflections http://www.youtube.com/watch?v=5wbryYTmW88
Blog Links	1. Course Tutorial Wiki http://ctliwiki.unitec.ac.nz/index.php/IphoneTutorials 2. Example student Blog http://rima803.Vox.com/ 3. Example student AudioBoo http://audioboo.fm/profile/ting019 4. Example student Group Blog http://groupb.groups.Vox.com/
Course Project Outlines	1. Environmental Recording Assignment http://docs.google.com/Doc?docid=0Adkx7n-UKqvBZGNocjRyZ2dfNDNkenRwbTdqOQ&hl=en_GB 2. MySpace Assignment http://docs.google.com/Doc?docid=0Adkx7n-UKqvBZGNocjRyZ2dfNDJkZ2s5N2ZjbQ&hl=en_GB 3. 4006 Performance Groups http://docs.google.com/Doc?docid=0Adkx7n-UKqvBZGNocjRyZ2dfNDFmOXczanhjaw&hl=en_GB
Timeframe	March 2009 through to November 2009.

Table 20: Outline of Bachelor of Architecture second year 2009 mobile project.

Course: Bachelor of Architecture, 2009	
Participants	• 115 students • 6 Course Lecturers • Technology Steward (Thom Cochrane – CTLI)
Mobile Technology	Dell Mini9 3G netbook, plus Nokia XpressMusic 5800 WiFi smartphone (or similar), participants responsible for 3G data, voice and txt costs.
Pedagogical Model	From Pedagogy to Andragogy
Pedagogical Focus	A first mlearning project for Architecture, investigating the potential of mobile web 2.0 within the course to facilitate group work and help build a 'learning community' among the 115 students. Focus was on the combined Design Studio course for 2009. Students create and share their architectural designs using Photoshop and archicad creating real and virtual presentations for 'crits'. For example: http://www.idsketching.com/. Investigation of location services (geotagging) and mobile code use in Architecture.
Community of Practice	Weekly throughout the entire course
Support LMS	Moodle
Deliverables	A peer-critiqued online Blog/eportfolio documenting and showcasing students' design processes and forming the basis of a collaborative hub with worldwide peers and potential employers/clients. Students were encouraged to experiment with the use of instant messaging, microblogging, QR Codes, and VODCasts for communication and collaboration.
YouTube Links	• Lecturer COP http://www.youtube.com/watch?v=cj20YUisVBM • Introduction of project to students http://www.youtube.com/watch?v=QMYtcx1gvxg • Rollout of XM5800 and netbooks to students http://www.youtube.com/watch?v=wemy0BDD1eE • Example student mobile VODCast http://moonshinenl.Vox.com/library/video/6a011016c17a4b860d011016437a99860b.html
Blog Links	• http://urd2.groups.Vox.com/ • http://waitangi.groups.Vox.com/ • http://archsyndicate.Vox.com/
Course Project Outlines	MLearning project outline http://docs.google.com/View?id=dchr4rgg_66fjgs36f5
Timeframe	March 2009 through to July 2009 with Lecturers. Student projects begin Semester2 2009.

Table 21: Outline of Bachelor of Performing And Screen Arts 2009 mobile project.

Course: **Bachelor of Performing and Screen Arts, third year Film and TV class**	
Participants	• 25 students • 4 Course Lecturers • Technology Steward (Thom Cochrane - CTLI)
Mobile Technology	Dell Mini9 3G netbook, plus Nokia XpressMusic 5800 WiFi smartphone (or similar), participants responsible for 3G data, voice and txt costs.
Pedagogical Model	From Pedagogy to Andragogy
Pedagogical Focus	Film and TV major students investigate the current and future uses of web 2.0 technologies in performing arts film production and distribution. Students research and report on various technologies using a weekly podcast/VODCast that is peer critiqued by students on the course. Students experiment with live video streaming and collation of video using Livestream.com. The focus is upon students developing an understanding of he importance of a quality online profile and presence in the emerging crowd-source web 2.0 environments.
Community of Practice	Six introductory COP sessions at the start of the course
Support LMS	Moodle
Deliverables	An assessed online Blog/eportfolio documenting and showcasing students' design processes and forming the basis of a collaborative hub with worldwide peers and potential employers/clients. Scripting, shooting, editing and presentation of a mobile video short film.
YouTube Links	• Introduction to the assessed student project http://www.youtube.com/watch?v=00d-t0F9AzY • Student reflections on the use of the WMDs http://www.youtube.com/watch?v=jEA7EEcAQCA
Blog Links	1. http://unutechsy309.groups.Vox.com/ 2. http://karenperedo.Vox.com/ 3. http://helloagnes.Vox.com/
Course Project Outlines	1. Assessment Outline http://docs.google.com/Doc?docid=0ATo8wcQiO76XZDI3Z2QzZl8yNGdmNjdxY2Ru&hl=en 2. Project Workshops Outline http://docs.google.com/Doc?docid=0ATo8wcQiO76XZDI3Z2QzZl8yOWNucDk5NWM1&hl=en_GB
Timeframe	March 2009 through to July 2009 with Lecturers. Student projects begin Semester2 2009.

In summary, the mlearning projects encompassed five different tertiary courses, forming five core case studies spanning from one to three years of implementation and refinement, and involved a total of 280 participants (Cochrane, 2009d; Cochrane & Bateman, 2010c). The learning contexts included: Bachelor of Product Design (2006 using Palm Lifedrive, 2008 using Nokia N80, N95, 2009 using Nokia XM5800, N95, N97), Diploma of Landscape Design (2006 Using Palm TX, 2007 using Nokia N80, 2008 using Sony Ericsson P1i, 2009 using Dell mini9 netbook), Diploma of Contemporary Music (2008, 2009 using iPod Touch, iPhone 3G), Bachelor of Architecture (2009, using Nokia XM5800 and Dell Mini9 netbook), and the Bachelor of Performing and Screen Arts (2009 using Dell Mini9 netbook and Nokia XM5800).

4.5 Ethics

4.5.1 Ethics approval

Approval for the research was sought from the Monash University research ethics committee and approved on the first application with no modifications required (See “Monash Ethics Approval Letter” dated 2 February 2007 in Appendix 13.12). The research data collection instruments and research documentation were developed and tested during two pre research trials in 2006, however no 2006 participant data was used in the research analysis. The ethics approval application involved developing processes for participant information regarding the research, participant ethics consent, and detailing processes surrounding the data gathering and handling. These are detailed further in the following sections.

4.5.2 Server Security

Installations of Moodle, and Mediawiki were hosted upon Unitec maintained servers. The servers were Internet accessible and maintained by the Centre for Teaching and Learning Innovation at Unitec. Moodle supported student logons via administrator assigned usernames and student configurable passwords. The Mediawiki software installation was by its nature open to public access, but wiki pages were locked by the researcher (as administrator of the software) to prevent spam or unwanted editing by non-participants.

4.5.3 Wireless Network security

The Unitec wireless network is encrypted using WPA, and required configuration of client wireless devices to enable connection to the wireless network. This information was provided by Unitec's IT department to the researcher for managing the installation of appropriate passwords on the participants' WMDs.

3G wireless data connectivity was available for accessing publicly available external web 2.0 services (such as YouTube and Vox). All of the web 2.0 services used supported individual participant sign on via a username and password and offered various privacy levels for hosted content.

4.5.4 Partnerships with lecturers and courses/classes

The WMD projects involved a partnership between the researcher, as the technology steward, facilitating the creation of a community of practice including the researcher, lecturer/s and students of the course. The researcher is an Academic Advisor in the Centre for Teaching and Learning Innovation at Unitec. The research projects were voluntary collaborative projects between the researcher and selected lecturers. The consent form signed by each lecturer included a clause for withdrawal from the research at any time. Student participants were graded by their lecturers who were also participating in the research. This is the same relationship that existed between the students and lecturers regardless of the research project. However, the consent form signed by each student included a clause for withdrawal from the research at any time, in which case lecturers would provide alternate means of assessing students' participation and grade in the course. Course assessment activities were thus designed to be achievable via either the WMDs or standard desktop computers if necessary.

4.5.5 Anonymity of research participants

Data collected from participants including: surveys, focus group responses, transcripts of reflective VODCasts, and quotations from participant blog posts were kept confidential, and no information that could identify participants was intentionally published. The issue of anonymity of participant data was specifically addressed in the information packs and consent forms provided to each participant at the start of the projects. Issues around online identity and security were explicitly discussed with all of the participants and the researcher during the regular support sessions, and participants were advised to keep their web 2.0 profile data to the minimum required by the service. The core eportfolio tool used (Vox) provided options for private groups for peer group work, and also the marking of individual posts and media uploads to be private, or available to groups defined as family, friends, neighbours, or publically available.

4.5.6 Informed Consent

Research participants were provided with an information pack (see Appendices 1 to 9 for attached forms for lecturers and students) about the research, and signed a participation consent form if they wished to be part of the project. The following participant forms were used throughout the research:

1. An explanatory statement (Appendix 13.3 for students, and Appendix 13.4 for lecturers).
2. An ethics consent form (Appendix 13.1 for students, and Appendix 13.2 for lecturers).
3. An acceptable use policy (Appendix 13.6).
4. An initial survey (Appendix 13.7 for students).
5. An initial project scope survey (Appendix 13.5 for lecturers only).
6. A final survey at the end of the project (Appendix 13.8 for students).
7. A set of focus group questions for use at the middle and end of the projects (Appendix 13.9).

The consent form detailed the expected commitment from the participants, and the intended research data usage by the researcher. Participating lecturers were given the consent forms personally by the researcher, and returned directly to the researcher, usually during the first professional development session.

Participating students were given the explanatory statement, consent form, and acceptable use forms during the first mlearning project session with both the lecturer and researcher present to explain and respond to questions. The forms were then directly returned to the researcher during the session. To alleviate students concerns about the security of information and intellectual property in an online environment when using web services such as blogs, and wikis, students were explicitly made aware of these potential risks and given advice on the type of information to make available on these services. No problems were encountered throughout the research regarding theft of participant information or unsolicited requests from other web users. There was minimal risk of stress due to the research data collection since the information collected was not of a sensitive nature.

As WMDs are generally small devices participants were advised to be attentive to possible risks of theft. They were advised not to leave their WMD in insecure environments. To support the learning associated with the new educational technologies used in the research, the researcher took on the role of 'technology steward' within weekly COP sessions (see section 4.7) that included tutorials for participants on how to use the hardware and software. The researcher was also available for contact outside of this time via electronic messaging and face-to-face during office hours.

4.5.7 WMD Use Ethics

Ethical issues specific to the use of WMDs were discussed with the participants, including: capturing and uploading images to the Internet, capturing or streaming live video, sharing geolocation data (for example Google Latitude), the appropriate use of communication tools such as Twitter where posts can be taken out of context, limiting personal information on publically accessible mobile web 2.0 sites, and user responsibility for voice, SMS, and excess data charges. All participants signed an acceptable use policy indicating the general type of WMD use behaviour expected during the projects (Appendix 13.6). Unlike reported cases of cellphone bullying in the secondary school environment (Fielden & Malcolm, 2007; McLoughlin & Burgess, 2009), there was no observed or reported misuse of the technology during the mlearning projects. However, one lecturer used 6GB of mobile data during one month on a 1GB plan, receiving a bill for $984 for excess data usage. As a result, a table of indicative costs associated with typical mlearning activities was created and used to inform participants of the cost implications of using 3G data during the projects.

4.6 Project Implementation Steps

Projects were initially anticipated to run for one academic semester (12 weeks), but in practice most of the projects spanned an entire academic year. As the research developed, it became clear that the length of time allocated to lecturer preparatory development needed to be significantly longer than the originally planned few weeks. At the same time the Community Of Practice model for scaffolding and support was developed and refined. The intentional COP (Langelier, 2005) for lecturer development worked best when there was at least a three to six month time-span prior to the mlearning implementation with students within each course.

The various mlearning projects were each unique and collaboratively negotiated between the researcher and the course lecturers as most appropriate for enhancing the course learning outcomes. Thus the implementation of each project was unique but based broadly upon a similar structure. This implementation plan evolved throughout the length of the research, with the successes and shortcomings of each implementation further refining the implementation of each following project. Table 22 outlines the implementation timeline model developed to facilitate the mobile web 2.0 projects. It must be emphasized that the researcher’s experience indicates that this process involves significant time for lecturer and student development. The timeframe of the projects was designed to firstly familiarise the lecturers with the tools and technology before introducing it to their students. Semester one goals of mobile web 2.0 projects were mainly to get lecturers and students experimenting and confident with the tools, embedding them into their daily course workflows, followed by more explicitly targeted pedagogically designed learning experiences in semester two of the project.

Table 22: Typical Mlearning Project Process and Timeline.

Project Phases	Project Timeline	Project Milestones
Phase One: Lecturer Professional Development and Project Planning	3 to 6 months pre project go live with students	• Establish a Community Of Practice with potential academic staff members, who are committed to working together, and exploring the potential of web 2.0 and mobile web 2.0 technologies in teaching and learning. • Provide course lecturers with smartphone and tutorials on setup.
	At the end of the Lecturer COP	• Brainstorm mobile web 2.0 project goals and course integration with course lecturers, creating or modifying course outlines and assessment activities.
	Before project go live with the students	• Purchase appropriate mobile smartphone and accessories (for example: folding Bluetooth keyboard). • Investigate best option for providing voice and data connectivity • Configure the smartphones with software appropriate for the project (for example: Vox client, Gmail client, Shozu client, Google Mobile and Moodle shortcuts etc…) • Setup LMS (for example: Moodle) support course for scaffolding students and forming a focus for the weekly Community Of Practice involving students, staff and the technology steward.
Phase Two: Project Go Live with Students	Project introduction to students	• Blog and Web 2.0 setup session with Students and Staff • Provide students with smartphone and begin weekly technology support sessions (Community of practice).
	On going, weekly throughout the project	• Support students and staff during project via weekly 'technology workshops' • Monitor student progress via their Vox Blogs/eportfolios
	Mid project during semester break	• Student and staff surveys • Focus group • Data analysis and report write up. • Re-evaluation of project for second semester • Use feedback and evaluation to modify Second semester mobile web 2.0 strategies and assessment activities.
	On going, weekly throughout second half of project	• Support students and staff during project via weekly 'communities of practice' • Monitor student progress via their Vox Blogs/eportfolios
Phase Three: Project evaluation	End of project	• Final Data gathering, analysis, and report write up.

4.7 Technical and Pedagogical Support Model

Many mlearning projects either assume student participants will have the skills required to master the use of the mobile devices used, or provide minimal technical and pedagogical support for the projects beyond a short series of introductory workshops (Kukulsa-Hulme & Traxler, 2005; Kukulska-Hulme & Pettit, 2007; Priestnall, et al., 2009). However, early on in the research project the researcher identified that the majority of our student participants were not the techno-savvy independent content creators that Prensky (2001) described. The research project was aimed at bringing about sustainable and transferable pedagogical change that would benefit lecturers and students, transforming pedagogy from a face-to-face classroom based instructivist paradigm to a context independent social constructivist paradigm. To achieve this goal, the second problem was creating an implementation approach that did not rely upon (or never go beyond) already techno-savvy ('geek') lecturers, but was capable of supporting and scaffolding the average lecturer to become confident integrating mlearning into their curriculum. This section outlines how this was achieved via the development, refinement and implementation of an intentional Community Of Practice support model.

4.7.1 Development of an Intentional Communities of Practice Model

Since Prensky's assertion of the emergence of a new generation of learners (Prensky, 2001), the notion of digital natives and digital immigrants has been a hot topic in education fueled by the initial surge and seemingly relentless development of web 2.0 social software portrayed as threatening traditional tertiary education pedagogies (Alexander, 2006; Anderson, 2007; Cych, 2006; JISC, 2009b; McLoughlin & Mark Lee, 2008). As a result, during early 2006 several academic heads of departments at Unitec formed a Community Of Practice (COP) with the researcher as the technology steward to investigate the potential of these emerging web 2.0 social software tools in tertiary education for both student engagement and integration into the teaching and learning environment.

This is the retrospective way of describing what occurred, as in fact none of the COP participants, including the researcher, initially understood the group to be a COP. The group was convened as a result of discussions between the researcher and one of the Unitec Deans requesting professional development in web 2.0 concepts. The researcher suggested that most of the web 2.0 tools were collaborative and social in nature and that the best way to learn about them was to create a peer support group that met regularly with the researcher as a technology guide, and to develop a specific goal for the group to achieve. An invitation was made to heads of schools at Unitec to join the proposed group by this Dean. An initial meeting was called at one of the Unitec cafes, where participants recorded their current understanding of web 2.0 tools and their own capacity to engage with these tools. This is available as a YouTube video at http://www.youtube.com/watch?v=-jn0HBIkF_U (Cochrane, 2006a). The group then decided to meet weekly to investigate web 2.0 technologies, and set themselves the goal of presenting their journey and findings using these tools at the annual Unitec Teaching and Learning Symposium. The COP was named 'Dummies2Delight' by the participants to reflect their journey of discovery and transformation. As the group progressed, the researcher and one of the group members were concurrently reading Wenger (2005), and both realized that what we were creating was in fact a Community Of Practice as defined by Wenger (2005), with the researcher effectively appropriating the role of the 'technology steward' (Wenger, et al., 2005). Similar to Wenger's (2005) description of communities of practice, this COP grew organically out of a perceived need, met together regularly as a group of supportive peers (the community), shared a common interest in investigating educational technology (the domain), was guided by a technology steward (the researcher), and produced artifacts based on their shared experience (the practice) such as wikis, YouTube videos, and blog posts.

The group concluded with a packed-out presentation of their transformational web 2.0 journey at the Unitec Teaching and Learning Symposium in late September 2006 (Available as a YouTube video compilation at http://www.youtube.com/watch?v=kUuJ-gW_vuc (Cochrane, 2006b)). The presentation highlighted the participants' evolving understanding of the nature of the group as a community of practice, as illustrated by a transcription of an exert from the videotaped presentation:

> Wenger says communities of practice are groups of people who share a concern, or a passion for something they do, and they learn how to do it better as they interact regularly, and that was absolutely what happened for us… We needed places of engagement and you are now sitting in sir's room, sir being Thom and every Tuesday morning for the last three months we've been meeting here first thing in the morning learning more and more things – this was our place of engagement. (Dummies2Delight participant, 2006)

The success of establishing a COP for professional development became the foundation for a new approach to professional development used by the elearning support team at Unitec (Cochrane & Kligyte, 2007a, 2007b), and also morphed into an intentional Community of Practice model that was used to underpin and provide pedagogical and technological support for the mlearning projects (Cochrane, 2007h). This model was used for lecturer development prior to implementing mlearning projects with their students. The COP model was also used to form the core pedagogical and technological support mechanism for each mlearning project implementation, forming collaborative projects involving the researcher, the course lecturers, and the course students as COP participants. The weekly COP sessions were used to generate discussion and feedback on the progress of each project, this feedback then helped direct the focus of each COP session, enabling technical and pedagogic issues to be identified and mitigated, as well as providing a forum for participants to share their new discoveries.

4.7.2 Institution-wide Model

4.7.2.1 Model

After the success of the first Dummies2Delight Community of Practice the Centre for Teaching and Learning Innovation (CTLI), led by the researcher, decided to put more resources into developing this approach to an academic staff development model as an alternative to generic staff development workshops. It was found that the COP approach enabled the COP members to define the scope and the aims of their learning explorations and enabled CTLI staff to offer more targeted support than previous generic workshops. The prolonged engagement of a COP ensured that the technologies were explored and integrated over a period of time, as opposed to the one off encounters usually experienced in previous CTLI workshops, and enabled enthusiastic lecturers to draw-in tentative colleagues to investigate the use of technology in their teaching practice.

Interest was developed throughout the institution by the Dummies2Delight workshop and presentation at the annual Teaching and Learning Symposium, giving the concept a high profile. As resources were limited, the initial approach to creating

Communities of Practice investigating educational technology was on an invitation basis. Invitations to form COPs were initiated with departments that either expressed an interest or appeared to have the potential to benefit from the approach. The model initially began using a viral mode of spreading, with initial participants within a department graduating from their first COP and then inviting their peers to participate in a further round of COPs. It was envisioned that eventually graduating COP members would become technology stewards for further COPs to be formed within their school.

An invitation letter briefly outlining the concept, commitment required, topics covered, and links to examples was sent to interested participants (See "Communities Of Practice Invite" http://docs.google.com/View?id=dchr4rgg_121d5djw7hb for the 2006 version and "Communities Of Practice: A new approach to academic IT development" for the expanded 2008 version http://docs.google.com/View?id=dchr4rgg_100f4rdwzdh). Following this, a first group meeting was scheduled, usually involving coffee and food as an incentive. At the first group meeting a goal, timeframe, 'workshop' style, modes and weekly time were negotiated, along with an indication of what the participants' initial confidence with educational technology, and in particular, what their prior mlearning and web 2.0 experience was.

The intentional COP model was progressively refined as the result of reflection on the implementation of each successive project (Cochrane, 2007j; Cochrane & Kligyte, 2007a). An overview of the development of the intentional Community Of Practice development model was created for the 2007 JISC online innovating elearning conference (Cochrane & Kligyte, 2007c), and is available at: http://idisk.mac.com/thom_cochrane//Public/JiscFinal.mov. Also influential in the model's later refinement was the work of Herrington and Herrington (2006b) on Authentic Learning and the use of this approach to inform the mlearning projects at the University of Wollongong (Herrington, Herrington, et al., 2009b).

4.7.2.2 Structure

After experimenting with several formats during 2006, a typical, manageable structure was established by the researcher for COPs to support and drive the mlearning projects from 2007 onwards. Each mlearning project was structured around two COP iterations (also outlined in section 10.3.3):

1. A small COP consisting of course lecturers and the technology steward (usually of 3 to 6 months initial duration).
2. Following the lecturer COP, the implementation of a COP consisting of the course lecturers and their students, and the technology steward, supporting the integration of the mlearning project into the course curriculum.

Initial contact was made by the researcher with a key lecturer within the selected department, who then invited their peers to form a COP to investigate the potential of web 2.0 and mobile tools to engage and enhance their students' learning within a social constructivism paradigm. Four to six group members (academic lecturers within a department) per COP plus the technology steward would then meet weekly for a one to two-hour workshop to explore the educational potential of a selection of different technologies. Participants were expected to have a suitable wireless laptop, and were supplied with a loaned netbook or smartphone as appropriate for their context (the same models as those intended to be used by students in the subsequent mlearning project). The first few COP sessions typically included:

- Participants received research explanatory statements, signing of ethics consent forms and an acceptable use policy form.
- The creation of several basic online accounts and identities, including: LMS support course enrolment and profile, Gmail, a Blog account, a YouTube and Flickr account, a Google Reader account (for RSS subscriptions), and creation of core communication tool accounts (for example: MSN, Twitter)
- Participants also completed an initial survey designed to evaluate their previous use and expertise with mobile and web 2.0 tools. Participants were also encouraged to record a short VODCast reflection outlining their reasons for joining the COP – these were used to reflect on participants' progress and journeys throughout the duration of the mlearning project.

After the use of elearning tools were established much of the interaction could be undertaken 'virtually' and flexibly, facilitating context independent peer and expert support. However the social element of meeting together regularly face-to-face was found to be very important in nurturing the COPs. Attempts at creating virtual fully online COPs were not very successful. The weekly COP sessions were facilitated by the researcher as the technology steward, and were held either in the CTLI multimedia lab, or elsewhere on campus (including the various campus cafés with wireless laptops). Each different lecturer COP culminated in a specific project goal (for example: a presentation at the Teaching and Learning Symposium, a presentation at a conference, a presentation to other academics in their department, incorporation of some of the technologies investigated into their own courses, or a specific mobile learning project). Topics, the goal, the LMS, and the COP weekly format were all open for negotiation with each lecturer COP group, allowing a customized experience relevant to each unique group, and allowing for the rapid change in the multitude of mobile web 2.0 options available.

4.7.3 Reflections

4.7.3.1 Successes

The 2006 Dummies2Delight COP created a core group of senior management evangelists for educational technology in the institution that had not previously existed. This in turn led to an increased interest across the institution from lecturers, many of whom attended the 2006 Dummies2Delight Teaching and Learning Symposium presentation. The development of the COP model during 2006 and 2007 led to a better use of the limited professional development resources of CTLI, in particular the researcher’s time. Subsequent COPs resulted in a range of collaborative mlearning projects between CTLI (the researcher), lecturers, and students. Finally, having a negotiated, concrete goal for each COP facilitated measurable outcomes that were often unseen by the usual generic staff development workshop approach previously taken by CTLI.

One of the most exciting results was that the COP model developed strong relationships between the technology steward and lecturers that then lead to ongoing collaborative projects. These collaborative projects were then used to show-case innovative ideas as a way of getting new people on-board by contextualizing the integration of technology into teaching and learning with concrete local examples.

4.7.3.2 Hurdles

There were several challenges identified in implementing the COP model. Some of the second-generation COPs were not as successful as the original Dummies2Delight group, leading to reflection on some of the assumptions made. Establishing a peer relationship between the technology steward and the rest of the COP participants was found to be crucial to move the group from a traditional workshop model to a COP model. Some participants assumed the role of the technology steward to be that of a teacher for the group, and consequently there was little peer support and collaboration developed in such groups. To make the conceptual differences between the traditional workshop model and the new intentional COP model explicit, a short guide sheet was created for potential participating lecturers (See "Just what is a COP anyway?" http://docs.google.com/View?id=dchr4rgg_94d8hj6s56). This covered the following issues:

1. The role of the 'technology steward' is to guide each COP in their choices of technology to explore.
2. Identification of a key person within a department with whom the technology steward built a relationship and rapport. This key person can then invite the other participants of the COP to join, ensuring that the members actually want to work together and share a common interest and working environment.
3. COP group members were selected on the basis of wanting to work together and having a common goal and interest.

4. Building in some form of social element was crucial, for example: the group would regularly meet for coffee, with wireless laptops providing connectivity.
5. Establishing a regular timeslot and venue to establish momentum.
6. Encouraging the group to define and own a common goal for the COP at it's beginning, for example: a group research output, a class project with students, or a group presentation at the Teaching and Learning Symposium.
7. Recognising that the technology steward is there to guide the group, but is not the only expert or there to run a 'workshop'. The core of the COP is a peer support group. Also recognizing that each COP group is unique and flexible, targeted to the goals of the members.
8. COP membership should be voluntary and may be dynamic as participants are drawn-in from the periphery.

Establishing the lecturer COPs via an invitation from the technology steward to potential members also required re-thinking. In a couple of cases the researcher unwittingly invited disparate groups of people to form a COP. A better approach was found to invite a key staff member in the school to nominate or invite the other members of the group that they wish to work and collaborate with in a COP.

Other issues included managing concrete goals and outcomes to keep the members of the COP motivated. Group size was important to create enough interaction without creating too many peripheral members. The participants' required access to the technology being investigated, which required a partnership with the institutions IT department. Installation and updating of software on lecturers computers and student labs was often restricted by the institution's IT department. Additionally, firewall and packet-shaping restrictions made certain media sites (for example: YouTube) and synchronous technologies such as Skype unusable until these issues were negotiated with IT by the researcher. Finally, limited resources, including the researcher being the only available technology steward limited the number of manageable COPs, making the move beyond viral implementation slow.

The second-stage COP implementations with students were initially limited by the amount of funding available to supply an appropriate WMD for all the participants. As the research implementation progressed, larger funding was made available to extend the lecturer and student COPs to entire classes, and then across entire three-year courses (in 2009). This impacted on the level of integration of the tools within the curriculum and assessment, with early projects consisting of student volunteers, and assessment activities designed to be achieved via a variety of technologies for those students not participating in the projects, while later projects could more explicitly explore the affordances of mobile web 2.0 as all students in the course were able to be provided with appropriate WMDs.

A sustained commitment by the COP participants was required to nurture and maintain the momentum of the group throughout its length (each COP generally lasted a full academic year). To sustain this commitment, lecturers and students needed to see direct correlation between the COP goals and their teaching and learning outcomes within each course context, and in most cases this developed over the span of one to two years. The first year of implementation was generally an initial investigation of the concepts and potential, allowing lecturers (and students) time to reconceptualise their teaching and learning processes. The second year mlearning project iterations or implementations were generally more ambitious and involved planned integration within the curriculum. The technology steward (researcher) therefore regularly built into the COPs new ideas for integrating the technologies in response to the developing understanding of the affordances of mobile web 2.0, and scheduled regular feedback and reflective events, capturing critical incidents along the way.

The COP groups that did not manage to sustain this momentum invariably lost focus and saw less direct impact on the teaching and learning environments. The case studies detailed in the following sections illustrate this and critique various identified critical success factors.

Case study examples of changing teaching practice and student generated learning scenarios were used to bring on board other lecturers, courses and departments, and to inform the institutional development of a new elearning strategy.

4.7.3.3 Key Issues

Some of the practical requirements to successfully support the formation and collaboration required for the COPs identified by the researcher include:

- Participants require basic computing and Internet usage skills.
- Participants require access to their own computer and Internet connection.
- Participants require a mobile phone and data account.
- Personalising and socializing the use of the technologies takes significant time.
- Conceptualising the pedagogical integration of the mobile web 2.0 tools within courses and course assessment also took significant time and scaffolding.

- The supporting role of the technology steward is critical, as is the development of collaboration and trust between the technology steward and the COP participants.

The goals of the COPs included the development of the participants, and the practical integration of the investigated technologies (mobile web 2.0) within the lecturers' course, facilitating a pedagogical shift to social constructivist, context-independent learning environments. Some of the key issues in achieving these goals from a COP that have been identified during the research projects include the importance of:

- The Technology Steward to guide the group.
- Developing quality partnerships between the Technology Steward and teaching staff.
- Dedication and peer support of the group.
- Communication.
- Choosing achievable goals.
- Team building and nurturing.
- Involving senior management.
- Building in reflection.
- Recognition of the uniqueness of each COP group.

4.7.4 Conclusions

While very time intensive, requiring prolonged commitment from both the participants and the technology steward, the use of an intentional Communities of Practice model for creating academic peer support groups to investigate the integration of social software and elearning and mobile technologies into tertiary education proved to be more successful and a better use of resources than general workshops for academic staff. Previously technology-wary tertiary academics have been transformed into educational technology evangelists, and the participation of senior management in COPs created a buzz throughout the institution. Academics who participated in the mlearning COPs felt better prepared for today's technology adept learners. The uptake throughout the institution of COPs for educational technology encouraged the establishment of collaborative projects between the researcher, academics and students. Lecturers who previously struggled with integrating technology into their pedagogical approaches began implementing mobile learning projects with students, and thus the awareness and uptake of mobile technologies in tertiary learning increased at Unitec. Key to the models success is its flexibility: recognizing that every COP formed is unique, requires negotiable content, motivational goals, and appropriate access to resources. Every COP requires a different approach for nurturing and motivation, however it must also be recognised that not all starting members will necessarily continue on as members throughout the entire life-span of the COP. Finally, the guidance of a Technology Steward is critical in establishing and guiding each COP in their investigation and use of technology.

4.8 Case Study Overviews

As the researcher investigated the affordances of web 2.0, social software, WMDs, and communities of practice, the synergies between them became increasingly apparent, as did the realization of the potential for a symbiotic amalgamation of these elements to support social constructivist learning environments. Wireless Mobile Devices (WMDs) coupled with social software tools potentially provide the basis for enhancing teaching and learning in virtually any discipline. This approach was tested, evaluated and refined within the thirteen mobile web 2.0 projects from 2007 to 2009. Each of the mobile web 2.0 projects followed a similar implementation model, which was progressively refined by feedback and reflection upon each subsequent project. The general approach used is outlined in this section.

4.8.1 Mobile Web 2.0 Concept Map

A variety of free mobile web 2.0 sites and tools were used in the mlearning projects. This approach was taken to eliminate the need for lecturers to repurpose content or programme any code for the mobile devices, relying rather upon the personal customisation options of these freely available web 2.0 services. However, the relationship between the different web 2.0 services was conceptually difficult for many of the lecturers and students (particularly during the first iteration of a mobile web 2.0 project). Therefore a graphical mobile web 2.0 concept map was developed by the researcher to illustrate the relationships and affordances of each of the mobile web 2.0 services. The concept map was refined through two main iterations during the research process, beginning with the initial web 2.0 tools used (Figure 7), and then developed into a more generic form (Figure 8) with the addition of new tools as the research progressed. A final iteration of the concept map is shown in Figure 1, section 1.3.1.

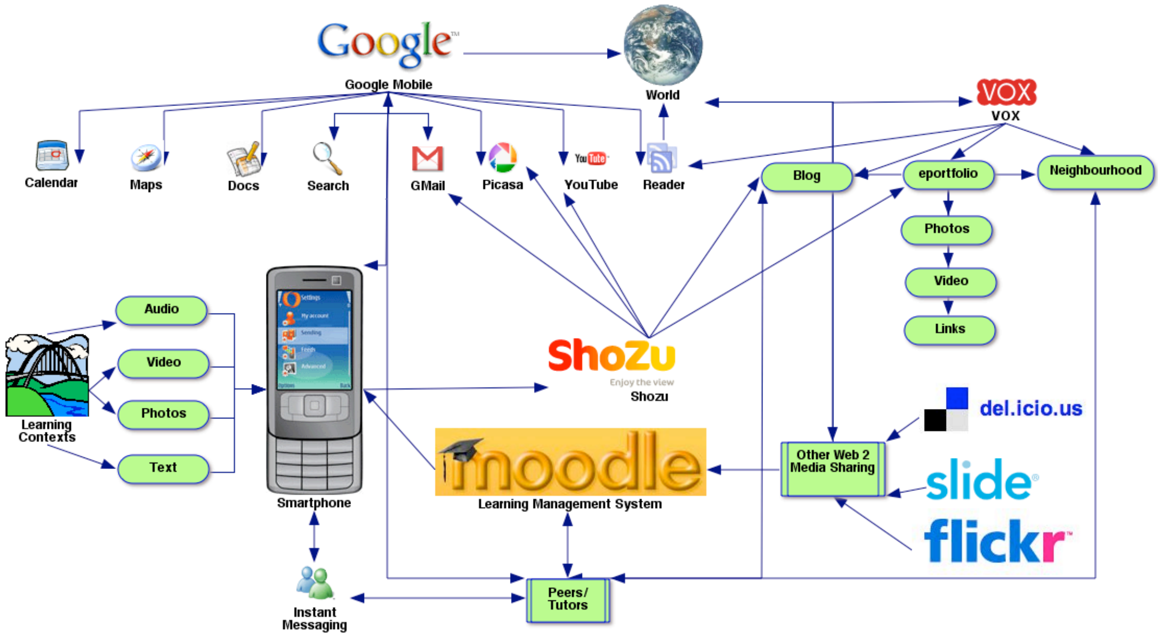


Figure 7: First version of mobile web 2.0 concept map.

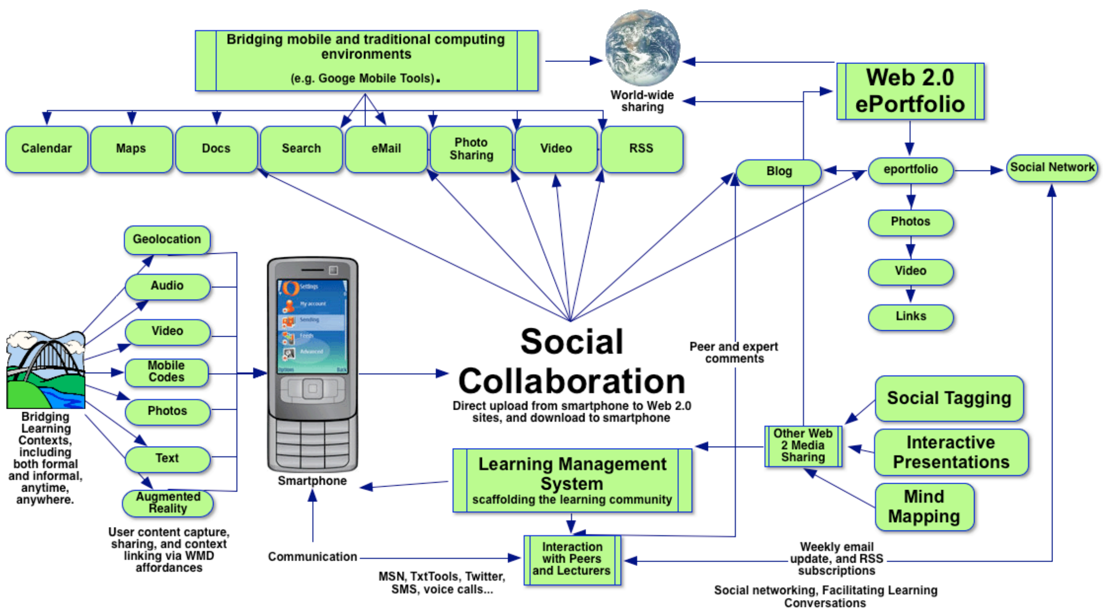


Figure 8: Generic mobile web 2.0 concept map.

4.8.2 Implementation Model

While the core activity of each of the projects was based on the creation of a reflective Blog, a variety of mobile web 2.0 technologies that supported the projects' underlying social constructivist pedagogy were investigated with both the students and lecturers throughout the semester during the weekly COP sessions (See Table 25 outlining the pedagogical alignment of example web 2.0 technologies). Students and lecturers were given the choice of what technologies (except for Vox, which became the preferred eportfolio host) they wished to experiment with within their learning and social contexts. Participants were encouraged to treat the smartphones as their own for the duration of the projects, and encouraged to personalise their use.

4.8.3 Action Research Cycles

Adopting an action research methodology allowed each project to analyze and implement mlearning interventions specifically for each different learning context, while having the benefit of being informed by the successes and failures of the other projects.

4.8.4 Problem Analysis

Each project involved the establishment of a pre-student rollout lecturer community of practice investigating the potential of mlearning to positively enhance each specific course. As part of this lecturer COP, lecturers were asked to evaluate this potential specifically for their courses using a survey template (see Appendix 13.5 "Initial feasibility study and needs analysis for lecturers"). This was then used as a reflection point later in the life of the COP.

4.8.5 An Mlearning Design Framework

Sharples (2000, 2010) is one of the most well known and one of the longest serving mlearning researchers. Building on Sharples work, Sharples et al. (2009) present a mature framework for designing the integration of innovative mlearning to support learning. The emphasis is upon starting with desired learning practices then choosing appropriate technologies to manage and support these practices.

> New digital technologies can support effective learning, but innovation in learning should not *start* from technology. Certainly, it is easy to notice some functionality in a piece of hardware or software and then move on to ask how this might enable good learning. But this should come after deciding what experience we want the learner to have: what *kind* of engagements with the world will best bring about learning. (Sharples, et al., 2009, p. 12)

This implies that the starting point of the design process is the learning practice and chosen pedagogical framework, which then informs the appropriate choice of mediating technologies. Sharples et al.'s illustrative generic framework for innovative technologies is based on activity theory, and shown in Table 23.

Table 23: A generative framework for new learning modes.

Learning Practice	Mediating Circumstances		
Interaction	**Context**	**Technology**	**Agents**
Exposition	**Setting**	**Time**	**Peers**
Reflective	Workplace	Synchronous	**Teachers**
Performative	Classroom	Asynchronous	**Mentors**
Networked	Home….	**Place**	**Technicians**
Community	**Process**	Contained	**Supporters**
Collaborative	Scripted	Co-located	Parents
Tutorial	Open	Distributed	Siblings
Assessing	**Curriculum**	Virtual	Carers…
Browsing	21st century	**Instrument**	
Cross-contextual	Nuffield	Representation	
Cross-conceptual	Basics…	Augmentation	
Case-based	**Subject**	Simulation	
Problem-solving	Maths	Construction site	
Inquiry-driven	ICT...	Recording	
Ludic		Computation	
Construction		Communication	

From "CAPITAL Year One Final Report," by Sharples et al, 2009, University of Nottingham. (p. 13)

Missing from Sharples et al. (2009) design framework are the critical elements of assessment, and pedagogical and technological support structures (Laurillard, 2007). This framework was useful as a basis for articulating the researcher's own mlearning framework.

The researcher's design framework for each of the projects is shown in Table 24. This framework was developed iteratively over the life of the research, which began in 2006 with two test projects that informed the practical implementation of the subsequent projects in 2007 to 2009. The framework table format is based loosely on that suggested by Sharples et al. (2009),

Table 24: MLearning project design framework.

Learning Practice	**Mediating Circumstances**		
Social Constructivism	**Context**	**Technology**	**Agent**
Lecturer Community of Practice	Lecturer professional development, pedagogical brainstorming	Face to face Scaffolded using LMS Smartphone Web 2.0 services	Lecturers as peers, with researcher as technology steward
Student and lecturer Community of Practice	Pedagogical integration and technical support	Face to face Scaffolded using LMS Smartphone Web 2.0 services	Students as peers, Lecturer as guide and pedagogical modeler, with the researcher as technology steward
Collaboration	Group projects	Social networking, Collaborative documents	Google Docs, student peers
Sharing	Peer commenting and critique	Web 2.0 media sites, eportfolio creation	RSS, student peers, lecturer
Student content creation	Student individual and group projects	Smartphone with camera and microphone, content uploaded to web 2.0 sites	Student and peers
Reflective	Journal of learning and processes, recording critical incidents	Web 2.0 hosted Blog	Personal appropriation, formative feedback from lecturer
Learning Context Bridging	Linking formal and informal learning	Smartphone used as communications tool and content capturing	Student interacting with context, peers, and lecturers

Within the researcher's framework presented in Table 24, the elements of assessment, and pedagogical and technological support are explicitly dealt with within the lecturer pre-project COP and in the implementation stage of the project within the student and lecturer collaborative COP.

4.8.6 Mobile Web 2.0 Affordances

The affordances of mobile web 2.0 are those unique capabilities and activities that these tools facilitate. This section briefly outlines some of the key mobile web 2.0 affordances used across the research projects. The research projects explored how a mix of mobile web 2.0 tools could enhance the student's learning throughout their whole course, and in particular how these tools could facilitate social constructivist learning environments, including student-generated content and student-generated contexts. Table 25 outlines a range of mobile web 2.0 tools and their pedagogical alignment with social constructivist activities and outcomes, building upon the mobile web 2.0 framework described in section 2.4.

Table 25: Project activities aligned to social constructivist pedagogical outcomes.

Activity	Overview	Pedagogical outcomes
A reflective Blog	A blog post (including media) can be uploaded directly to VOX using the Vox client on Nokia smartphones, or media sharing utilities such as Shozu (http://www.shozu.com), or emailed to VOX xxxxxx@moblog.vox.com	Formation of collaborative communities (Farmer, 2004). Facilitating a move from a centralized to distributed publishing model for learning communities (Wenger, et al., 2005). Developing critical and reflective thinking
An eportfolio	VOX (http://www.vox.com) includes media sharing (video, audio, documents, images, links…) and linking (YouTube, Flickr etc…) as well as social networking.	Collaborative sharing of media and peer critique also forms the basis for a career portfolio.
Email	Gmail (http://gmail.com) provides a free email account that can be used on almost any Internet capable device. A Gmail account also opens free access to all other Google web services. The Google Java application optimises Gmail for phones.	Communication and collaboration across contexts.

Activity	Overview	Pedagogical outcomes
RSS	RSS facilitates subscribing and tracking/sharing of online activity. It provides a link between multiple your web 2.0 media sites. Google reader (http://reader.google.com) is a web based RSS reader, while Newsgator (http://www.newsgator.com) also provides RSS clients for synchronisation via PC, Mac or mobile.	Student generated content aggregation facilitating bridging between learning contexts.
Shared Calendars	Google Calendars (http://calendar.google.com) can be shared between groups of people via invitation. Google Calendars use an open format that provides interoperability between many calendar systems – for example: iCal on Mac OSX	Time scheduling and collaboration of group activities.
Image Blogging	Dedicated image sharing repositories such as Flickr and Picasaweb offer more interactive features than Vox's image repository, and are linkable to Vox and other Blogging systems. Direct mobile upload to Flickr can be achieved via either the Vox client, or email. Picasaweb mobile is supported via Shozu destination uploads.	Event, data and resource capturing and collaboration. Facilitating student generated content.
Video Blogging	YouTube (http://www.youtube.com) is a popular video-sharing site. The mobile version supports viewing of videos online in the mobiles web browser, or via a downloadable Java client for specific phones. Uploading mobile videos to YouTube is achieved via email attachments.	Event, data and resource capturing and collaboration. Facilitating student generated content.
Shozu	Shozu is a service for linking online mobile Blog and Media sites together via either the Shozu client application, or an email sent to go@m.shozu.com	Shozu provides links between student-generated content and web 2.0 eportfolios.
Podcasting	Uploading an audio file to Vox creates a podcast episode that others can subscribe to via an automatically created RSS feed.	Student recorded interviews, critiques, and reflections, that can be shared.
Instant Messaging and Skype	Fring (http://www.fring.com) is a free Instant Messaging and Skype client for most mobile phones. It allows messaging between the most popular IM systems. It works best over a WiFi connection, or good 3G connections.	Synchronous communication for dialogic interaction.
Shared Bookmarks	Delicious (http://del.icio.us) is a social bookmarking site – allowing the creation and sharing of Internet bookmark libraries and searching via tags (descriptive keywords). Mobilicious (http://mobilicio.us) a mobile optimised version.	Collaboration and categorisation of online resources for building a shared repertoire of resources within a learning community.
LMS	Moodle is a mobile friendly Learning Management System, hosted on a production level Unitec server. Course notes, discussion forums, and various activities can be hosted on Moodle.	Supporting scaffolding, support and administrative elements of courses.
Mobile Google	A gateway into the Google Mobile services (http://mobile.google.com) via the phones web browser. iGoogle (http://www.google.com/ig/i) is a customisable mobile Google Homepage.	A suite of mobile-formated web 2.0 tools that support a range of learning community building and sharing of student generated content.

Activity	Overview	Pedagogical outcomes
Mobile Codes	Mobile Codes (Datamatrix codes in this case) provide sharing of URLs, text and messages via scanning using the Smartphone's built-in camera. Codes can be created and downloaded from http://mobilecodes.nokia.com and scanned using either a compatible scanning application on the mobile phone.	Student QRCode creation and decoding for concept linking and sharing of learner-generated content.
Web Browsing	Most smartphones feature a capable Built-in Web Browser, but in some cases Opera Mini may work better, and Opera Mini has several tools built-in (such as: RSS feeds, and synchronisation with Opera on a PC)	Supporting group knowledge building, research, and information literacy (Walsh, 2008).
Document Reading & Editing	Google Docs (http://docs.google.com) is Microsoft Word, Excel and PowerPoint compatible. Documents can be uploaded and shared and edited by a group. They are viewable online in a web browser without MS Office. Docs can be created on mobile devices by emailing the document to a private Google Docs address. To edit uploaded documents a full PC web browser is required, or a full version of 'QuickOffice' on a smartphone – a mobile version of MS Office (costing approximately $60).	Documentation, reflection, critique, description, and collaborative document publishing.

4.8.7 Reflection and Refinement

Vavoula et al. (2009) discuss principles and methodologies for evaluating mobile learning research including:

1. Capturing longitudinal data across multiple contexts
2. Use "cooperative inquiry" (Hsi, 2007)
3. "Critical incident analysis" (Sharples, Josie Taylor, et al., 2007) – critical incidents can be recorded, compiled then reviewed
4. User produced artifacts (blogs, eportfolios, logs...)
5. Triangulation of data
6. Utilising participants as co-researchers: agreeing to log interactions, actively recording learning experiences, motivation? - What benefits do participants get?
7. Ethics (and monitoring processes)

Their recommendations include:

- Research should be in tune with new thinking about learning.
- Research should consider the impact of context *(context aware capturing tools, blog, geotagging)*, and be longitudinal, covering formal and informal environments.
- Research should consider different types of data and analysis.
- Research should involve learners as co-designers or co-researchers.

  (Vavoula, et al., 2009)

Vavoula and Sharples (2009) have also recently developed an evaluation framework for contextual learning (mlearning) based on lifecycle evaluation, described as the 3M approach. This approaches evaluation from three levels:

1. The Micro level
   a. Concerned with technology usability
2. The Meso level
   a. Concerned with educational issues
3. The Macro level
   a. Concerned with organizational issues

Within the context of this research, the first point of evaluation has been chosen to be the Meso level – that is starting from the standpoint of transforming educational practice. This has then informed the micro level implementation of appropriate mlearning activities within each course, and these experiences have then informed the Macro level (institutional strategy) evaluation. The 3M evaluation framework is useful for creating awareness of these three different levels of evaluation and implementation, but the evaluation examples given tend to focus upon a series of discreet events rather than longitudinal learning community building. This is the advantage of the intentional communities of practice model that this research has adopted. The weekly COP became a regular source of feedback and reflection for continual evaluation of the mlearning projects, and a central focus for building learning communities among the participants. The COP also formed the key point of contact for both pedagogical and technological support, both of which are usually glossed over in most mlearning project implementations, leaving both the students and the lecturers to face the steep learning curves of dealing with learning new technologies while at the same time trying to implement them within innovative pedagogies.

4.9 Resource Management

The following section discusses how each of the research projects were resourced and the management of these resources. This required significant negotiations, planning, and time from the researcher. Ultimately, good resource management choices were critical to the success of the research project. While the aim of the research projects was to pave the way for student owned WMDs, to seed the concepts and explore the critical success factors the research funded the cost of the devices, and experimented with funding the cost of cellphone network data connectivity. Thus WMDs were purchased or leased by Unitec through various funds, and then loaned to the research participants to use as if they owned them for the length of each research project. Participants signed an “Acceptable Use Policy” (Appendix 13.6) undertaking to repair or replace broken, stolen or lost loan equipment. Each of the WMDs underwent a selection screening evaluation prior to roll-out in a research project, thus test WMD units were purchased several months before each project to critique their capabilities and create an appropriate software image for installing on the devices for each project. These test units were generally purchased out of the annual CTLI budget costs by the researcher (who is the senior eLearning and Learning Technologies Academic Advisor at CTLI). Partnerships with various WMD suppliers were explored with varying success throughout the research.

4.9.1 Research Funding

A variety of methods for funding the research projects were used. These are outlined here.

4.9.1.1 2006 Palm NZ

After discussions with Renaissance New Zealand in 2005, (the New Zealand Palm importer) a set of ten Palm Lifedrives and ten Palm TX WiFi PDAs and twenty folding infrared keyboards were given to the researcher for mlearning trials at Unitec (Value around $20000). These were used for the first pre-trials in 2006. Feedback from trial participants indicated their preference for a wider connectivity option than WiFi only, and a preference for a single mobile device, rather than carrying a PDA and a cellphone. The lack of built-in camera on the Palm device was also limiting. In hindsight, 2006 heralded the death of the stand-alone PDA, and the birth of multi-functional smartphones.

4.9.1.2 2007 Innovation and Development Fund

In 2006 the researcher was invited to take part in a multi-institution research project developing aspects of a set of national eLearning Guidelines (ELG project). A project outline (See Innovation Development Fund Application 2006 http://docs.google.com/View?id=dchr4rgg_90g3n73thd) including a budget of $30000NZ for mlearning research was approved, and funds made available in 2007. These funds were used to supply WMDs and repay participants' 3G data costs in the 2007 and 2008 Diploma of Landscape Design mlearning projects and the third-year 2008 Product Design mlearning project (Cochrane, 2008c).

4.9.1.3 2008/2009 Quality Reinvestment Programme

The Quality Reinvestment Fund (QRF) was a competitive internal programme development fund available for Unitec programme innovations during 2008 and 2009. Four rounds of funding were applied for and granted for four of the mlearning projects. These included:

- $15000 for Diploma Contemporary Music iPod Touch project 2008
- $10000 for upgrading the Nokia N80s to N95s in the Bachelor of Product Design third year project 2008.
- $10000 for extending the mlearning projects in the Bachelor of Product Design across Year One and Year Two in the second half of 2008.
- $36000 for funding the 2009 Bachelor of Product Design mlearning projects.

4.9.1.4 2008/2009 CTLI Budget

The researcher included budget costs within the CTLI annual budgets in 2008 and 2009 for the increasing demand for mlearning projects throughout the institution. Following the enthusiastic response from participants in the 2007 and 2008 mlearning projects, the researcher was encouraged by the Dean of Teaching and Learning at Unitec to increase the 2009 CTLI budget to fund mlearning projects at department levels rather than course levels. Thus budget was included in the 2009 CTLI budget for two hundred smartphones and two hundred 3G/WiFi netbooks. CTLI budget contributions to the mlearning projects included:

- 2008: $17000 for seventeen iPhones
- 2009: $360000 for two hundred smartphones and two hundred netbooks.

4.9.1.5 2009 AKO GPPG

At the end of 2008 the researcher applied for and received a $5000 grant from the AKO Aotearoa Good Practice Publication Grant (GPPG) to create a video outline of the impact of the mlearning and COP development at Unitec (See AKO Aotearoa Good Practice Publication Grant letter 2009 http://docs.google.com/View?id=dchr4rgg_889vff54hc). The video is available for viewing on YouTube at http://www.youtube.com/watch?v=FcwL8kQoRSI.

4.9.1.6 2010 Unitec eLearning Strategy Implementation Budget

The use of WMDs and intentional COPs was integrated into the new Unitec elearning strategy developed during 2009. The 2010 budget for initial implementation of the Unitec elearning strategy included a further two hundred smartphones and two hundred netbooks to facilitate a move to a ubiquitous student-owned WMD model for the institution by the end of 2012.

4.9.2 Hardware

4.9.2.1 CTLI Laboratory

CTLI had a dedicated computer laboratory (Thirteen Macintosh desktops) for lecturer professional development workshops, which was used throughout the research project for COP sessions with various groups of lecturers and the smaller student groups involved in the research. Since 2006 the researcher was the administrator of the laboratory, enabling the custom configuration of the all Macintosh laboratory. This became the first dual-boot (OSX/WinXP) laboratory on the Unitec Campus with the lease of Intel-based iMacs in 2006.

4.9.2.2 Wireless Laptop Workshop Set

CTLI leased a set of twelve MacBook Pro wireless laptops for facilitating workshops and COPs anywhere on Campus. These were also custom configured with a dual-boot (OSX/WinXP) image by the researcher beginning in 2006. These were extensively used for facilitating the setup of lecturer and student web 2.0 accounts as part of the various COPs. The wireless laptops freed the COPs from fixed computer laboratory contexts. As the research progressed, participating lecturers were encouraged to replace their own desktop computers with appropriate wireless laptops, and an increasing number of students owned their own wireless laptop as well. Unitec's new 2010 elearning strategy (Appendix 13.13) aimed to have all lecturers using wireless laptops by 2012, and all (as appropriate) students owning a WMD for use with their studies.

4.9.2.3 Wireless Netbooks

Netbooks are basically a small wireless laptop available at an affordable price. The size, weight, long battery life (usually), and integrated 3G connectivity of netbooks differentiate them from traditional laptops. The netbook form factor was popularized by the incredibly successful Asus Eee PC, which was launched in late 2007. In 2008 a set of five netbooks were purchased by the researcher, for evaluation and investigation of their potential as supporting tools for the mlearning projects. A COP of five lecturers was formed around the evaluation of the netbooks. As a result, two hundred 3G/WiFi netbooks were included in the CTLI budget and leased for mlearning projects throughout 2009. These were negotiated from Vodafone NZ as part of negotiations for supply of a discounted student 3G data plan from Vodafone (which unfortunately never eventuated). A purchase of this size required a budget business case to be submitted to the Unitec finance committee (See Mlearning Business Case Semester2 2009 http://docs.google.com/View?id=dchr4rgg_97dhbpxjfs). As the netbooks were Unitec IT non-standard configurations, setup, configuration and support were the responsibility of the researcher. However, other team members at CTLI were seconded to help with configuring the netbooks (See http://www.youtube.com/watch?v=KVp40oTjPYY). Customised images of third party open-source and free applications, student login accounts, and WiFi settings were pre-installed on the netbooks by the researcher (See Table 26). The netbooks were primarily used to scaffold the creation of mlearning participants' web 2.0 accounts, freeing the projects from requiring computer laboratory access, and facilitating a flexible COP environment. A two-stage implementation of the netbook roll-out was used, with sixty netbooks deployed to pre-existing COPs with lecturers and students, and two new lecturer COPs established in semester one 2009 in preparation for roll-out to students in semester two 2009. See the "Architecture Mlearning Project Outline 2009" (http://docs.google.com/View?id=dchr4rgg_87d83pvddq) for more details.

Table 26: Custom Installed Netbook Applications.

Application	Description	Pedagogy
Firefox	Free web browser	Main access to web 2.0 tools. The netbook is used as a window into online social networking.
AVG Free	Free Virus Protection	Developing self-sufficient computer competency
Thunderbird	Free email application	Communication and collaboration
iTunes + QuickTime	Media librarian and player	Managing and critiquing Podcasts and VODCasts
Nokia PC Suite	Synchronize data with Nokia smartphone	Enabling context independent scenarios by utilizing the smartphone
VLC	Open source Video player	Information gathering and critique
Flock	Free social media integrated web browser based on Firefox	A social software hub for sharing and collaboration
Picasa3	Google's free image librarian, uploader and editor	Creating eportfolios
ComicLife	Cheap comic strip annotator	Presentations and eportfolios
Trillian	Free multi-client Instant Messenger	Communications and collaboration
FeedDemon	Free RSS subscription application	Managing social software information
Skype	VOIP and Video Conferencing	Communication and collaboration
Audacity	Open source audio editor and recorder for Podcasts etc…	Student created Podcasts
Flash updater	Install latest version of Flash	Many Web 2.0 sites are dependent on Flash
Google Updater	Updater for Google Tools	Information management

4.9.2.4 Moodle and Mediawiki Servers

While Blackboard was the institutionally supported LMS (Learning Management System) in 2006, the mlearning projects used a test Moodle and Mediawiki server to support and scaffold the projects COPs. These were moved to production level servers during 2006 and 2007 (http://moodle.unitec.ac.nz and http://ctliwiki.unitec.ac.nz). Then an institutional evaluation of Moodle was undertaken in 2008, with a resultant decision to move from Blackboard to Moodle in 2009. The transition to Moodle was part of Unitec's new elearning strategy and was scheduled to be completed by 2012. Moodle had several advantages over Blackboard for the research project:

- Integration with RSS, Wiki's, Blogs and web 2.0 services.
- A Social Constructivist underpinning (Dougiamas, 2005).
- The availability of a PDA template for courses, making courses small-screen, PDA-friendly.
- A More intuitive file management structure than Blackboard.
- Open Source platform, therefore software and extensions are free.
- There was a large (and growing) support and development base within New Zealand for the Moodle platform.

Course content to support the COPs was made available for download from Moodle, and the social-collaborative tools embedded within Moodle were utilized within the project courses. A Txttools (http://www.txttools.co.uk) plug-in for Moodle was purchased in 2008 to facilitate SMS messages from course lecturers to participating students.

Mediawiki was used to present outcomes of the mlearning projects without requiring participant logins.

4.9.2.5 Choosing and Configuring the Smartphones

The capability of WMDs increased dramatically over the period of the research. However, accessing a variety of funds enabled the research project to utilize the best of current smartphone technology each year. The initial key specifications to meet the research requirements for the smartphones were:

- WiFi connectivity
- Ease of text entry
- Availability of third party applications for extending functionality

Feedback from the initial 2006 mlearning trials indicated students also preferred the following WMD features:

- Constant connectivity, therefore a smartphone rather than a PDA
- A good built-in camera
- A built-in GPS
- Video recording and streaming capability
- Relatively small size and 'cool' design

A rubric for evaluating the choice of smartphone was developed during 2008 and 2009 (see the Discussion section 6.1.2). Windows Mobile based WMDs were not used because of their small market share among students, and lack of interest in these more business-oriented devices from students. The following WMDs were used for the mlearning projects:

- 2006: Palm Lifedrives, Palm T|X, and IR folding keyboards
- 2007: Palm Treo 380, Nokia N80 smartphone
- 2008: Folding bluetooth keyboards, Nokia N80, Sonyericsson P1i, Nokia N95, Apple iPod Touch, Apple iPhone 3G
- 2009: Folding bluetooth keyboards, Nokia N95, Nokia XM5800, Apple iPhone 3G, Nokia N97, Dell Mini9 netbook

As a result of the of the feedback from the 2007 and 2008 mlearning projects, two hundred 3G/WiFi smartphones were included in the CTLI budget and purchased for mlearning projects throughout 2009. These were also negotiated from Vodafone NZ as part of negotiations for supply of a discounted student 3G data plan from Vodafone. This purchase was part of the same budget business case submitted and approved by the Unitec finance committee (See Mlearning Business Case Semester2 2009 http://docs.google.com/View?id=dchr4rgg_97dhbpxjfs). As was the case with the netbooks, the smartphones were Unitec IT non-standard configurations. Therefore setup, configuration and support were the responsibility of the researcher. Customised images of third party applications, WiFi and 3G settings, and mobile web 2.0 bookmarks were pre-installed on the smartphones by the researcher. However, other team members at CTLI were once again seconded to help with configuring the smartphones (See http://www.youtube.com/watch?v=h1foB0OeXZY).

Table 27 is an example table of smartphone image applications, mapped to supporting pedagogies, installed on the Nokia XM5800 smartphones by the researcher.

Table 27: Example Custom Installed Smartphone Applications.

Application	Description	Pedagogy
Fring	Multi-client Instant Messaging, Twitter, and Skype	Communication and collaboration
Google Maps	Location Mapping	Gathering contextual information
QIK	Live video streaming	Event and inspiration capturing
Google Reader Widget	RSS subscriptions	Web 2.0 management
Nokia Barcode Reader	QRCode decoder	Engagement and information sharing
Wireless Keyboard	Driver for wireless keyboard text entry	Faster text entry
Screensnap	Screenshot application	Sharing and peer support
PhoneTorch	Emergency Light	Creating safe environments
Adobe PDF Reader	To read PDFs	Information gathering
QuickOffice Reader	To read MS Office documents	Information gathering
Zip Manager	For unzipping email attachments	Data management
Photoflow	Interactive slideshows	Presentations and sharing
Tweet60	Twitter client	Communication and collaboration
Accuweather	Daily weather report	Information gathering
Pixelpipe	Upload captured media to almost any Web2 site	Sharing of student generated content

4.9.3 Software

The research project focused on free web 2.0 hosted solutions, and open source software installed on the researcher's Mac OSX Server based at Unitec. These software tools were chosen to be client platform independent (That is, they will run on any of the chosen WMDs). They were also chosen on the basis of their mobile support, quality of end user license (such as anti-porn policies), and on their likelihood to be sustainable over a significant timeframe. For example:

Blogs

Hosted on http://www.blogger.com (2006)

Hosted on http://wordpress.com (2007)

Hosted on http://www.vox.com (2008/2009)

Wikis

Option1: Mediawiki on Mac OSX server managed by researcher, http://ltxserver.unitec.ac.nz/mediawiki/

Option2: Using the built-in wiki feature of Moodle

Option3: Wiki server dedicated to Blackboard at Unitec

Option4: http://www.wikispaces.com

Photo sharing

Option1: Hosted on http://www.flickr.com

Option2: Hosted on http://picasaweb.google.com

Social Book marking

Option1: Hosted on http://www.shadows.com

Option2: Hosted on http://del.icio.us

Podcasting

Option1: Shared over local network using iTunes

Option2: Hosted on http://www.podomatic.com

Option3: Hosted on http://www.vox.com

Video Blogging

Option1: Hosted on http://www.youtube.com

Instant Messaging

The free AIM, MSN, or Google Talk instant messaging services were used.

RSS

RSS was used as a core enabling/delivery mechanism common to all of these social software tools (for example: http://www.newsgator.com/ and http://reader.google.com).

As other new social software tools became available, they were evaluated for suitability and inclusion into the research project.

4.9.4 Wireless Connectivity

WiFi connectivity was a key requirement for the chosen WMDs, facilitating free wireless connectivity for participants while on the Unitec campus. Beyond campus, ubiquitous connectivity was available via 3G data. During the course of the research project the cost of 3G data in New Zealand dropped significantly (by a factor of fifty times). Various options for paying for 3G data were explored throughout the research project. In 2007 students were supplied with a prepay SIM card and twenty dollars credit, and were responsible for topping up costs. In 2008 participants (including lecturers) were reimbursed the cost of a 1GB per month 3G data plan for the duration of the projects. Students were responsible for any voice call and text message costs incurred using the smartphones. In 2009, with the significant drop in 3G prepay costs in late 2008, participants were required to supply their own prepay

SIM or on account SIM and pay for 3G connectivity themselves. Negotiations were also established to set up an educational 3G wireless cellular data plan for Unitec students with Vodafone New Zealand, however this was not achieved. With the mid-2009 launching of Telecom New Zealand's XT cellphone network and the entrance of 2Degrees into the New Zealand cellphone market, there may be more opportunities for negotiating student data rates in the future as the research project becomes integrated into Unitec's new eLearning strategy.

4.10 Chapter Summary

In this chapter I have outlined the participatory action research methodology used throughout the research. The research questions and supporting data collection processes are detailed, and the various mlearning project participants are outlined, encompassing five course contexts, and thirteen mlearning projects between 2007 and 2009. Ethical issues have been identified and discussed, and the general approach to each of the mlearning projects has been described. The chapter also details the development of the community of practice model used as the basis of the technical and pedagogical support of the mlearning projects. A generic overview of the implementation of each project was given, and issues surrounding the management and supply of WMD and web 2.0 resources were discussed. The following chapters 5 to 9 detail the actual mlearning projects and their results.

5 CASE STUDY 1: DIPLOMA OF LANDSCAPE DESIGN, 2007 TO 2009. (DISRUPTIVE TECHNOLOGY, TECHNOLOGY SUPPORT)

This chapter introduces and evaluates a case study that explores the integration of web 2.0 and wireless mobile devices in a tertiary course: the Diploma of Landscape Design. The case study describes three iterations of mobile web 2.0 projects from 2007 to 2009, with each project comprising an action research cycle. These included the following projects: The Ellerslie Flower Show 2007 using Nokia N80 smartphones (Project outline in Table 9), a field trip to Japan in 2008 using Sonyericsson P1i smartphones (Project outline in Table 12), and the collaborative SHac09 project in 2009 using Dell Mini9 netbooks (Project outline in Table 18).

The iterations of the Landscape Design mlearning project illustrate the disruptive nature of mobile web 2.0, disrupting the traditional course pedagogies and student expectations. The case study evidence supports the researcher's thesis that wireless mobile devices can be used to intentionally create disruptive learning environments that facilitate social constructivist approaches to teaching and learning, as explored in the International Journal of Mobile Learning and Organisation (Cochrane, 2009e). The case study also illustrates the critical nature of proper technology support for the participants. These themes are discussed further in section 6.4 of the chapter.

The chapter is structured into a description of each project, followed by the identification and discussion of themes arising from each research cycle, and the design implications identified for the following cycle. This is repeated for each of the three projects, 2007, 2008, and 2009. The chapter then draws together these themes to identify critical success factors related to the implementation of mobile web 2.0.

5.1 2007 Project: The Ellerslie Flower Show

Pre-project discussions and brainstorms between the course lecturer and the researcher (in the researcher's role as an academic advisor in elearning and learning technologies) established the driving motivation behind the project. The motivation was the course lecturer's wish to create flexibility within an existing programme of study using learning technologies, facilitating a change in pedagogy, but also realizing the need for pedagogical and technical help to do so. This realisation led to the lecturer becoming a participant in a community of practice, facilitated by the researcher, investigating web 2.0 technologies and their potential in education (Cochrane, 2006a, 2006b; Cochrane & Kligyte, 2007a). Reflections on the experience of the researcher and the other participants (including the course lecturer) during the 2006 community of practice were supported by research into intentional communities of practice, for example the work of Langelier (2005), and subsequent exploration of applying this approach to teaching and learning with the lecturer's own students. The 2006 COP highlighted the role of a 'technology steward' as described by Wenger et al. (2005) to guide the community of practice in successfully integrating the use of supporting technologies. The group identified the researcher as the technology steward within the 2006 community of practice (See section 4.7 for more detail). The 2007 Ellerslie Flower Show project then became a way to implement the new pedagogical strategies identified by the lecturer during the 2006 community of practice facilitated by web 2.0 tools and first experimented with in a 2006 student trial

(Project outline in Table 8). The lecturer reflected upon their journey of mobile web 2.0 discovery and pedagogical change during a minisymposium presentation to colleagues in mid 2007. This was video-taped and transcribed by the researcher:

> Once I learnt how to use the technology I then moved on to be able to work with the students. I modified an elective exercise that we didn't formally teach, but was an opportunity for students to put their studies into practice by creating a design for the Ellerslie Flower Show. We decided to make it a course, that doesn't have to have content, but a process, synthesizing all aspects of their Landscape Design course and we can bring in all these learning technologies to support it, including blogs, wikis, and an eportfolio instead of presenting it the traditional way. So in 2006 we trialed it and have built on the idea since then. (Course lecturer, 2007)

This illustrates the key stages that the lecturer went through: becoming familiar with the use of new technologies in a lecturer COP, applying the lecturer's experience to her own teaching practice, refocusing on creating a learning community rather than content delivery to the students, and utilizing web 2.0 tools to facilitate student-generated content and contexts. The relationship established between the researcher and the course lecturer during the 2006 COP led to the researcher partnering with the lecturer, cooperatively planning the Ellerslie Flower Show project, and taking on the role of the technology steward for supporting both the course lecturer and students in basing the Ellerslie Flower Show project within a community of practice rather than a traditional lecture series. The relationship between the course lecturer, the researcher, and the students were also identified by the lecturer:

> Thom helped us along the way with this... The Community of Practice that was fostered and the new skills that the students gained in the e-world were fantastic and contributed to them doing so well. It's been a great success. (Course lecturer, from transcribed videotaped presentation, 2007)

The researcher's role as the technology steward within the Ellerslie Flower Show community of practice involved facilitating a COP involving the lecturer, the students, and the researcher, via regular weekly face-to-face workshops in the researcher's computer lab at the start of the project helping the participants to setup their online eportfolios, establishing a Moodle support course for scaffolding the web 2.0 integration into the project, and providing regular technical and formative feedback and encouragement to the participants, for example via blog posts and instant messaging. Once the group established the use of collaborative online tools the researcher was able to continue supporting the COP virtually beyond the face-to-face sessions. The researcher also sourced, setup, and supported the integration of the Nokia smartphones within the second half of the project.

The project began in February 2007, with Diploma Landscape Design students implementing the use of Blogs, online image sharing, eportfolios and RSS aggregation to create three collaborative team-based project designs for the Ellerslie International Flower Show (November 2007). With research funding made available in July 2007, students were provided with Nokia N80 smartphones to post to their Blogs and upload photos and videos to their online eportfolios via 3G or WiFi networks. This provided the students with the ability to work in collaborative design teams within situated learning environments outside of scheduled class time, and also to document the implementation of their Flower Show projects from any context. This also allowed the lecturer to follow students' progress and provide formative feedback from virtually anywhere. This proved very useful, as much of the project involved sourcing materials, ideas and plants from a wide variety of locations that were off campus, and beyond the formal learning environment. For example, in response to the focus group question "In what situations would the WMDs be most effective?" a student responded: “As a mobile computer – instead of a laptop, and as a communication tool for a team who are in different places all the time, too busy to meet, to transfer information, pictures, documents etc”. It is these unique context-bridging affordances that enable wireless mobile devices to enhance learning as described by Cook et al. (2007) and Vavoula (2007b). The project investigated implications for learner support, and the pedagogical changes that these technologies introduced.

5.1.1 Project Outline

The aim of the course was to allow students to develop an area of specific interest outside the scope of other formal courses within the programme. There was no formal lecture schedule for this project. The area of specialisation involved a negotiated research project or field study or design project. Previously the outcome of the negotiated project had been the production of a traditional paper-based portfolio illustrating the students’ design and development process. The bulk of the project was undertaken outside of the formal face-to-face campus setting, with students gathering design materials and ideas from various remote sites. The 2007 project was designed as a collaborative project involving the course lecturer, the researcher, and the course students as co-learners within this new approach to an elective course. Working with the researcher, the course lecturer redesigned the course (See the full course outline in “Diploma Landscape Design Project 2007” http://docs.google.com/View?id=dchr4rgg_99fq4nmzfx) to use various elearning tools to enhance students’ Ellerslie Flower Show projects, including:

- A reflective Blog
- Commenting on each others’ Blogs

- An online photo album
- Discussion forums and file sharing via Moodle
- A smartphone to capture and share photos, video, and facilitate communication

5.1.1.1 Project Participants

A summary of the course participants and project is given in Table 9 in section 4.4.3 of the thesis. The course was an optional negotiated project that students elected to participate in, their selection was finalised by their lecturer on their presentation of a concept proposal for a garden exhibition at the annual Ellerslie International Flower Show. The students were all second year Diploma Landscape Design students. There were a total of eight students forming three teams (Two teams of three and one team of 2 students). The students completed an initial project survey (attached in Appendix 13.7) to establish their previous experience with mobile and web 2.0 technologies, which provided a technology-use profile of the students (Figure 9).

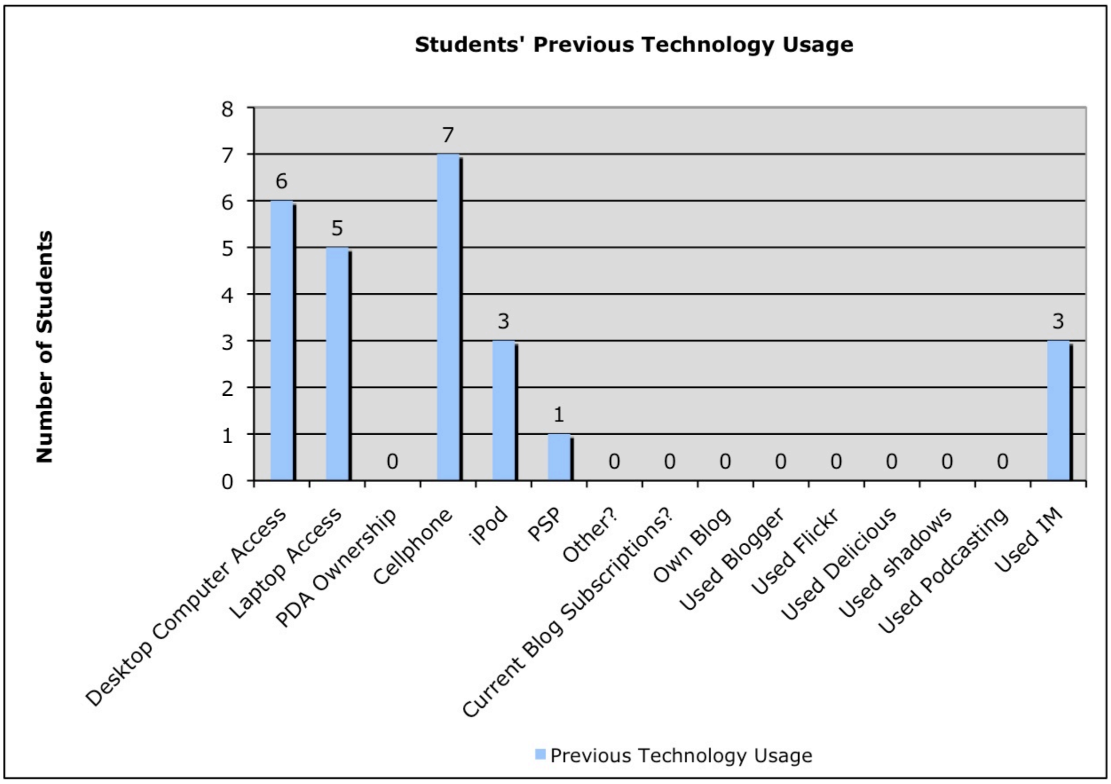


Figure 9: Diploma Landscape Design 2007 students' previous technology usage.

The results, shown in Figure 9, were surprising, for example: one student had had no access to a computer at home at all. None of the students owned a PDA or a smartphone, and one student did not own a cellphone at all. None of the students had previous experience of subscribing to blogs or owning their own blog, or any of the web 2.0 services included in the survey. Only three students responded that they had previously used instant messaging. Their ages ranged from 18 to 49, with an average age of 30, and a gender mix of three male and five female students. Thus the student profile for this project did not match that of the 'Net Generation' proposed by Prensky (2001) and Oblinger and Oblinger (2005) with none of these students exhibiting previous web 2.0 content creation skills. This made the technology support structures built into the project for the students very important for its success.

5.1.1.2 Blogging

The core activity of the project was the setup and development of students' Blogs as reflective journals on their flower show design process. Drawing on experiences from previous student blogging projects in 2006, Wordpress (http://wordpress.com) was chosen as the online blog host on the basis of its configurability, speed of access, and its option of a mobile web 2.0 interface.

The project was supported via the Moodle learning management system (LMS). Three technology workshop sessions introduced students to creating and configuring their Blogs, Flickr (http://wwww.flickr.com), and Google Reader (http://reader.google.com) accounts. Supporting notes, links, discussion forums and tutorials were hosted on Unitec's Moodle server. This approach allowed the researcher as the technology steward to remain in contact with the participants and offer online support while in Sydney during April and May of 2007, continuing to be part of the community of practice by supporting the project remotely.

The researcher kept a journal summarizing each face-to-face COP session with the students, observing that students found Wordpress easy to setup, however students found the concept of subscribing to each other's blogs difficult to grasp, and consequently their Wordpress blogs became largely individual reflection spaces with little peer commenting evidenced.

The project was re-evaluated at the end of semester one 2007. At this point students were expected to have decided upon their team project design concepts, and in the following semester to implement the designs, including sourcing materials and fund-raising to cover the projects costs. The course lecturer wanted to explore moving beyond blogs to using an eportfolio to enable collection of rich media documenting the build process. The Vox software (Six Apart Ltd, 2007b) was chosen as a suitable free online hosted blog and eportfolio system. Vox supported the project by providing mobile web 2.0 integration, including a Vox client (Six Apart Ltd, 2007a) for the Symbian S60 operating system, Windows Mobile, and Palm OS mobile devices. Vox also provided tools to import Wordpress blog posts into the Vox blog, so students would not lose their previous Wordpress investment, although most students continued to use Wordpress as well as Vox for the rest of the project. Vox included a selection of additional online tools beyond blogging, including aspects of social networking. This included a weekly neighbourhood activity email digest, that helped increase the online activity of the students as they became more aware of each other's activity forming a closer online community. The impact of the Vox to student online engagement is shown in the difference in the average number of blog posts per student per month in Figure 10, with Vox showing a marked increase in student blog postings in comparison to Wordpress.

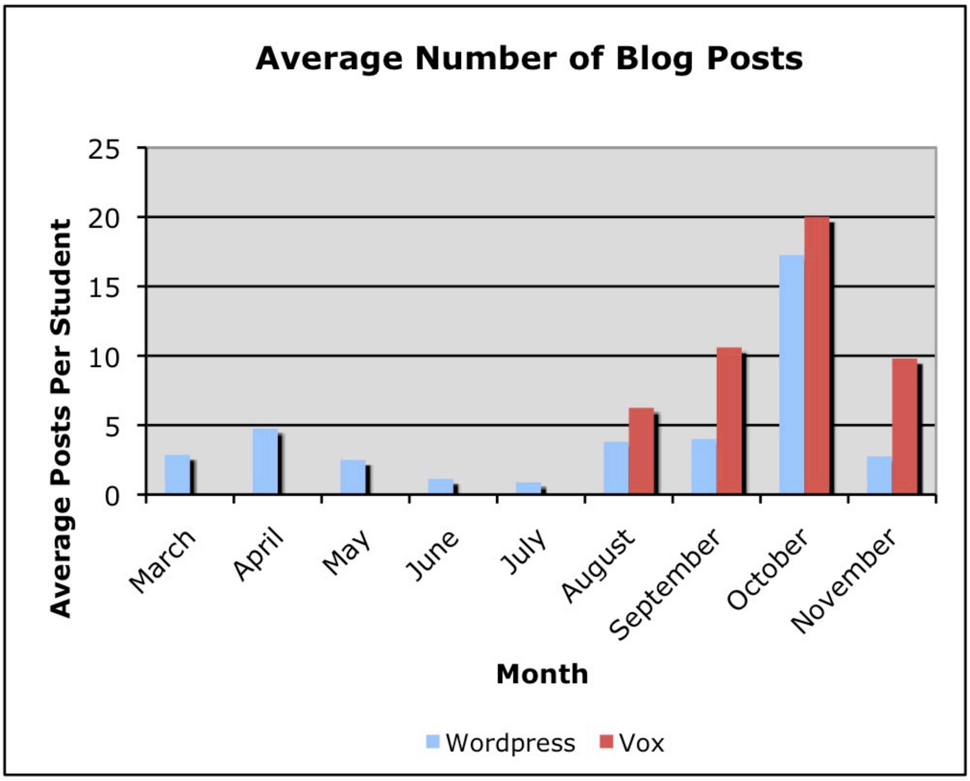


Figure 10: Comparison of participant Wordpress and Vox Blog posts.

5.1.1.3 Introduction of Mobile Blogging (moblogging) using Nokia N80

The unique element of this project was the incorporation of mobile blogging (moblogging) and the investigation of the benefits of wireless mobile devices to enhance the learning environment. Two previous mlearning trials in 2006 had used Palm` PDAs. These PDAs had WiFi access but no cell phone connectivity and no built-in camera. Focus group feedback from the 2006 students indicated their preference for wider wireless connectivity than WiFi, and for the inclusion of a built-in camera in the mobile device. Because a partnership with Palm had been already established and a set of Palm blogging applications already trialled, the researcher and lecturer decided to use the new Palm Treo 680 as the wireless mobile device for the 2007 project. A wholesale price was negotiated with Palm as a special deal for the students to purchase their own Treo 680 each. However the Palm Treo failed to grab the students' interest, with only one student taking up the offer. Reasons cited by the students for this included:

- The Treo's lack of WiFi and 3G connectivity. The Treo 680 was limited to GPRS only, which at the time was expensive and slow.
- The poor resolution of the built-in camera (VGA)
- The size of the handset – students preferred a smaller handset

This left the mobile aspect of the project in limbo while an alternative device and approach was investigated. In lieu of using a PDA or smartphone, students were shown how to use SMS to blog from their own current basic cellphones.

During the re-evaluation of the project, the Innovation and Development Fund (IDF) funding was finalised, providing the project with the funds to purchase a class set of suitable smartphones. Of the currently available smartphones the Nokia N80 (Nokia, 2007) was the most cost-effective solution that fulfilled the requirements identified for the project (see the following list). The Nokia N80 included the following specifications:

- WiFi and 3G connectivity
- 3MP camera
- 512MB memory card
- Compact size
- High resolution screen
- Access to a wide range of Symbian S60 mobile applications, including a Vox and Flickr client.
- Nokia cellphone market share at this time was 40% of worldwide cellphone market (O'Brien, 2008) and 56% of the worldwide smartphone market (Fabris, 2007).

The researcher purchased the N80's through a parallel importer, configured them for the Unitec WiFi network, and supplied students with a pre-paid Vodafone network SIM card for mobile voice and data. Students were required to sign acceptable use forms for using the N80s, including taking liability for returning the units at the end of the project. The smartphone was used to upload content (photos, videos and text) to each student's online blog host via a mobile formatted web interface, or via email, or alternatively using third party mobile applications such as Shozu (http://www.shozu.com) downloaded and installed on the smartphones. Blog posts and comments could be read easily using the built-in web browser on the smartphone as the blog hosts were chosen because they provided mobile friendly versions of their interfaces. Participants were encouraged to subscribe to each others' blog RSS feeds (Really Simple Syndication, or Rich Site Summary) using Google Reader (http://reader.google.com) which also had a mobile formatted version (http://m.google.com/reader). Participants were shown how to setup email and various supporting applications on their smartphones. However, commenting on other participants' blog posts was achieved by using Internet connected laptop or desktop computers as this was a feature unavailable via mobile. Moodle was accessible for viewing course tutorial media and web links using the smartphones built-in web browser, which did a good job of automatically reformatting Moodle (without any specific mobile modification) for a small screen.

Several mlearning technology sessions were facilitated by the researcher for students and the course lecturer covering the use of Vox and set-up and moblogging via the N80. Unfortunately these sessions were poorly attended by one of the three student project teams. Students were shown how to blog and upload photos and video from their smartphone to Vox and Flickr and via Shozu (A moblogging service http://www.shozu.com) to their Wordpress blog if they preferred. The introduction of Vox increased online collaboration, while moblogging increased students' uploading of media to their blogs, as shown in an analysis of the average number of mobile blog posts and average comments made by students (see Figure 11).

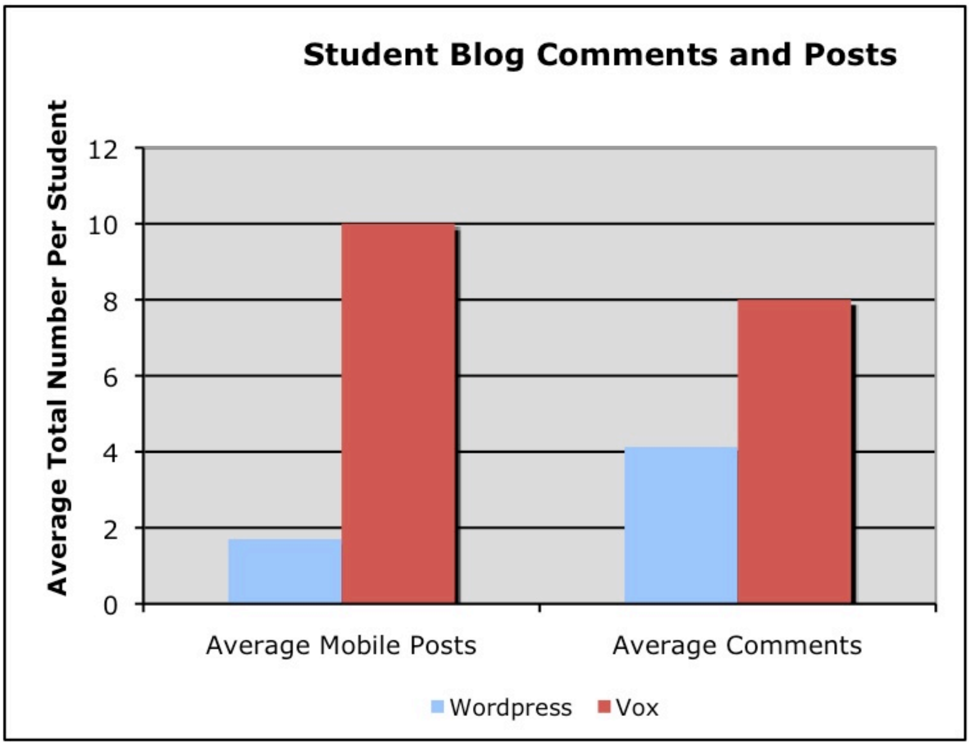


Figure 11: Average numbers of blog comments and posts by students.

The culmination of the project was the judging of the student teams garden designs at the Ellerslie International Flower Show in November 2007. This was a huge success with all three teams winning a gold award for each of their gardens (Koubaridis, 2007).

5.1.2 Themes Arising

Themes are drawn from comparative analysis of the initial student survey with the final end of project student survey, collation and analysis of student blog posts and comments, responses to the focus group questions, and the researcher's own observations during face-to-face contact with the students recorded in the researcher's offline research journal. Three key themes identified by the researcher included: the disruptive nature of the introduction of mobile web 2.0 technologies into the course, the critical nature of COP formation for pedagogical and technical support for the participants, and the importance of the appropriate choice of technologies.

5.1.2.1 The disruptive nature of mobile web 2.0

The disruptive nature of mobile devices, as described by Sharples (2000, 2001, 2005) and Stead (2006), required the lecturer to rethink the course learning environments and assessments in order to integrate the technology into their pedagogical approach. As Laurillard (2007) reinforces, the role of the lecturer in designing and facilitating effective mobile learning environments was critical. The course lecturer and the researcher purposely designed the Ellerslie Flower Show project to be a departure from the previous paper-based portfolio elective approach, experimenting with new forms of lecturer engagement with the students and new forms of student-generated content facilitated via mobile web 2.0. This introduction of new technologies and new ways of working provided a catalyst to also introduce pedagogical change into the course.

This disruption was not limited to the role of the lecturer, but also to students' workflow and perceptions of education. For some of the students in the project the facilitation of anytime anywhere learning and the use of their social devices were met with feelings of intrusion and resistance. However, the majority (63%) of the students indicated they found a new sense of empowerment and connectedness in this new educational environment. There were three student groups (teams) involved in the project. Of these, two groups engaged with the integration of mobile technology into the project and the move from Wordpress to Vox for hosting student eportfolios, while one group chose not to. This led to a stark contrast in feedback on the usefulness of mobile technology in supporting students' learning environment between the engagers and non-engagers. Figure 12 for example represents students responses to question twelve of the final student survey, showing a contrast between the two engaging groups of students' perception of the positive impact of the use of WMDs in contrast to the non-engaging group's negative response.

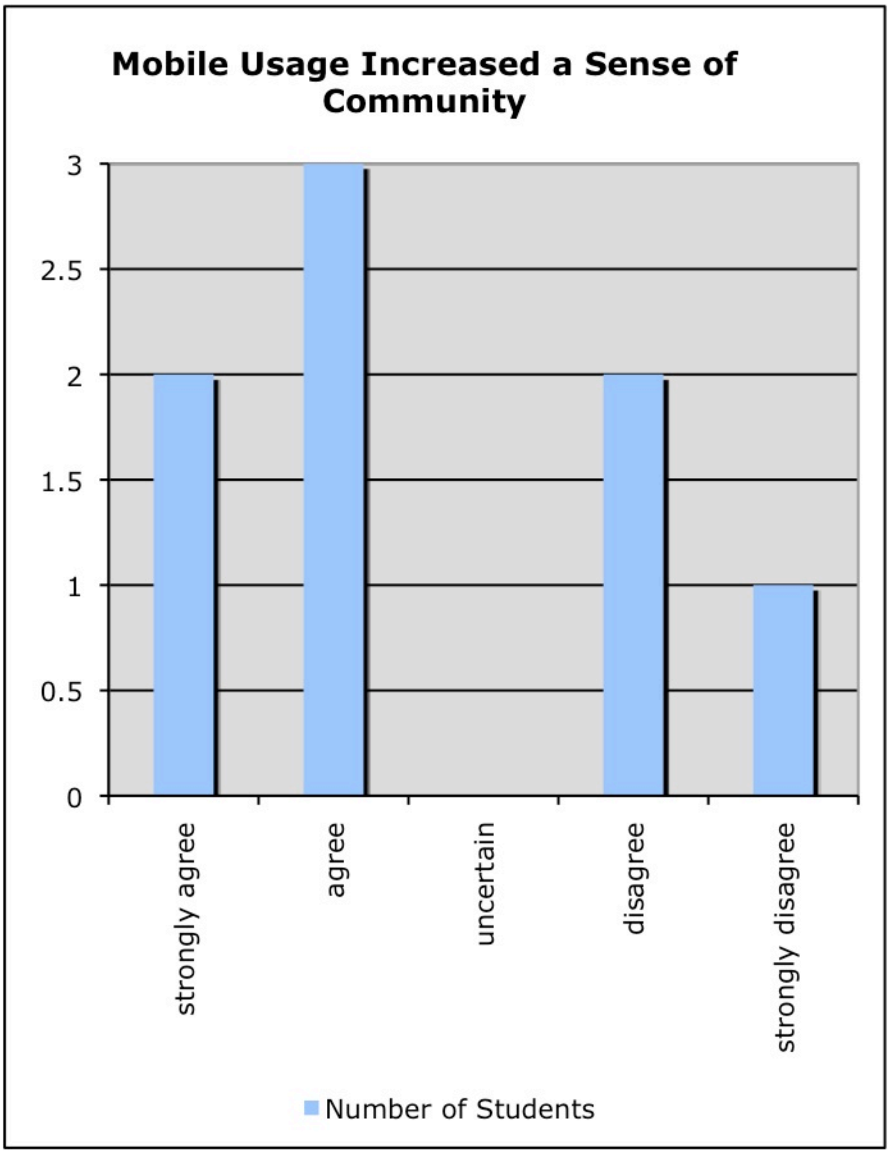


Figure 12: Student responses to final survey question 12.

Discussions with students during the technology sessions and the end of project student survey indicated that the two engaging groups responded enthusiastically regarding the ability of mobile devices to enhance educational experiences, while the non-engagers responded strongly in the negative. There was no obvious demographic reason for this contrast.

However, COP session observations and blog activity analysis by the researcher indicated that the non-engaging group were characterised by:

- Reluctant bloggers, in contrast to the other two groups blog activity their blog posts tended to be summative rather than recording their thoughts and process along their design journey.
- Exhibited little online community building, illustrated by this group making no comments on each other's Blog posts, or the other groups' Blogs.
- Attended less than 50% of the technology support sessions, and therefore remained on the periphery of the community of practice.
- Did not attend the technology sessions introducing the smartphone and mobile blogging.
- Either forgot to carry the smartphone with them, or forgot to keep it charged. They did not engage with the smartphone for the project or attempt to use it in their own social experience. Rather they preferred using their own mobile phone and separate digital camera.
- Change adverse. They preferred to keep their Wordpress blogs going rather than move to Vox when it was introduced mid way through the project.

The introduction of WMDs in the course required changes in pedagogical strategies, creating a focus on student-generated content, and contexts (beyond the face-to-face classroom environment), and also in the collaborative nature of student engagement. The non-engaging group required more scaffolding to see the benefits of these changes than the engaging groups.

5.1.2.2 COP formation

The course was designed by the lecturer and researcher to be supported by a similar community of practice model to that experienced by the lecturer during the 2006 Dummies2Delight lecturer COP. However, the non-engaging group did not prioritise attending the tutorials that formed the focus of the supporting community of practice, preferring to work in isolation to the other two student groups, and effectively choosing to stay on the periphery of the supporting community of practice. Because the non-engaging group missed the critical mobile set-up and mobile blogging technology support sessions they struggled to learn how to operate the smartphone on their own, and preferred to use their own simple non-smartphones for txting and phone calls, and dedicated digital cameras for photos. This group was offered additional technology support sessions for smartphone configuring and moblogging, however they attended the sessions unprepared, either without their smartphone, or with it uncharged. The group members were also offered individual technical assistance but did not take up the offer. When asked by the researcher for feedback on why they chose not to engage with the smartphone they stated they were too busy to learn how to use the smartphone within the course, and their use of the smartphones was limited to experimenting at home with them.

In contrast, the other two student groups enthusiastically attended the mobile technology support sessions, coming prepared with their smartphones, forming the core-group of the supporting community of practice. According to feedback received by the researcher during the COP sessions and responses to the focus group questions, this engaging group used their smartphone wherever they went, enabling them to turn any context into a learning context. They generally found the N80 easy and fun to use. However, help in the initial set-up of the smartphone (in particular its wireless connectivity set-up) was considered essential.

The contrasting response from participants is not unusual, as is illustrated by a similar response from non-engaging students within a mobile learning smartphone project conducted by Cook et al. (2007). What is needed are strategies for early identification and scaffolding for such learners. This was therefore explored in the design of the following mobile learning project, where the emphasis on the supporting community of practice within the project was increased.

5.1.2.3 Appropriate choice of supporting technologies

The choice of blog host and the choice of smartphone were both found to have a large impact upon students' engagement and collaboration. To evaluate the impact of these choices student Blogs were monitored by the course lecturer and the researcher via RSS feed subscriptions. Students were encouraged to subscribe to each other's Blogs via Google reader, and to interact by making regular comments on each other's blogs. Blog analysis was made by the researcher based on a collation of the number of student posts and comments and types of media uploaded to their Blogs.

While initial setup support was required for students moving from Wordpress to Vox the increased level of collaboration exhibited by the increase in comments on each other's Vox blogs compared to Wordpress comments made the move worthwhile. The frequency of Blog posts and comments increased after the introduction of Vox and the N80s (see Figure 11). This can be accredited partly to the way Vox facilitated a collaborative environment via its 'neighbourhood' feature.

Students who used Vox assigned each other as Vox neighbours and were automatically provided with email notifications of comments on their Vox Blog and new posts on their neighbourhood Vox Blogs. Vox also sent out a weekly email news notification with a summary of Vox neighbourhood activity. Unlike Wordpress, students were not reliant on checking RSS feeds to keep track of one another's Vox blogs. This was important, as the previous 2006 trials had indicated students take time to integrate RSS subscribing and reading into their daily routine. The introduction of Vox also coincided with the implementation of the Nokia N80 camera phones and the beginning of the busiest period of the project. However a direct comparison between Vox and Wordpress usage was made possible by the non-engaging group refusing to move from Wordpress to Vox usage. Two students also continued their Wordpress Blog alongside their new Vox Blog.

Student responses to the focus group questions indicated that students valued the ability of their Blogs to provide a dynamic link between their projects and their friends, family, and project sponsors. The two mobile engaging groups highly valued the photo capabilities of the smartphone and its basic communication functions (txt and voice calls). For example, one student's mother learnt how to txt during the project to send encouraging messages during the long project hours on site. In contrast to the students' general rejection of the attempted introduction of the Palm Treo 680 into the start of the course, the engaging students were very enthusiastic about the subsequent introduction of the Nokia N80, as illustrated by example student feedback:

> Thanks so much for the N80s! They have been fantastic. In fact I have become quite attached to mine and would like to purchase one - it would be great for my new job. (Student email feedback, 2007)

> The N80 was fantastic, easy to use and had every feature you could think of needing and more. I am definitely going to invest in buying one for future use as with work it will be easy to stay in contact with people, check emails etc. (Student Survey feedback, 2007)

The researcher observed that those students with the least computer skills at the start of the project became the most avid bloggers (producing the most Blog posts and comments) in both the 2006 and 2007 projects. These students reflected during the focus group that they found the experience empowering and the support of other students and the technology steward invaluable. A common theme emerged regarding the essential nature of the technology sessions for supporting the setup of the mobile devices. Focus group feedback from both the students and lecturer indicated they wanted more time for exploring the full potential of the smartphone in future projects. Students requested that the smartphones be made available earlier in the project next time. The final student survey responses indicated that the integrated nature of the phone's communication and recording capabilities was perceived as making access to information easy, and a way of bridging time and distance. For example, in response to the final survey question: "In what situations would the WMDs be most effective?" one student replied: "As a mobile computer – instead of a laptop, and as a communication tool for a team who are in different places at the time, too busy to meet, to transfer information, pictures, documents" (Student, 2007).

5.1.3 Implications for the Next Research Cycle

This project illustrated the transformation of a traditionally facilitated learning environment (paper-based portfolio) to one based on a social constructivist pedagogy using mobile and web 2.0 technologies (a collaborative mobile facilitated eportfolio). The project illustrated that appropriate tutor professional development and technology support allowed the lecturer to integrate educational technology into their course (Cochrane, 2007h). Developing the intentional community of practice support model was explicitly explored in following projects. An action research approach to the project enabled aspects of the project to be re-evaluated and reworked during the project (for example moving from Wordpress to Vox, and choosing the Nokia N80 instead of the Treo 680 smartphone), leading to better alignment of the project implementation with the project goals, and these choices were used to inform the choice of technologies for the following project. It was the researcher's and the lecturer's belief that the alignment of mobile technologies with social constructivist pedagogy and new learner preferences provides the potential for the development of collaborative learning communities, enhancing student-student and student-tutor communication and interaction. However the 2007 project student profile illustrated that 'Net Generation' skills cannot be assumed and appropriate support structures must be established for the integration of new mobile web 2.0 tools. The project highlighted the disruptive nature of mobile technology in education, where most students and the course lecturer embraced the potential that it afforded, while one group of students chose not to engage. In general, the project illustrated that mobile blogging coupled with web 2.0 tools potentially provide the basis for enhancing teaching and learning across multiple learning contexts, providing an environment that stimulates reflection, critique, collaboration, and user generated content. The following projects built on this foundation basing the core activity of each project upon the creation and maintenance of a reflective Blog or eportfolio as part of a course group project. In general, the next projects aimed to investigate integrating the use of WMDs and web 2.0 across an entire course, rather than just a project within a course.

To facilitate greater student reflection the issue of ease of text entry on WMDs was addressed using bluetooth-folding keyboards in 2008. Finally the issue of off-campus wireless connectivity was tackled by providing students with a 1GB per month 3G mobile data plan. Building on this project, three mobile projects were established for 2008 in three different learning contexts using three different WMDs. The results of these projects are discussed in the following sections of this thesis.

5.2 2008 Project: Field Trip to Japan

5.2.1 Project Outline

In 2008 the course lecturer teamed up with a second Landscape Design lecturer to integrate the moblogging project within an elective field trip to Japan. For the 2008 project, a newer WiFi smartphone was chosen (the Sonyericsson P1i) with a better camera and a wider range of text entry options (touch-screen, handwriting recognition, full mini qwerty keyboard, and supplemented with a Bluetooth folding keyboard). Lecturers and students were also supplied with a 1GB per month 3G data account for the duration of the project. The project was conceived to bridge the students' learning experiences in Japan with their learning experiences and environment on and off campus in New Zealand both before and after the trip.

5.2.1.1 Participants

The project was a collaborative partnership between the researcher, the course lecturers, and course students. Students volunteered to participate in the mobile web 2.0 project, signing ethics consent, acceptable use policy, and research outline forms. An outline of the project and the participants is given in Table 12 in section 4.4.4 of the thesis. The 2008 project was based on an elective investigative field trip to Japan, for which the participants were required to be able to fund the cost of the trip themselves. This added cost factor effectively limited the participants to a small group of students who could afford the trip with the age range of the participants being from 42 to 69, with an average age of 55. Not all of the students participating in the Japan trip volunteered to be involved in the mobile web 2.0 project. The Japan trip ended up with a total of fifteen students and two course lecturers, with six of the students participating in the mobile web 2.0 project. All of the mobile web 2.0 participants were part-time students who had either part-time or fulltime jobs related to landscape design, this resulted in a markedly different student profile to that of the 2007 project.

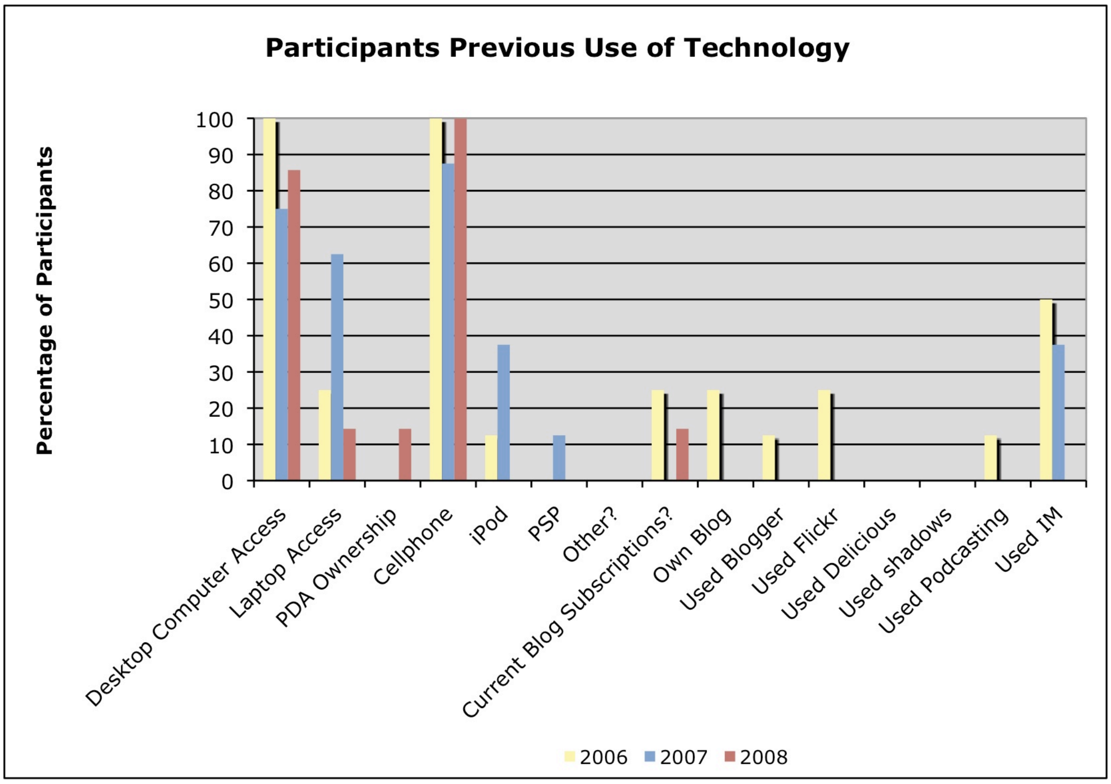


Figure 13: Comparison of 2006, 2007 and 2008 students' previous technology experience.

The 2008 student participants had very little previous experience of web 2.0 or mobile technologies (apart from traditional standard cellphone use), and significantly less experience than previous student groups (as illustrated in Figure 13), and student participants had particularly demonstrated a lack of engagement with web 2.0 tools prior to their involvement in the mobile web 2.0 projects. This had implications for the level of pedagogical and technical support required to make the projects successful.

5.2.1.2 Pedagogical and Technical Scaffolding

The 2007 mobile web 2.0 project identified the need to get lecturers and students up to speed with the mobile web 2.0 technologies before the course project entered critical time-consuming stages. The early integration of the use of the mobile web 2.0 tools and the development of a regular weekly community of practice were highlighted as potential ways of supporting the mobile web 2.0 projects. Therefore the researcher and lecturers planned to establish a COP with the students, lecturers and the researcher as the technology steward in semester one in preparation for the elective course beginning in semester two 2008. However the course participants were all part-time students and were reluctant to attend the COP sessions before the start of the course. Hence COP sessions were limited to four introductory sessions in semester one, followed by a three month break then four more COP sessions in the month leading up to the trip to Japan in semester two. Key elements of cultivating a community of practice as emphasized by Wenger, McDermott and Snyder (2002) were compromised by this approach, including: a lack of sustained engagement leading to weak development of a sense of community, a lack of modeling of the expected communities practices by the lecturers leading to the students remaining on the periphery of the group, and a resultant reverting to the COP sessions becoming workshop sessions rather than forming the core of a developing community of practice. The first four COP sessions were held in the researcher's computer lab, while the second set of COP sessions were held in a very noisy shared computer lab space, neither of which were conducive to the students' forming a sense of group space or belonging. The 2008 group did not establish a sense of community identity until they were together on the trip to Japan, where they spent significant time together. At this point there was little opportunity for the technology steward to help the group as they encountered technical issues while in Japan with connectivity options, and as a result several of the student participants, and one of the lecturers, struggled to integrate the mobile web 2.0 technologies into their workflows.

5.2.1.3 Blog Analysis

Table 28 gives an overview of the average blogging activity per participant associated with the Diploma of Landscape Design mobile web 2.0 project during 2008. Although the 2008 group were allocated a 1GB per month 3G data plan, most of the group made minimal use of the data plan leading up to the trip to Japan. Being part-time students, most of the group limited their blogging activity to when they were on campus, using WiFi, although the Smartphone's camera was used for capturing images and video off campus. The usage, and therefore modeling of the mobile and web 2.0 tools was similar to that of the students' usage. The user interface (UIQ3) of the smartphones was too daunting for several of the participants, who subsequently did not personally or socially integrate the use of the technology beyond the face-to-face contact with the rest of the group. The bulk of their blogging activity was through the use of desktop or laptop computers, with images and video captured on the smartphones generally transferred to their computers from the smartphones for easier uploading.

Table 28: Overview of Landscape Design participant blog activity, 2008.

Blog Analysis	May	June	July	August	September	October
Lecturer Monthly Data Usage	0.16MB	42MB	0.035MB	3MB	1.5MB	0.5MB
Student Monthly Data Usage	0.61MB	1.38MB	0.016MB	0MB	7.45MB	2.07MB
Lecturer average number of Mobile Blog posts	2	0	0	7	2	0
Student average number of Mobile Blog posts	2.5	0	2.8	4.2	2.5	0.5
Lecturer average total number of Posts	3	0.5	1	15	5	2
Student average total number of Posts	2.8	1.2	7.2	10.8	6.8	4.5
Lecturer average Number of Blog comments	6	0	1	10	3	0
Student average Number of Blog comments	4	0.4	4.3	9.3	5.7	3.2
Lecturer average number of media uploads	8	0	4	22	18	10
Student average number of media uploads	4.8	3.4	9.3	14.2	20.2	25

5.2.2 Themes Arising

Feedback from students on the use of mobile web 2.0 within their course and during the trip to Japan yielded a variety of responses. While all of the participants integrated the use of an online blog and eportfolio into their course workflow, only a few integrated the regular use of the smartphones into their course workflow and social routines. Transcriptions of student VODCast reflections at the end of the project, available for viewing on YouTube at http://www.youtube.com/watch?v=c8IZSVtaMmM, highlighted several issues including: the high cost of roaming 3G data, "Once I got the hang of it, using it *[the smartphone]* in Japan was quite fun, but the cost of sending stuff back was quite a shock once I got back" (Student1, 2008), the limited connectivity options while in Japan, "There were fewer WiFi spots available than we anticipated and that certainly was a restriction" (Student2, 2008), and the complexity of the smartphone, "I found it difficult to operate the phone and the camera – I much prefer a little handheld camera that I have greater control over, and I found the camera phone just too complex" (Student3, 2008). Student feedback thus highlighted the appropriate choice of mobile technology for the student profile and nature of the project. The choice of WMD had been made upon reflections on the previous project in 2007, rather than an analysis of the specific requirements of the 2008 project.

Reflections on the project from the two lecturers were positive and focused upon the increased communication and collaboration achieved, "The phones were extremely good for texting, because I can write whole words rather than bits of words" (Lecturer1, 2008), "It's been great for social networking" (Lecturer2, 2008), and the ability to capture ideas anytime, "the phones are also really useful for taking photographs when you are unprepared and suddenly need something to record with" (Lecturer1, 2008). Critical issues identified by the lecturers included the need for assessment integration, "As with the Flower show project last year, it's been important to tie the device work with our assessments and our group process" (Lecturer2, 2008), and the usability of the smartphone "It might be good to try a different phone – some of the students have found the lack of intuitiveness a little difficult on the Sonyericssons" (Lecturer2, 2008).

5.2.2.1 Disruptive Pedagogy

The use of blogging and mobile blogging challenged the established workflow and suppositions of the newest lecturer to participate in the project, who consequently made no mobile blog posts directly from the smartphone. Discussions with the researcher revealed that the lecturer's previous approach to capturing and sharing images of example plants and landscape designs had been to use a high quality analogue camera, digitize the photos, and then edit each photo meticulously before allowing students to view the images, thus focusing upon the quality of the images rather than the concepts portrayed. In contrast, the affordance of a cameraphone is to be able to quickly capture an idea or potential design idea on the spot and upload it directly to the user's blog for immediate sharing. Thus moblogging focuses upon capturing opportunities and sharing ideas rather than high-quality content in the first instance. This required a conceptual shift for the second lecturer, and therefore an affordance that was not modeled to the students in the course. The process of transforming pedagogy can take significant time (Moser, 2007; Olney & Lefoe, 2007). However, conceptual shifts were evidenced by the second lecturer at the end of the 2008 project, and continued into the following 2009 Landscape Design mlearning project. These conceptual shifts were observed by the researcher when the lecturer saw the potential of web 2.0 tools for sharing off-campus experiences with their students after the return from Japan and during a subsequent trip to Rome, as shown by their continued blogging after the end of the Japan project.

5.2.3 Implications for the Next Research Cycle

While the establishment of the project was based upon preceding mlearning projects, there were several unique factors that limited it's success, including: the age and IT literacy of the participants, usability issues with the smartphones, an unforeseen lack of WiFi hotspots in Japan, and the high cost of international roaming 3G data. However, the project does confirm some of the critical success factors for mobile web 2.0 integration that the mlearning projects have begun to identify. The identified critical success factors can be compared to the outcomes of similar social constructivist based mlearning projects such as those undertaken at the University of Wollongong (Herrington, 2008; Herrington & Herrington, 2006b; Herrington, et al.,

2008) which were based upon the nine principles of authentic learning (Herrington & Oliver, 2000).

1. The level of pedagogical integration of the technology into the course criteria and assessment.

While the experiences of previous mobile web 2.0 projects (2007 and the 2008 Product Design mlearning project) informed the integration of the project criteria and assessment, the mobile use within the project was made optional for students and less than half of the students subsequently volunteered to use the smartphones, limiting the development of mlearning authentic contexts and activities (Herrington, et al., 2008).

2. The level of lecturer modeling of the pedagogical use of the tools. This is similar to Herrington et al.'s (2008) principle of access to expert performances enabling modeling of processes.

While the researcher had established a close working relationship with one of the course lecturers, the actual project leader for 2008 was new to the concepts of mobile web 2.0 integration. Discussions with the researcher revealed that the lecturer defaulted to using the smartphone mainly for texting and the occasional photograph. It was hoped that the 2008 experiences would inform the lecturer's understanding of the pedagogical potential of smartphones and mobile web 2.0 and lead to more effective lecturer modeling in future projects.

3. Creating a supportive learning community, or in terms of authentic learning collaboration allowing for the social construction of knowledge (Herrington, et al., 2008).

One of the pedagogical affordances of the student blogs was the ability to support peer and lecturer reflection, critique and feedback by way of commenting on student blog posts. The social networking capabilities of Vox also facilitated collaborative interaction. Similarly Herrington et al. (2008) emphasized opportunities for reflection and articulation. However the 2008 Diploma Landscape Design mlearning project group did not socialise the use of commenting as much as was hoped, and higher interaction from the course lecturers was required to scaffold this concept better for future projects. Herrington et al. (2008) also emphasized the need for coaching and scaffolding by the teacher.

4. Appropriate choice of mobile devices and software.

The smartphone for the 2008 project was chosen on the basis of feedback from the 2007 project that indicated that the limited text entry capability of the smartphone used in 2007 was a significant deterrent to students' moblogging beyond simple image and video uploads. In hindsight however, considering the 2008 participants' profile, a smartphone with a simpler user-interface was a more crucial factor to facilitate students integrating the device into their daily workflows. The purchase and appropriateness of smartphones for mobile web 2.0 projects needs to be informed by not only the key affordances of the devices for the project, but also by the preferences and capabilities of the participants.

5. The importance of technological and pedagogical support.

The experiences gained during the 2007 project helped to develop a community of practice model for supporting the integration and use of mobile web 2.0. A key to the model is its flexibility, recognising that each group of students and lecturers is unique. However, it was difficult to establish a regular COP session with the 2008 group, due to their limited on campus attendance and lack of a suitable computer lab space. Supplying students with wireless laptops as well as smartphones would have facilitated more flexibility for COP spaces (both physical and virtual). Similarly, the lecturers needed to explicitly timetable course time for getting up to speed with the technology and time for investigating the pedagogical integration of the technology into their courses.

This mobile web 2.0 project did not achieve the integration within the participating students' and lecturers' workflows as had been hoped. Being a small group project, its outcomes are not necessarily transferable beyond it's own setting. However it serves to illustrate several critical pedagogical success factors surrounding the integration of mobile web 2.0 scenarios in tertiary education.

There was enthusiasm from the course lecturers for continuing with the integration of mobile web 2.0 projects within the curriculum. In particular, exploring a more flexible approach to facilitating supporting communities of practice with students utilizing wireless laptops rather than a fixed computer laboratory, as was the case in 2007 and 2008.

5.3 2009 Project: SHaC09

Following an enthusiastic response from the majority of students and lecturers involved in all of the 2008 mlearning projects (including the Diploma of Contemporary Music, Bachelor of Product Design, and Diploma of Landscape Design), internal institutional funding was sought, and approved, for extending these small projects to a major large-scale mlearning project in 2009 involving the use of 250 smartphones, and 200 netbooks. The third iteration of the mlearning integration into the Diploma of Landscape Design was one of these funded projects for 2009. An outline of the project and participants can be found in Table 18 in section 4.4.5 of the thesis. The researcher and the course lecturers brainstormed the 2009 mlearning project integration into the Diploma Landscape Design during the end of 2008 break and before the start of the 2009 academic year. Reflecting on the experiences of the previous mlearning projects a staged and scaffolded approach to the implementation of the 2009 mlearning project was taken. The first semester of the project utilized 3G and WiFi capable netbooks (Dell Mini9), a peer reviewed paper has been published on this project (Cochrane, Bateman, Cliffin, et al., 2009). Then in semester2 of 2009, a small group of the Diploma Landscape Design students were also provided with a 3G touch-screen smartphone (Nokia XpressMusic 5800) to facilitate documenting a Flowershow design competition project. Discussions with the course lecturers led to the decision that the most appropriate courses within the Diploma of Landscape Design to integrate mlearning into were their elective courses where students design authentic projects, usually for real clients. The student profile for these elective courses was comprised of mature part-time students, with many of the students being in the forty plus age group. Therefore it was decided that staging and scaffolding the introduction of web 2.0 tools into these students' learning experience was imperative as their previous technology experience was limited (See Figure 14). Responses to the pre-project student surveys indicated that there was little difference in students' previous technology experiences between 2006 and 2009 (See Figure 14). Using netbooks as the chosen WMD for 2009 was seen as the best way to scaffold students' learning without the initial extra cognitive load of learning a smartphone interface, as had been the experience with the 2008 Landscape Design mlearning project students. Thus the 2009 Landscape Design mlearning project was simplified as much as possible.

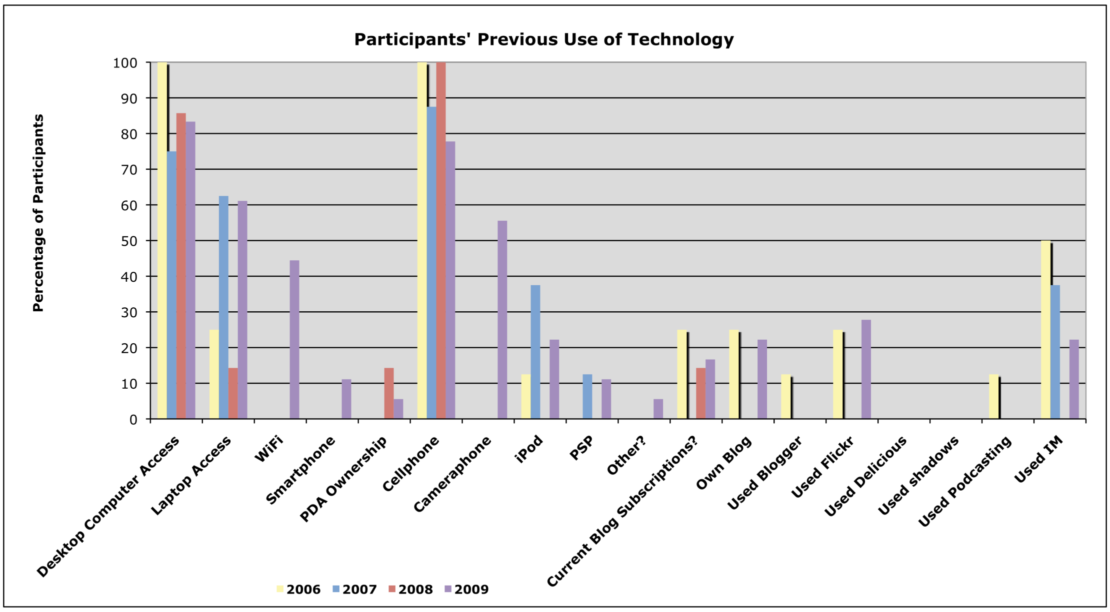


Figure 14: Comparison of Diploma Landscape Design student previous technology experience 2007 to 2009.

5.3.1 Project Outline

The project was guided and supported by weekly technology sessions forming the core of a community of practice of the students and lecturers facilitated by the researcher as the technology steward (Wenger, et al., 2005) integrating mobile web 2.0 technologies within the course. The mlearning projects prior to 2009 had comprised small groups of students from the third year elective course that volunteered to participate in the projects. The breadth of funding secured for the 2009 projects enabled all students in the third year Diploma Landscape Design course to voluntarily participate if they chose. All participants were provided with either an appropriate 3G-enabled netbook and additionally in the case of the elective Flowershow project a smartphone for the duration of their course in 2009.

5.3.1.1 SHAC09

The semester1 project was a collaborative sustainable house design project between the third year Product Design course and the second year Landscape Design course. The Ning (http://www.ning.com) social network was used to facilitate collaboration between the two different courses (http://designprojects.ning.com) creating an interactive collaborative 'hub' for the project participants.

1. Product Design students used Nokia N95 smartphones and folding Bluetooth keyboards to capture and share design ideas and reflections on design via the use of an online blog/eportfolio.
2. Landscape Design students used 3G and WiFi enabled netbooks to facilitate the development of a collaborative design process via Ning forums, and online media sharing sites such as Flickr (http://www.flickr.com) and YouTube (http://www.youtube.com).

The Sustainable Habitat Challenge (SHaC09) was a national competition in the form of a collaborative project for teams around New Zealand to design, develop, and build sustainable housing in their local community (http://www.shac.org.nz). Throughout the SHaC09 project, data sharing was enabled through a range of software applications. Staff and students made project work and resources available to the rest of the world online, via blogs, wikis and other web 2.0 applications. The following diagram (Figure 15) illustrates the range of web 2.0 tools used and the types of interaction between the project members facilitated by these tools.

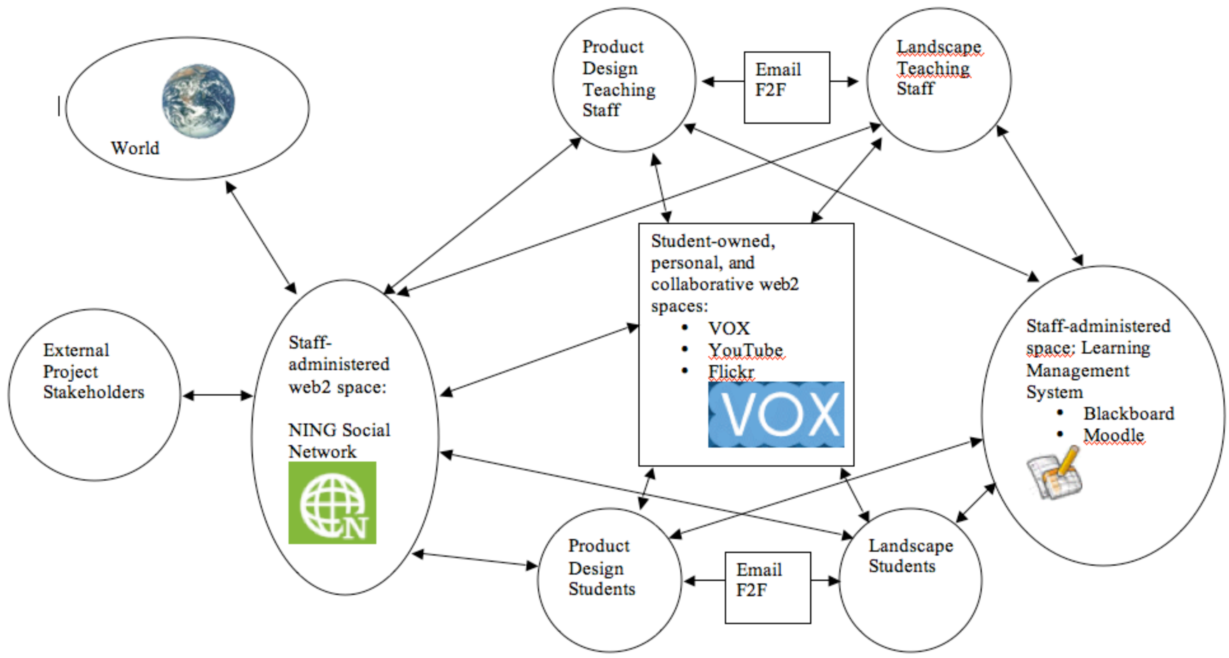


Figure 15: SHaC09 collaborative project concept map.

The arrows in Figure 15 indicate the interactions and collaboration facilitated by the various tools. Vox formed the hub of students' personal eportfolios and sharing of project related media that could then be embedded into the project Ning site administered by the course lecturers. Peer student commenting and critiquing between the three student groups via Vox and Ning was encouraged. Ning formed the hub for project management, collaboration and cross-departmental communication, and feedback from the external project stakeholders. Ning was also used as the public face of the project to anyone interested in following the project. Specific academic briefs were developed collaboratively for each student group involved in the project by the lecturers in the departments of Design, Landscape Design, Communication, and Applied Trades, with input from the researcher. Web 2.0 tools including Ning, and Google Docs were used to develop the project briefs and supplement in person meetings during the writing stage. Finalised project briefs were distributed to students via the institutions learning management systems (Moodle and Blackboard). The student groups also communicated via email and several face-to-face project meetings.

The Diploma Landscape Design project plan was to begin with the provision of 3G and WiFi capable netbooks for all of the students in the course during semester one, facilitating the setup and establishment of their online web 2.0 eportfolios, followed by the introduction of smartphones for bridging anytime anywhere learning contexts in semester two. Due to delays with the supply of the devices, the personalised mobile aspect of the project was compromised. However the delay in the arrival of the netbooks was mitigated by the use of a loan set of wireless laptops when the students met face-to-face weekly to engage in tutorials and individual and group posting sessions, with additional posting throughout the week.

Students in the Diploma of Landscape Design were given a studio brief to design the garden for the Unitec entry to the Sustainable Habitat Challenge (SHaC09). Effective collaboration and the use of the communication technology for on-line journaling contributed to student grades. During their completion of the SHaC09 tasks, Landscape students were asked to research into sustainable technologies suitable for residential houses and gardens and based on six distinct areas; water, waste, landscape materials, renewable energy production and plants (for mitigation and food production). Students recorded their findings and discussed them on-line, with a summary statement produced at the end of the process (http://designprojects.ning.com/forum/topics/landscape-research-summaries).

5.3.2 Themes Arising.

The following section summaries the Landscape Design lecturers' reflections on the semester one mlearning project that was published as a peer-reviewed conference paper (Cochrane, Bateman, Cliffin, et al., 2009). These reflections represent significant pedagogical transformation for the participating lecturers in their conceptualisation of the benefits and appropriation of mobile web 2.0 into their courses (in comparison to that shown in the 2008 mlearning project), which was extremely encouraging for the researcher.

The benefits of the project identified by the lecturers were:

- Flexibility of learning space and time facilitating COP formation
- Increased participation and engagement of the students
- Enhancing group work

5.3.2.1 Flexibility of learning space and time facilitating COP formation

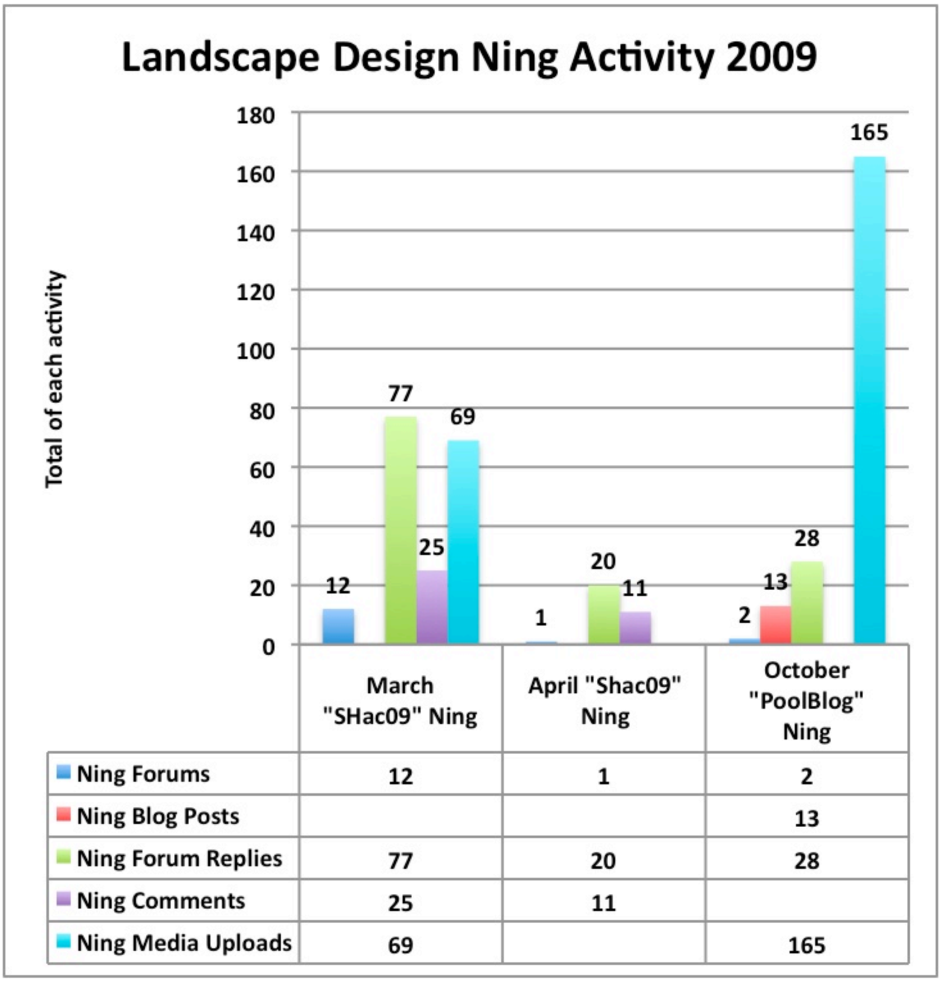
One of the keys to facilitating the 2009 Diploma of Landscape Design mlearning project was the formation and nurturing of an intentional community of practice, mediated by the use of wireless laptops (netbooks). This was in contrast to the noisy, shared fixed computer lab space that was utilized as the COP meeting place for the 2008 Diploma of Landscape Design mlearning project. The flexibility of learning space provided by a fully mobile computing environment was much more engaging for students, and more conducive to learning community development. This is illustrated in lecturer reflections on the semester one SHaC09 project below.

> We set ourselves up in the back of Long Black Café in an open learning situation with the notebooks around a big table. It seemed to work very well. They liked the access to food, they enjoyed the aspect of all getting together once a week to blog and it seemed to spur them on to get going independently as well. So all in all, a great project. (Diploma Landscape Design Lecturer, 20th May 2009)

The set up of the weekly support COP physical space was influential in the success of the project. The COP was held in an open space adjacent to a café, and at the beginning of the usual timetabled design studio session. Students were very enthusiastic about this, with full attendance at every session. The novelty of the group learning space, the learning of new elearning skills and the collaboration and interaction made possible by the Ning social networking site proved to be a successful combination.

5.3.2.2 Increased participation and engagement of the students

Participation in blogging and engagement with the SHaC09 project were observed by the lecturers to engage more students than a typical discussion mode in the face-to-face classroom. Lecturers observed a democratising effect when using web 2.0, noting that the communication was more anonymous and therefore less intimidating for certain students. Previous experiences had shown that the integration of the mobile web 2.0 technologies into the assessment was critical for student motivation. Therefore contributing to the Ning discussions was required as part of the project formal assessment criteria. All students participated in the group project postings, and all groups successfully produced useful research summaries for other groups to access.



	March "SHac09" Ning	April "Shac09" Ning	October "PoolBlog" Ning
Ning Forums	12	1	2
Ning Blog Posts			13
Ning Forum Replies	77	20	28
Ning Comments	25	11	
Ning Media Uploads	69		165

Figure 16: Landscape Design Ning activity 2009.

As Figure 16 indicates, the addition of the smartphones to the Pool Blog project increased the amount of student-generated content uploaded to Ning. Ning proved to be a useful hosting site allowing students and staff to blog, contribute to discussion forums, and upload photos, videos and text files. However lecturers commented that the many layers of interaction made it difficult to review the participation of each individual student, and Ning's interface was initially quite daunting for the participants. Scaffolding the students' cognitive load over a longer period of time so they can become comfortable with the tools before being required to use the tools in critical and reflective ways would help.

5.3.2.3 Enhancing group work

The course lecturers reflected that the use of web 2.0 for the SHaC09 project meant that students could engage with each other in their group project's through documenting and contributing to research updates on the project Ning site at any time and from any place. The use of web 2.0 also supported the multi-disciplinary dimension of the SHaC09 project as it allowed students from the collaborating different schools to read, comment and discuss online. Co-operation between groups and the sharing of information were enhanced by the flexibility and connectivity afforded by web 2.0. In three weeks the students were able to document a significant body of research on sustainable technologies and provide succinct summaries for other groups to refer to for their subsequent design process. The students were more enthusiastic about group work than in previous projects as they found out-of-class communication greatly aided by the use of web 2.0 tools. A transcript of a lecturer VODCast reflection posted to their blog highlighted the projects impact on student engagement and group work:

> They have been really effective in their research phase of their designs using the technology. They've used Ning extensively and we've been really impressed with the level of participation... They seem to really enjoy the ability to contribute to the discussions at any time digitally, and we had each group performing really well, the conversations between groups was good, and the multidisciplinary work with Design worked very well for us. So the group work was fantastic. (Diploma Landscape Design Lecturer, 20th May 2009)

Although the participation and research outcomes were achieved, the levels of design reflection were not high. This will prompt further refinement of the design brief for subsequent projects to develop closer integration of the blogs into the reflective design phase, in terms of both studio session planning and assessments.

Individual blogs rather than a single collaborative social network site (Ning) will be trialed for this purpose in the future.

5.3.2.4 Student Feedback

Analysis of the final student surveys and focus group feedback revealed several themes discussed in this section. Students found the netbooks easy to use, as they were already conversant with windows based. Students unanimously agreed that the wireless netbooks facilitated anywhere anytime learning and Internet access. The ability to access information via the Internet during classes was especially appreciated, as students' computer access was previously limited to shared labs that were more often than not busy. Several students commented that the netbooks facilitated better interaction with their classmates and lecturers for communication, collaboration and sharing, however most focused on the personal affordances of the devices and connectivity.

Table 29 provides a comparative overview of 2007 to 2009 student responses to the end of the mlearning project survey. The netbooks were used as the core mlearning device in 2009 as a response to the low engagement with the smartphone of the 2008 project group. While the netbooks provided a lower cognitive load for the students than the integration of the smartphones into the course, they also did not 'disrupt' (positively) students' perceptions of learning and collaboration as much as the smartphones did. Therefore the 2009 mlearning project relied mainly upon the affordances of web 2.0 tools to create the pedagogical shift from teacher-directed pedagogies to a social constructivist learning environment.

Table 29: Diploma Landscape Design student comparative feedback on mlearning experience 2007 to 2009.

End of project Survey Question	**Percentage Student agreement/satisfaction with statement (strongly agree plus agree)**		
	2007	**2008**	**2009**
4. What has been your experience of group work facilitated by Blogs and RSS?	75%	17%	40%
6. It was easy to use the WMD?	63%	33%	73%
7. This mobile learning experience was fun.	62.5%	33%	60%
8. Based on my experience during this project, I would use a WMD in other	50%	33%	67%
9. I would be willing to purchase my own smartphone?	50%	50%	20%
11. In your opinion, does mobile learning increase the quality of learning?	62.5%	17%	47%
12. Mobile blogging helped create a sense of community (group work)?	63%	33%	67%
13. Accessing your course blog was easy using the mobile device?	50%	17%	67%
14. Mobile learning increases access to education?	63%	33%	73%
15. Communication and feedback from the course tutor/lecturer were made easier?	75%	50%	67%
16. Mobile learning is convenient for communication with other students?	75%	50%	67%

The netbooks did not expose the 2009 students to the unique affordances of mlearning that smartphones facilitate, such as: anytime anywhere access to a quality built-in camera for student-generated content such as image and video recording, live video streaming/sharing of events, and student-generated contexts facilitated by geotagging and geolocation via a built-in GPS. Rather, student final survey and focus group feedback indicated that students viewed the netbooks mainly as tools for facilitating flexible learning spaces and convenient Internet access.

5.3.3 Implications for the Next Research Cycle

To achieve a higher level of course integration the Diploma of Landscape Design mlearning projects need to go beyond the established second year elective project to be staged and scaffolded across both years of the diploma programme. Beginning with a focus upon establishing students' eportfolio in the first year of the course, to the integration of student-generated content and student-generated contexts facilitated by WMDs in the second year of the course. The ontological shift required of the lecturers to enable this level of course integration is currently limited by a focus on implementation barriers that can be creatively overcome.

5.4 Case Study 1 Critical Success Factors

This section summarises the key lessons learnt from the 2007 to 2009 Diploma of Landscape Design mlearning projects.

5.4.1 Pedagogical Integration

The mobile web 2.0 project with the Diploma of Landscape Design was born out of a desire to provide flexibility and enable situated learning environments for students who are predominantly part-time, and to create authentic teams of students who work on real-world projects as part of their final year course. The course lecturer envisioned mobile web 2.0 tools as potential facilitators of this pedagogy, but required technological and pedagogical support to implement these ideas. In 2007 students used Nokia N80 smartphones to document and share their design for an exhibition garden at the annual Ellerslie Flowershow. The 2007 project highlighted the disruptive nature of mobile web 2.0 technologies (Sharples, 2000), and their potential to move teachers and learners from an instructivist to a social constructivist pedagogy (Cochrane, 2008g). The 2008 project integrated the use of smartphones for reporting a field-trip to Japan. The short-term nature of these projects and the wide-range of student experiences and capabilities in the increasingly mature and part-time student demographic of the course led to a rethink of the mobile web 2.00 integration in 2009, and a focus upon 3G enabled netbooks for creating student eportfolios. The choice of focusing upon WiFi and 3G netbooks for 2009 lowered the cognitive load for the students, but did not achieve the leveraging of the unique affordances of smartphones to bridge learning contexts. The course now needs to look beyond discrete projects and move towards complete integration across the programme to maximize the teaching and learning benefits of mobile web 2.0.

The integration of mlearning across the Bachelor of Product Design provides a model of course integration. The way forward for the authentic integration of mlearning into the Diploma of Landscape Design is to stage and scaffold the integration over the two years of the course. Thus starting in the first year with the integration of netbooks (or laptops) and web 2.0 tools to move the learning environment from teacher directed pedagogy to social constructivist pedagogies without too high a cognitive load on the students. Then integrating the use of smartphones into the second year of the course to leverage their unique affordances and facilitate further movement along the pedagogy to heutagogy continuum (Luckin, et al., 2008).

5.4.2 Lecturer Modeling

Modeling is a necessary aspect to the success of student engagement and how it occurs and the direction it takes. In addition, some discussions need to be stimulated or reignited to be kept alive or deserve some response or redirection, requiring lecturer participation (Laurillard, 2007). To engage at this level can be very time-consuming for lecturers, but this must be factored into these projects.

5.4.3 Creating a Supportive Learning Community

The use of an intentional COP model for supporting the pedagogical and technical issues for each mlearning project has worked well. The researcher has taken on these roles, and modeled this process to the course lecturers. As the course lecturers have gained experience and confidence they can become more independent of the researcher’s direct input, taking on the role of technology stewards themselves in future mlearning implementations. This is the goal of the approach, and it remains to be seen whether this is fully achievable.

5.4.4 Appropriate Choice of Supporting Technologies

Over the last three years mobile web 2.0 devices have been used to extend students access to social networking tools to support communities of practice around particular projects. The first was for a negotiated study course where students designed and built an exhibition garden for the Ellerslie Flower Show. The second was to integrate the moblogging project within an elective field trip to Japan. Significant benefits in student collaboration and reflection via the use of eportfolio assessment were gained in this project. The appropriate choice of WMD suited to both the particular requirements of the learning context and the preferences of each group of learners is critical for the success of the projects. WMD WiFi capability provides free connectivity while on campus, and the researcher has been working with the institutions IT department to ensure appropriate areas of the campus are covered by WiFi to facilitate the mlearning projects.

5.4.5 Technical and Pedagogical Support

The mlearning projects have helped transform the Landscape Design lecturers' perceptions of pedagogy, and also their willingness to engage with new technologies to enhance their students learning. This has been a significant process, starting with the course director being a participant in the first educational technology COP facilitated by the researcher in 2006. The integration of mlearning must be authentic and relevant to the learning context and to the particular learning environment as a whole (Herrington & Herrington, 2007, 2006b). Therefore capitalizing upon the unique affordances of the mlearning tools is very important. Without prior knowledge, or expertise with these mlearning tools, the lecturers can find this is rather difficult to assess, and are likely to take some trial and error to develop appropriate authentic assessments.

5.5 Chapter Summary

Chapter five has provided an overview and analysis of the Diploma of Landscape Design mlearning projects from 2007 to 2009. The Diploma of Landscape Design projects formed iterative action research cycles and the chapter described how each subsequent mlearning project was informed by the reflections upon the previous project. The lessons learnt from the first Diploma of Landscape Design mlearning project in 2007 were also used to inform the design of the Bachelor of Product Design and the Contemporary Music mlearning projects in 2008. The chapter draws out the practical impact of the mlearning implementation critical success factors that were identified in the literature review within the context of the Diploma of Landscape Design. The case study highlights the disruptive impact of mobile web 2.0 on tertiary education and the importance of technology support scaffolding mlearning integration.

6 CASE STUDY 2: BACHELOR OF PRODUCT DESIGN, 2008 TO 2009. (PEDAGOGICAL TRANSFORMATION AND CONTEXT BRIDGING)

This chapter introduces the research case study that explores the integration of web 2.0 and wireless mobile devices in a tertiary course: the Bachelor of Product Design at Unitec New Zealand. The chapter describes two iterations of mobile web 2.0 projects from 2008 to 2009, including: Bachelor of Product Design 2008 using Nokia N80 (Project outline in Table 10, section 4.4), Nokia N95 (Project outline in Table 13), and the Apple iPhone smartphones (Project outline in Table 14), and 2009 using the Dell Mini9 netbook (Project outline in Table 17), Nokia XM5800 (Project outline in Table 16), Nokia N95 and Nokia N97 smartphones (Project outline in Table 15).

The case study follows the transformation of pedagogy within the course from an initial project in the third year of the course in 2008 to integration across the entire three years of the course in 2009. The chapter explores how the introduction of mobile web 2.0 technologies into the Bachelor of Product Design programme have impacted, disrupted and transformed the established teaching and learning approaches. The Product Design mlearning project iterations illustrated the potential to transform traditional teaching approaches and introduce student-generated content and student-generated contexts via mobile web 2.0. Several scenarios are detailed illustrating this transformation, facilitating context bridging collaborative learning environments. Analyses of this case study have been published in various peer-reviewed papers (Cochrane & Bateman, 2009d, 2010a, 2010c; Cochrane, Bateman, Cliffin, et al., 2009; Cochrane, Bateman, & Flitta, 2009a, 2009b; Cochrane, Flitta, et al., 2009a).

The chapter is structured into a description of each project, followed by the identification and discussion of themes arising from each research cycle, and the design implications identified for the following cycle. This is repeated for each of the projects during 2008, and 2009. The chapter then draws together these themes to identify critical success factors related to the implementation of mobile web 2.0.

6.1 Pedagogical Change 2006 to 2008

The underpinning pedagogy chosen for the project was social constructivism, focusing upon students recording and documenting their learning collaboratively across multiple contexts using mobile web 2.0 tools. Social constructivist learning environments prepare students for the types of graduate capabilities and characteristics that are required by successful Product Designers. These were identified by course lecturers in the pre-project needs analysis (Appendix 13.5), including: the development of teamwork skills, collaboration, design documentation and sharing in an Internet connected world. Web 2.0 provides tools for a learning and teaching environment that facilitates social constructivism beyond the bounds of institutionally managed elearning systems (LMS's). Brown (2006) calls this "Dewey for the digital age, a profoundly social construction of understanding enabled by the Internet" (Brown, 2006, p. 23). Mobile web 2.0 adds the extra dimensions of context awareness (geotagging and geolocation), ubiquitous connectivity, mobile codes, student-generated content and student-generated contexts. Thus student engagement, collaboration and empowerment are facilitated (JISC, 2009a).

One of the key drivers for the introduction of mlearning into the course was the development of a flexible, context bridging teaching and learning environment. The following is a transcript from a video reflection (http://www.youtube.com/watch?v=jznHfb8dsvs) recorded by one of the Product Design lecturers at the start of a 2007 lecturer community of practice (COP) investigating the potential of mobile web 2.0 technologies.

> What do I want to get out of this community of practice? The first thing that I would say would be 'freedom'. As somebody who has 2 or 3 offices around the campus sharing with other people because I move around the campus a lot, and somebody who works from home and travels around a lot for Unitec – I want to be able to speak with my students and members of staff and basically connect with Unitec and other people and institutions with ease and freedom. So being nomadic and being able to roam around and not have to be in one place to communicate with students on a daily basis is really important. (Course lecturer, 2007)

Therefore the course lecturers were interested in investigating the mobility, ubiquitous connectivity and context-bridging affordances of WMDs to facilitate flexible communication and collaboration.

6.1.1 First attempts at pedagogical change 2006

In 2006 a mobile learning trial was implemented within one course of the third year of the Bachelor of Product Design programme (Project outline in Table 8) using Palm WiFi PDAs and web 2.0 tools such as Blogger.com and instant messaging (Cochrane, 2006c). This was the researcher's first attempt at the integration of mlearning within a tertiary course. From reflecting on the implementation of the 2006 project the researcher identified several limitations: there was little course integration, limited buy-in from course lecturers, limited campus WiFi coverage, no course time allocation for continuing technical or pedagogical support for the participants beyond an initial two hour introduction, no real sense of learning community developed, and the results effectively illustrated how not to approach mlearning. At the same time the researcher was developing a community of practice (COP) model for educational technology literacy in tertiary academics (Cochrane & Kligyte, 2007b). Product Design course lecturers were invited to form an intentional community of practice to investigate the use of web 2.0 tools within their teaching. While there were no formal changes made to the original paper-based portfolio implementation of the major project in 2006 as outlined in Table 30, reflections on the 2006 experiences informed subsequent implementation and research into mobile learning (Cochrane, 2007f, 2007g, 2007h). The 2006 trials were also used to develop and test the research questions and data collection instruments.

Table 30: Third year Bachelor of Product Design major assignment 2006.

Assignment Iteration	**Deliverables**
2006	• A report summarising all research undertaken and the key findings and insights. • All forms of prototype and test modeling i.e. 3D sketch models / ergonomic models / interface design wireframes / proof-of-concept working models, etc. • All drawings, sketches and CAD models.

6.1.2 Introduction of web 2.0 technologies and tools 2007

In 2007 one of the third year course lecturers integrated the optional use of web 2.0 tools such as blogging (via Wordpress) into the third year course using student-owned laptop and desktop computers. This integration was achieved with regular technological support from the researcher. Table 31 summarises the changes to the major assignment in 2007. Several advantages in moving to this learning environment were envisioned by the lecturer:

> Research shows us that there are 'far more dyslexic Art and Design students than we ever realized' (Hercules, 2001, p. 2) and that dyslexia raises many issues for studio-based teaching methodologies. By implementing the use of student reflective design journals as living, media-rich blogs it was hoped that these students would be engaged and empowered in their learning. (Course lecturer, 2007)

The implementation of educational blogging was achieved by modifying the major assignment deliverables from a paper-based report to an eportfolio in the form of an online blog, as outlined in Table 31.

Table 31: Third year Bachelor of Product Design major assignment 2007.

Assignment Iteration	**Deliverables**
2007	• A report summarising all research undertaken and the key findings and insights. • All forms of prototype and test modeling i.e. 3D sketch models / ergonomic models / interface design / proof-of-concept working models, etc. • All drawings, sketches and CAD models. • A project plan for Part Two of the Major Project • A blog that runs throughout your major project. You should post to your Blog regularly • Use your blog to collate project information and reflect on your design process. Also regularly comment on each other's blog posts – providing critique, feedback, and links to appropriate resources.

Table 31 indicates that the use of blogging was added onto the existing course outline without major reconceptualisation of the project goals, representing a first step in pedagogical reconception by the lecturer. The impact of this pedagogical intervention on the teaching and learning environment led to the establishment of a Product Design lecturer COP investigating the integration of web 2.0 and mobile web 2.0 into the course in the second half of 2007. The lecturer COP was then used as a model for supporting students participating in the 2008 mlearning project. Subsequently a general mlearning project outline for 2008 was developed by the researcher and presented for discussion with the course lecturers (See Mobile learning project Outlines 2008 http://docs.google.com/View?id=dchr4rgg_101wvprwjdp). This formed the basic plan for the 2008 Product Design mlearning project.

6.2 2008 Project: Introduction of Mlearning

Starting in February 2008, an explicit and integrated approach to mobile web 2.0 within the third year course was established. An outline of the project and participants is given in Table 13 in section 4.4.4 of the thesis. The focus of this project was the development of group product design teams formed between the students and external client product manufacturers. Students were to develop a commercially viable product for their assigned client. Student blogs and eportfolios (using http://www.vox.com) were used to record and reflect upon their design processes, and were made available to the client for comment and interaction. Two lecturers and nine randomly selected students were initially supplied with a Nokia N80 WiFi/3G smartphone and folding Bluetooth keyboard (Funded from a collaborative elearning project), which was later upgraded to a Nokia N95 smartphone when additional research funding was obtained. The researcher pre-configured the smartphones for the campus wireless network, and also installed a custom set of mobile web 2.0 applications. Participants were encouraged to personalize the smartphones and use them as if they owned them throughout the year of the course. Ethics consent forms and acceptable use policies were signed by all participants. Participants were also expected to attend a weekly COP exploring the integration of mobile web 2.0 into the course, comprised of the researcher, the lecturers, and participating students. Students used the smartphone for recording and uploading evidence of their design process and prototypes to their Vox blog and other online media sites such as YouTube for video, thus they became content producers and users, or 'produsers' as termed by Bruns (2007). Students were marked on the evidence of their design process and reflections embedded in their blog posts and web 2.0 media uploads, as well as their critique and reflection on other students' blogs via commenting. The smartphones were also used as a communication tool between students and with lecturers for immediate feedback via instant messaging, email and RSS subscriptions. Students were responsible for paying for a voice call and text message account but were reimbursed the cost of a 1GB per month 3G data account. WiFi Internet access on campus was free of charge.

6.2.1 Third Year Product Design 2008 Mlearning Project Outline

The third year major assignment was modified in 2008 (Compare Table 30, Table 31 and Table 32) to assist students to grasp and understand the complexity of the design process, facilitate social constructivist learning and integrate mobile web 2.0 tools within the student projects. The full assignment outline is available for viewing on Google Docs (Bateman & Cochrane, 2008), included here are the details of deliverables for 2008.

Table 32: Third year Bachelor of Product Design major assignment 2008.

Assignment Iteration	**Deliverables**
2008	• A report summarising all research undertaken and the key findings and insights. • All forms of prototype and test modeling i.e. 3D sketch models / ergonomic models / interface design / proof-of-concept working models, etc. • All drawings, sketches and CAD models. • A project plan for Part Two of the Major Project • A VOX blog/eportfolio that runs throughout this phase and the rest of the year. You should post to your Blog at least weekly (preferably daily). 1. Use your VOX blog/eportfolio to collate the above, and reflect on your design process. Also regularly comment on each other's VOX blog posts – providing critique, feedback, and links to appropriate resources. Your VOX blog/eportfolio should include the following: 2. An audio Podcast 3. A Video VODCast 4. Uploaded images (include geotags if possible – i.e. Google Maps links of image locations) 5. Text posts (Reflection, critique, process, summary, comments…) 6. Links to Web 2.0 multimedia site original content (for example: create your own accounts on YouTube, Flickr, Google Docs, Slide.com etc…) 7. Use shared Google Calendars for course events/dates. • Electronic communication will be via Gmail, MSN Messenger and RSS feeds (for example: via Google Reader or Newsgator).

Table 32 represents a major reconceptualisation by the lecturer of the integration of technology into the course when compared to their course outline in 2006 shown in Table 30. Feedback from the main course lecturer on the integration of mobile web 2.0 into the major project for 2008 was very enthusiastic, identifying the work involved in this change, and the benefits, including: increased engagement for both the lecturers and the students, and a reconception of design studio interaction.

> It isn't 'easy' working in this way but it is immensely valuable and exciting. I think that it would be very hard to go back to traditional teaching only methods now I have begun to use blogging and mobile blogging. (Lecturer, June 2008)

> Without the mobile devices (as in 2007) blogging was confined to the studio using laptops, so mobile blogging has changed the nature and engagement level! ... We are looking forward very much to continuing the learning process and seeing how we can reshape the face of studio, art and design education. (Lecturer, August 2008)

In addition to the third year major project, other third year Bachelor of Product Design courses were modified by the inclusion of mobile web 2.0 technologies, including the New Product Commercialisation (NPC) paper taught by a second Product Design lecturer. Table 33 provides an outline of the change in NPC assessment deliverables in comparison to the paper-based 2007 implementation and the 2008 implementation enhanced by mobile web 2.0.

Table 33: Third year Bachelor of Product Design NPC Assignment Changes.

NPC Assignment Iteration	**Deliverables**
2007	• One booklet that provides a concise overview of successful product development and commercialisation processes. This booklet must have high production values and must reflect the importance that design plays in this process (see letter that you have been sent to read more detail of what is required).
2008	• A blog that provides a concise overview of successful product development and commercialisation processes. The blog must reflect the importance that design plays in this process. • On a weekly basis and in addition to notes taken at each of the guest lectures, you must find an article that raises issues related to “New Product Commercialisation” (for example: NZ magazines Design and Business, such as IDEALOGY, BRIGHT, UNLIMITED), the article maybe directly relevant for example: the description of an NPC project, or it may simply raise issues that you can discuss in terms of NPC for example: the impact of imports, a clever marketing initiative, tax changes for R&D. • Using a blog as a means of communication, you will write a synopsis of the article followed by your own interpretation of the points raised in it (Around 500 words per post). The synopsis and comments are to be published in a blog along with a link to the original article either as a web link or magazine’s reference for the submission. Tag your NPC project blog posts (and any other relevant media you upload to your Blog – for example: supporting images, video, podcasts, embedded YouTube videos) with the tag word “NPC” to allow tracking and collation of your posts. You could also define an “NPC” collection within Vox. • Collaboration and interaction are important aspects of the project. Therefore each student will work with their group to refine their chosen article and any additional comments on it using the ‘comments’ feature of each other’s Blogs. The article will then be presented every week at the tutorial group sessions. It is expected that each member of the work-group will be familiar with the article and be able to assist the author in reporting back.

The two lecturers involved in the mobile web 2.0 implementation in 2008 became technology ‘evangelists’ to the rest of the lecturers in the course and began drawing them into the 2008 mlearning community of practice. Consequently, additional internal funding ($10080) to expand the mobile learning integration within the Bachelor of Product Design was successfully obtained for semester2 2008. Thus in semester2 of 2008, similar voluntary mobile web 2.0 projects were established in both the first and second year of the Product Design course as well.

6.2.1.1 Scaffolding the Learners

The intentional COP model for pedagogical and technological support for the integration and implementation of mobile web 2.0 initially used in the 2007 Landscape Design mlearning project was again used by the researcher and further developed for the 2008 Product Design mlearning project. Using this model the projects were guided and supported by a weekly community of practice (COP) facilitated by the researcher as the 'technology steward' as described by Wenger et al. (2009; 2005). This involved a weekly discussion and mlearning tutorial around a table in the students' design studio between the participating students, the Product Design lecturers, and the researcher. All participants, including the researcher, students and the lecturers created online eportfolios using a collation of mobile accessible web 2.0 sites (Illustrated in Figure 1, section 1.3). As students 'owned' these online spaces, they invited the course lecturers and the researcher into these spaces as neighbours within the community to participate and provide formative feedback. This enabled participation and lecturer expert modeling within a community of practice both face-to-face and virtually, facilitating sustained interaction and engagement of the participants throughout the length of the course. The mlearning projects were designed as collaborative projects involving the researcher, the course lecturers, and the students on the course, with feedback from the participants modifying the projects as needed. The institution's Learning Management System (LMS, Moodle) was used to provide scaffolding and support for both lecturers and students, hosting tutorials and resource links for the use of the smartphones and web 2.0 software. Lecturers were encouraged to model the use and integration of mobile web 2.0 in their own daily workflows and to provide regular formative feedback to students via posts on their blogs and other media. A ten minute video overview of the project process, including staff and student feedback focusing on the 2008 Bachelor of Product Design project, can be viewed on YouTube at http://www.youtube.com/watch?v=8Eh5ktXMji8 (Cochrane, 2008e).

6.2.1.2 Lecturer reflections on the impact of mobile web 2.0

Product Design lecturers were asked to provide reflective feedback on the impact of the mlearning interventions on their teaching practice and on their perceptions of the impact upon their students' learning and engagement. These reflections were captured as VODCasts, and as written answers to the following four questions.

Q1. What potential benefits do you see for mobile web 2.0 technologies to enhance teaching and learning?

Q2. Have you seen increased engagement in the course from students when using this technology?

Q3. What are the key issues to successfully integrating this technology into courses?

Q4. In what way has your teaching approach changed by using this technology and tools?

Indicative responses are available at https://docs.google.com/fileview?id=0B9kx7n-UKqvBMTNkNzY2ZWEtYzMyMS00YmVlLTg2MWItZThmMTQwNmYyYTZh&hl=en_GB. These lecturer reflections helped inform the identification of the critical success factors discussed in section 5.4.3.9, and are also discussed in a peer reviewed journal paper (Cochrane & Bateman, 2009d).

6.2.1.3 Blog, Survey and Focus Group Analysis 2008

The following themes were identified by the researcher from data analysis of the 2008 student blogs, student survey, and focus group feedback, which can be viewed at https://docs.google.com/fileview?id=0B9kx7n-UKqvBNWI3ZTI3NzMtYmI4Ny00ZjVjLTgxZDktNzJjNGYxOGJkYmY3&hl=en_GB. Although for the majority of students these projects were their first real experience of using web 2.0 tools in their learning environment, their feedback indicated they found it an enjoyable experience. They particularly valued the reflective and collaborative nature of blogging and the convenience of mobile blogging: "VOX creates a dialogue in real-time, with students and staff being able to comment and have input" (Third year Product Design student, 2008). While initially finding learning the various Smartphone interfaces daunting, students integrated their use into their everyday lives. Students particularly valued the ability to capture and record ideas and content using the smart phones' multimedia capabilities (Cochrane & Bateman, 2008b).

Feedback from students clearly related their desire (and expectation) of regular formative feedback from their lecturers on their progress at virtually anytime or anyplace. Students' also expressed the time intensive nature of regular moblogging and peer commenting, but unanimously (in 2008) preferred this approach to producing an essay or other more traditional assessment. Least valued by students was the ability to access course content on the smart phones. This is a reflection on the underlying pedagogy chosen for the projects (Social constructivism) where a conscious decision was made to focus on communication, collaboration and user generated content rather than re-purpose course content for small screens. The majority of students believed that the use of WMDs increased the quality of their learning experience, and students used the mobile device across a variety of contexts, making connections between these various learning contexts (both formal and informal) both convenient and explicit.

Compilations of 2008 student and staff VODCasts (Online video recordings) are available on YouTube:

- Bachelor of Product Design Year 1 (2008)
  http://www.youtube.com/watch?v=8QUfw9_sFmo
- Bachelor of Product Design Year 2 (2008)
  http://www.youtube.com/watch?v=6jwAFXBZAz0
- Bachelor of Product Design Year 3 (and Lecturers, 2008)
  http://www.youtube.com/watch?v=8Eh5ktXMji8

6.2.1.4 Example Context-Bridging MLearning Scenarios

Students used the mobile web 2.0 technologies to blog their assignment posts from virtually any context, effectively creating 'learner-generated contexts' as described by Luckin et al. (2008). As an example, four of the students decided to go on a mid-term 'research' trip to the snowfields of Queenstown, officially to test their prototype snow-kite harness designs. However, two of these students were scheduled to present their NPC research to the class that week. These students therefore recorded their NPC class presentations on their N95 smartphones while travelling, and uploaded the virtual presentations to their Vox blogs for the rest of the class and the course lecturer to view and comment on their presentations, in almost real-time. To 'prove' they were in Queenstown they also blogged mobile videos of their campervan situated in Queenstown scenery. Therefore the use of mobile web 2.0

facilitated a bridge between two physically separate learning contexts, illustrating one of the unique affordances of mlearning described by Vavoula (2007a).

During the second semester of 2008, a third year Bachelor of Product Design student decided to use the smartphone's camera to record still images and video podcasts outlining significant and iterative steps in his negotiated major project design process when designing a snow kite harness. This allowed the student to reflect and critique their design work and design methodology using visual media rather than simply creating a text-based book or online journal. This took place over the six-month product design project. Video clips were recorded on the N95 from the design studio on campus, from testing in the local park, and from test flights during two ski-field trips in the South Island of New Zealand. The course lecturers followed the student's blog posts, offering tips and design guidance while on campus, at home, and while attending overseas conferences. The video clips were later edited and compiled into a ten-minute video overview of the most significant design steps taken over course of the design project. The compilation video was then uploaded to YouTube and the student's blog for showcasing and sharing. Upon graduation the student continued to use his blog to track the further development of his major project through to commercialisation. Via his blog the student was able to regularly and easily update all of the stakeholders now involved in his project.

> Without the mobile technology I would have had to do a lot more writing, and because I don't like writing I suspect I would have skipped out a lot of my ideas – I have a lot of ideas and then I either discard or include them, and that's something I'm learning as a designer is to document my thought processes, its part of the design process so you can reflect on your decisions. So I found with the mobile technology, being able to pick up the phone, turn it on, video myself talking to it like it was a diary, sort of Captain Kirk style, that I can actually use the design processes that other people write, easier to do. So it made it easier for me to video my thoughts and feelings about the project. (Third year Product Design student, 2008)

A compilation of the student's VODCasts (2008) is available at http://www.youtube.com/watch?v=Y4QEvQURWtc.

A summary of the student presenting his experiences to 2009 students is available at http://www.youtube.com/watch?v=TSzPgeNDDBY.

This illustrates the affordances of mobile web 2.0 tools to facilitate user content creation and sharing, and context independent (ubiquitous and seamless) input from their lecturers, as emphasized as a critical element in mlearning by Laurillard (2007), creating a context-independent learning 'conversation'.

During the course of the year course lecturers attended conferences in three overseas countries: Japan, UK, and Spain as well as numerous New Zealand conferences in cities outside of Auckland. Lecturers used mobile web 2.0 technologies to share these experiences and stay in contact with their students from these countries and locations. These lecturer experiences were documented and reflected upon in a collaborative peer-reviewed journal paper with the researcher (Cochrane, Flitta, et al., 2009a). The use of mobile web 2.0 technologies allowed real time text, video and still images of the conferences, sites, design and architecture to be easily and immediately uploaded to the lecturer's blog for students to see and share in. The use of instant messaging and blog comments allowed students to remark on the posts, pose questions and request further information on the conference before the end of the visits. The use of mobile web 2.0 technologies allowed the lecturer, his fellow lecturers and students to stay in regular contact sharing comments and project concerns: in effect a 'virtual studio situation' was created. This supports Laurillard's (2007) assertion that "M-learning, being the digital support of adaptive, investigative, communicative, collaborative, and productive learning activities in remote locations, proposes a wide variety of environments in which the teacher can operate" (p. 172). Upon the lecturer's return, there was no need for time consuming catching up to take place and students were not significantly disadvantaged due to his taking time away from studio teaching.

6.2.2 MLearning Expansion

In the second semester of 2008 parallel mlearning projects were established across all three-year groups of the Bachelor of Product Design. Outlines of these three projects are provided in Table 10, Table 13 and Table 14 in section 4.4.4 of the thesis. The extension of the project into all three years of the course provided an opportunity for a comparative analysis of the results of these three mlearning projects. Students' previous technology experience was established at the start of each mlearning project via an initial survey (See Figure 17).

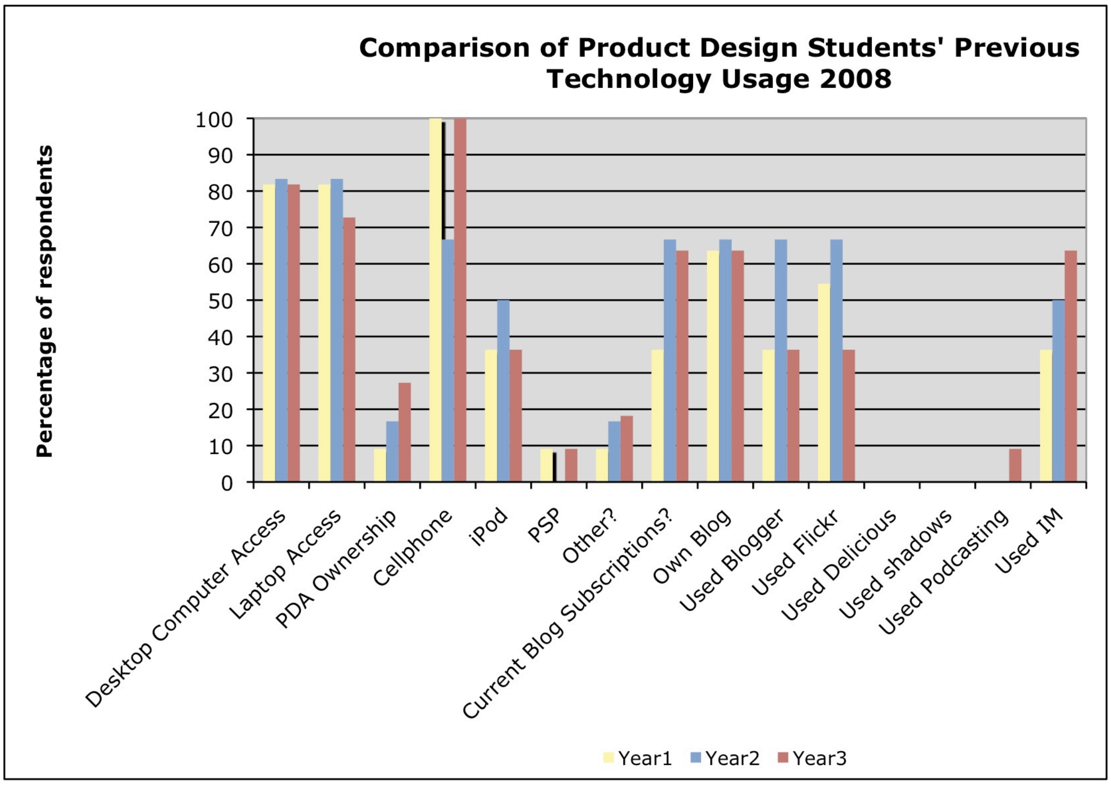


Figure 17: Comparison of Product Design 2008 students' previous use of technology.

Figure 17 indicates that participants in the three 2008 projects had similar previous experiences of mobile and web 2.0 technologies. While most participants were to some extent consumers of web 2.0 media, the majority were not previously involved in regularly creating web 2.0 content (for example: regularly blogging, uploading videos to YouTube). The Product Design course had established an ethos of student-owned laptops in second and third year. Therefore participant access to wireless laptops was relatively high, and cellphone ownership almost ubiquitous. Instant messaging usage was lower than expected, though this may be more to do with use within a learning context rather than social usage.

6.2.2.1 Comparative Staff feedback

Reflections on the impact of the 2008 mobile web 2.0 project from the Bachelor of Product Design lecturers were recorded as VODCasts and made available on YouTube.

- Third Year Lecturer, Part1: http://www.youtube.com/watch?v=irMZU1k-G4s
- Third Year Lecturer, Part2: http://www.youtube.com/watch?v=-WoAZjgPYM8
- First Year Lecturer: http://www.youtube.com/watch?v=0H8AvrrHQuQ

Transcriptions of these reflections are available at https://docs.google.com/fileview?id=0B9kx7n-UKqvBM2JlMjZjYjAtMjEzNi00MGVjLWJkMzEtMzkzMjViZGFkYmRm&hl=en_GB.

The third year lecturer was extremely positive about the evidence of transformation in both his students' engagement and level of critical reflection generated by the project, and the impact on his own pedagogical approach. No comments were supplied from second year lecturers, as they declined to participate. The first year lecturer focused upon the integration of web 2.0 technologies in the course assessment, and initially regarded the mobile affordances as an interesting addition rather than integral. However by the end of the project the first year lecturer was far more positive about the potential pedagogical affordances of mobile technology in the course.

6.2.2.2 Comparative Student feedback

This section briefly compares the student responses from the Product Design projects across the three year groups in 2008 to the end of project surveys.

Students were asked to describe what they used the smartphones for (beyond moblogging for assignments). Their answers displayed a wide variety of integration of the smartphone's capabilities into their daily learning, work, and social lives. Student feedback indicated the variety of ways students appropriated these tools and what they valued. The connectivity, ability to capture events and ideas, and opportunities for formal and informal feedback from peers and lecturers feature highly in student expectations and experiences. These expectations have vital implications for the impact on lecturer integration of the tools and workload perceptions. Transcribed indicative student feedback is available at https://docs.google.com/fileview?id=0B9kx7n-UKqvBMDk2Y2ZhYzctZTk2My00YzhkLWI3ZWYtOGQxMjE5YWJkZjE5&hl=en_GB.

Table 34 gives a comparative overview of the three groups of students' feedback gathered from the final survey at the end of each project.

Table 34: Comparative Product Design 2008 student survey feedback.

End of project Survey Question	**Percentage Student agreement/satisfaction with statement (strongly agree plus agree)**		
	Year1	**Year2**	**Year3**
4. What has been your experience of group work facilitated by Blogs and RSS?	100%	66%	80%
6. It was easy to use the smartphone?	58%	83%	90%
7. This mobile learning experience was fun.	86%	100%	90%
8. Based on my experience during this project, I would use a smartphone in other courses	56%	66%	90%
9. I would be willing to purchase my own smartphone?	43%	50%	80%
11. In your opinion, does mobile learning increase the quality of learning?	43%	67%	60%
12. Mobile blogging helped create a sense of community (group work)?	43%	33%	60%
13. Accessing your course blog was easy using the mobile device?	56%	66%	50%
14. Mobile learning increases access to education?	70%	66%	80%
15. Communication and feedback from the course lecturer/lecturer were made easier?	43%	16%	70%
16. Mobile learning is convenient for communication with other students?	42%	66%	70%
AVERAGE:	**54%**	**62%**	**75%**

Table 34 indicates that the third year students reported the highest level of satisfaction with the mlearning project and its impact on their learning environment. Reasons for this are discussed in the themes arising for 2008. Virtually all of the students enjoyed the experience and saw significant benefits from it. The most obvious feedback differences involve the impact of the mlearning projects on the development of learning communities and communication between students and lecturers. First year students were dissatisfied with the iPhone's inability to record video and the low quality of the built-in camera. These affordances were perceived as invaluable for recording students' design processes and steps.

6.2.3 Themes Arising

This section expands on the implications of the results from the three mobile web 2.0 projects described above, focusing on the critical success factors in mlearning implementation that the research has indicated. Based on the experiences gathered from the eight mobile learning projects from 2006 to 2008 (Cochrane, 2006c, 2007j, 2008b) the researcher short-listed several critical success factors:

1. The level of pedagogical integration of the technology into the course criteria and assessment.
2. The level of lecturer modeling of the pedagogical use of the tools.
3. The use of regular formative feedback from both Lecturers and student peers.
4. Appropriate choice of mobile devices and software.
5. Technological and pedagogical support.

These success factors were measured against:

1. The level of student engagement and satisfaction achieved – as evidenced in evaluative surveys and focus group feedback.
2. The level of moblogging achieved by students in the courses.
3. Lecturer reflective feedback.

These are explored in the following section, and in the feedback and results of the three 2008 Product Design mlearning projects described herein.

6.2.3.1 The level of pedagogical integration of the technology into the course criteria and assessment

Focus group feedback from the third year lecturers identified assessment integration as a key issue:

> We ran a 2007 project that did not carry an assessment weighting and the uptake was lower than for this 2008 project where assessment of the blog was embedded. It makes sense that students want to receive credit for doing something that takes time, focus and commitment. (Third year lecturer, 2008)

Third and first year students enjoyed using their blogs and mobile devices as part of their courses, however second year students enjoyed the social aspects of mlearning but a lack of integration into the course assessment by the second year lecturer limited its perceived importance. While moblogging was seen as a relatively time intensive activity, students saw many benefits from changing previously paper-based journal type assessment activities into collaborative multimedia eportfolios. Students also appreciated the level of context flexibility that the WMDs provided, with many students blogging from home or sites of research rather than having to be in a face-to-face studio environment. As illustrated in section 6.2.1.4 students used the mobile web 2.0 technologies to blog their assignment posts from virtually any context.

6.2.3.2 The level of lecturer modeling of the pedagogical use of the tools

Focus group feedback from third year lecturers identified lecturer participation with the technology as a key issue.

> It is vital that staff participate in the blogging process and run their own blogs alongside the student ones. Students want to see that staff are visiting the blogs and commenting on posts as well as offering links to sites where students can pick up information that might assist

> them with their projects. This doesn't mean staff are required to comment on all posts but reading the blogs is important as students will often ask 'So what did you think of my last post then?' (Third year lecturer, 2008)

Third year lecturers demonstrated a high level of integration of the mobile web 2.0 technologies into their daily workflows, constantly carrying the N95 and Bluetooth keyboard with them, checking student blog posts, posting regular formative feedback, no matter where in the world they were (See examples in section 6.2.1.4 of this chapter earlier), and highly valuing the weekly mlearning community of practice sessions.

For the second year students the disengagement of their course lecturer from the project was alleviated by the input from the researcher, who became a surrogate modeler of the use of the technology. But this did not fill the learning context void. Student focus group feedback indicated that they were aware of the level of involvement and feedback to students of the third year lecturers, so they could see the potential of the pedagogical integration of mlearning within the course, but did not experience it themselves.

The first year lecturer embraced the use of web 2.0 tools within the course using group blogs and online media sites to record student group work, but was more hesitant in integrating the use of the iPhone into their workflow or social life. After experimenting with the iPhone for a couple of weeks the first year lecturer abandoned its use preferring to continue using their Blackberry smartphone, predominantly as a mobile email device. Interviews with the lecturer and focus group feedback identified the key issues with the iPhone for the first year lecturer were its lack of video recording, and the inability to synchronise the iPhone to the institution's push email system. Additionally the first year lecturer did not wish to utilise instant messaging, did not regularly maintain their own blog, and refused to engage with students' blog posts beyond the stated assessment criteria. This was because these activities were perceived to be additional work for the lecturer, rather than approaching these activities as ways to work more flexibly as the third year lecturers had done. Therefore, in comparison to the third year lecturers, there was a lack of personal appropriation as described by Carroll et al. (2003) of the technologies by the first and second year lecturers, and Table 34 illustrates this clearly influenced the appropriation of the technologies by their respective students as well.

6.2.3.3 Creating a supportive learning community

A common theme in student focus group and survey feedback from all three projects in 2008 was their desire to receive more formative feedback by way of comments on their blog posts from their lecturers. Additionally students requested more peer commenting on their blogs. This is a culture or practice that needs to be established within the community of practice supporting the mlearning projects.

Failing the use of the WMDs by the second year lecturers, students in the project developed a strong sense of community among themselves and with the technology steward (the researcher) but achieved little course integration. In comparison, third year students described mobile web 2.0 scenarios beyond social use, modeled and driven by their lecturers, illustrating how they integrated the technologies into multiple learning environments, while also critiquing and collaborating with their peers.

6.2.3.4 Appropriate choice of mobile devices and software

Comparing the response observed by the researcher of different student groups to a variety of smartphone across the mlearning projects so far, the choice of smartphone for student buy-in to the mlearning projects has been found to be critical. The smartphones need to fulfill the core affordances of mlearning projects as well as be perceived as 'cool' items by the students. Students became personally identified with the use of their smartphones. This is aptly illustrated by a poem created by another third year student about returning to use their old cellphone after returning the N95 at the end of the 2008 year. This was recorded by the student using their N95 and then uploaded in the form of a YouTube video (http://www.youtube.com/watch?v=o91eCF3mB44) on the eve of returning their N95:

Mourning the N95

"This is what I am left with!
It cannot…
Take Photos
Email
Check the wind
Make videos
Be my friend
Tell me where Ennismore Rd is
Or how to get there
Take more photos
Do other Internet things
Film this
Be my calendar,
Reminder,
Or memory
(I have a bad memory)
The screen on this is tiny
There is no -
Sports tracker
Bouncy ball
Keyboard
VOX

Location Tag
YouTube
Plus all the rest
I miss my N95
Everything else
Doesn't
Cut
It"

The iPhone was perceived to be less relevant to the Product Design course than the Nokia N95's because of it's lack of video recording capability, and as such the first year students did not tend to personalise its use as much as the second and third year students did the N95s. The iPhone experience was also coloured by students' experience of Vodafone support while initially setting up their voice and data plans. Many Vodafone retailers were unaware that the iPhone was capable of working on any voice and data plan in New Zealand and attempted to push students into expensive iPhone only contracts. The iPhones have however been used very successfully within mobile web 2.0 projects with Diploma of Contemporary Music students with the researcher (Cochrane, 2008a; Talagi, 2008) where they were more of an appropriate match to the requirements of the teaching and learning context, and the Macintosh based computing environment used in this course.

6.2.3.5 Technological and pedagogical support

The use of an intentional community of practice (COP) model for supporting and facilitating the mobile web 2.0 project was very successful from both the students' and lecturers' perspectives. However integration of mlearning into the courses has been observed by the researcher to be predicated on the lecturers' engaging in a community of practice with the researcher and the students. This was the major flaw with the second year project, where the course lecturer did not join the mlearning project COP in 2008, and thus the pedagogical integration of the mobile web 2.0 technologies was not achieved. However, those lecturers who did engage were very enthusiastic about the results becoming core members of the community of practice, but failed to draw the second year lecturers beyond the periphery of the group.

6.2.4 Implications for the Next Research Cycle

Reflections on the identified critical success factors were used to modify the design of the 2009 mlearning projects within the Product Design course. In order to address first and second year lecturer modeling of the pedagogical use of the technology, the 2009 mobile web 2.0 projects were timetabled to provide explicit time and support for lecturers to learn the use and daily integration of the mobile devices before beginning the projects with their students. A smaller subset of mobile web 2.0 affordances was also focused upon to keep the learning curve from being as steep as in the 2008 projects (see Table 35). Thus a staged and scaffolded approach to the introduction and integration of mobile web 2.0 technologies into the course was developed across the three years of the course for 2009 (See Table 36), explicitly aiming to use the integration of mobile web 2.0 to facilitate the staged transformation from pedagogy to heutagogy (Luckin, et al., 2008; McLoughlin & Lee, 2008) across the entire length of the course, culminating in the exploration of the context-bridging affordances of mobile web 2.0 to facilitate collaboration and to create a virtual ‘nomadic’ third year design studio beyond the face-to-face classroom.

6.3 2009 Project: Mlearning Integration

Following the enthusiastic response from the students and lecturers involved in the 2008 mlearning projects, internal institutional funding was sought, and approved, for extending these small projects to a major large-scale mlearning project in 2009 involving the use of 250 smartphones, and 200 netbooks across the institution. What began as an investigation of the affordances of web 2.0 in Product Design in 2007 developed into a mobile web 2.0 proof of concept project within the third year of the Bachelor of Product Design in 2008. The project then quickly spread to projects within the first and second year of the programme in semester2 of 2008. The success of these projects led to the implementation of integrating mobile web 2.0 technologies (based on an explicit social constructivist pedagogy) across all three years of the programme in 2009 (http://www.youtube.com/watch?v=8Eh5ktXMji8).

In response to four reflective questions posed by the researcher to the Product Design lecturers at the end of the 2008 mlearning projects, participating lecturers noted that the integration of mobile web 2.0 within the course significantly engaged students and provided the basis for a flexible, context bridging learning environment. Thus the Product Design lecturers, along with the help of the researcher, planned the integration of the use of mobile web 2.0 tools across all three years of the course for all Product Design students and lecturers in 2009. While it was believed that a student-owned smartphone model was the best ultimate approach, it was decided to take another year of seeding the integration of mobile web 2.0 into the programme before this was fully feasible. The cost of both the smartphones and mobile data dropped significantly during 2008 and 2009, and a variety of funding models will be explored for 2010 and following.

Focus group feedback from participating students in 2008 indicated that the coverage of mobile web 2.0 affordances during the 2008 COPs was too broad, presenting a high cognitive load (Kirschner, 2002; Valcke, 2001) for the students. Students were overwhelmed by the options available in the timeframe provided, and preferred to focus on fewer affordances, and learn to use them well. Therefore specific mobile affordances were chosen and utilised as a focus of the 2009 Product Design course (See Table 35, the tinyurls reference Educause "7 things" series of articles on each technology).

Table 35: Affordances of smartphones mapped to social constructivist activities.

Activity	Overview	Examples	Pedagogical focus
Video Streaming	Record and share live events	Flixwagon, Qik http://www.qik.com	Student generated content and collaboration.
Geo tagging	Geotag original photos, geolocate events on Google Maps	Flickr, Twitter, Google Maps http://tinyurl.com/5a85yh	Metacognitive, adding metadata to content and events
Micro-blogging	Post short updates and collaborate using micro-blogging services	Twitter http://tinyurl.com/2j5sz3	Community building via asynchronous communication and collaboration
Txt notifications	Course notices and support	Txttools plug-in for Moodle and Blackboard	Scaffolding, learning and administrative support
Direct screen sharing	Video out to video projector, or large screen TV	Microvision Show http://tinyurl.com/celgot	Student presentations, peer and lecturer critique.
Social Networking	Collaborate in groups using social networking tools	Vox groups, Ning, peer and lecturer comments on Blog and media posts http://tinyurl.com/4uz6rj	Formative peer and lecturer feedback.

Students' core activity was again situated around a reflective blog that was accessible via mobile devices, and provided a key source of participant reflections. Students' Vox Blogs were planned to become reflective journals of their design processes and learning throughout the year, as well as building up a showcase of their Product Design capabilities for example:

- Their ability to critique as well as be creative
- Their ability to communicate, collaborate and convey ideas
- Their ability to work with new technologies as part of the process (mobile web 2.0 being core in enabling this).

Students' Vox blogs also became a 'hub' for aggregating (Collating) web 2.0 media from other sites as indicated in Table 35, such as: Flixwagon, Qik, YouTube, Flickr, and Picasa.

In order to achieve an explicit move to a social constructivist learning environment using mobile web 2.0 tools in 2009, a staged, and scaffolded approach was adopted. The 2009 project implementation was influenced by reflections upon the 2007 and 2008 mlearning projects, and also the developing conceptualizations of mlearning drawn from the emergence of learning theories based broadly upon social constructivist foundations. These included: Authentic learning (Herrington, et al., 2008), Pedagogy 2.0 (McLoughlin & Lee, 2008a), Learner Generated Contexts and the Pedagogy, Andragogy, Heutagogy (PAH) continuum (Luckin, et al., 2008). The planned staged approach therefore allows the bridging of the PAH continuum, and the embedding of mobile web 2.0 affordances that support each stage. Therefore the integration of mlearning (mobile web 2.0) across the three years of the Bachelor of Product Design programme in 2009 was structured as in Table 36:

Table 36: Scaffolding the rollout of mobile web 2.0 throughout the Product Design course.

Implementation Stage	**Web 2.0 Tools**	**MLearning Tools**	**Course Timeframe and focus**	**PAH alignment**
Level 1	Social Collaboration with peers and lecturer.	Introduction of netbooks and establishment of basic web 2.0 sites	Semester1, Year1 Blogging	Pedagogy
Level 2	Student generated content.	Netbook plus mid-range smartphone (Nokia XM5800)	Semester2, Year1 Student VODCasts, geotagging, moblogging	From Pedagogy to Andragogy
Level 3	Social collaboration with peers and external 'clients'. Context Aware	Student-owned laptop plus mid-range smartphone (Nokia XM5800)	Year2 Social networking, Mobile Codes, Geolocation	Andragogy
Level 4	Context Independent. Student generated contexts.	Student-owned laptop plus high-end smartphone (Nokia N97)	Year3 Microblogging, facilitation of 'virtual studio', location recording	From Andragogy to Heutagogy

This explicitly scaffolded approach to the integration of mlearning across the three years of the Bachelor of Product Design programme was implemented in 2009. Participants in the 2009 mlearning project encompassed the entire three years of the Bachelor Of Product Design course as outlined in Table 15 to Table 17 in section 4.4.5. Integration across all three years of the course allowed staging of the pedagogical and technological changes required to integrate these tools, beginning with a focus upon lecturer-directed (pedagogy) student eportfolios in first year, followed by student-generated content (Andragogy) in second year, and student-generated contexts (towards heutagogy) in the third year of the course.

6.3.1 Third Year Product Design Mlearning Projects 2009

The third year Product Design 2009 mlearning project is outlined in Table 15, section 4.4.5.

6.3.1.1 SHaC09

The first project planned and implemented for 2009 involved collaboration between several departments at Unitec including Landscape Design and the third year Product Design. The project was titled "SHaC09". An introduction to the SHaC09 project can be found in section 5.3.1.1 where it is outlined as part of the 2009 Diploma of Landscape Design mlearning project.

Justification of the integration of mobile web 2.0 into the third year Product Design course was based upon the results of the previous projects and the changing nature of the needs of Product Design graduates. A change in pedagogical approach to the third year studio environment was facilitated by the project. This pedagogical change within the course was described by the lecturers as part of the 2009 project planning, and reflected upon in a collaborative conference paper (Cochrane & Bateman, 2010e).

> The standard Atelier Method or studio teaching environment of one communal space and one timetable is unlikely to offer the best support and learning opportunities for today's creative students; it does not mirror the 'real contemporary world'. Over the last two to three years, the introduction of mobile web 2.0 tools into the Bachelor of Product Design has facilitated significant flexibility for students allowing them to stay connected, share their ideas widely, participate in world wide creative communities and choose to work in virtually any context on and off campus. (Course lecturer, 2009)

Therefore throughout the duration of the final year of Product Design in 2009, students were required to integrate mobile web 2.0 into their studio practice. Students and lecturers were provided with smart phones (Nokia N95 during semester one, upgraded to Nokia N97 smartphones for semester two) and participated in a weekly community of practice that focused on understanding and experimenting with mobile web 2.0 tools and technologies. Whereas in 2008 students were given a 1GB data plan for the duration of the course, in 2009 they were required to fund the data and voice connection plans themselves, while Unitec provided free WiFi Internet access on campus.

Collaboration and communication were key aspects of the SHac09 project. To this end product design students participating in ShaC09 were required to manage their internal (with product design staff) and external (with Landscape, Communication and UATI staff) communications rigorously. Face-to-face modes of communication were augmented with the use of mobile web 2.0 technologies to enable real-time updating of project progress and issues.

Product design students worked in one of five product design groups each of which focused on a specific SHaC09 design challenge. However, the final designs they created and presented were to be arrived at individually and individually assessed. Students were required to carry out aspects of research in their group, sharing information via group meetings and web 2.0 tools. Students were required to use their Vox blog/eportfolio to collate their SHaC09 project outputs, and reflect on their design process. They were also required to regularly comment on each other's Vox blog posts, providing critique, feedback, and links to appropriate resources.

6.3.1.2 Nomadic Studio

A second project developed for the third year Product Design students in 2009 was entitled the "Nomadic Studio", and attempted to move students and lecturers even further along the PAH continuum (Luckin, et al., 2008) towards heutagogy or independent student learning. An outline of the nomadic studio is given in the following section.

During 2009 students were required to undertake a regular ‘nomadic’ session where they worked away from the studio, but continued collaborating and learning conversations via mobile web 2.0 connectivity. Web 2.0 tools were thereby integrated into both the face-to-face and online environments, facilitating a pedagogy that enabled students to engage with peers, instructors, and the community in creating and sharing ideas. This was a similar approach to McLoughlin and Lee’s (2008a) use of social software to transform pedagogy. Throughout the SHaC09 project, data sharing was enabled through a range of web 2.0 software applications. Staff and students made project work and resources available to the rest of the world online, via blogs, wikis and other web 2.0 applications. Moving further away from the Atelier Method critiqued by Brown (2006) and building upon the work carried out in 2008, the research focus for 2009 was on the seamless integration of web 2.0 into the Bachelor of Product Design as well as augmenting the level of flexibility for students to allow them to choose to work in virtually any context on and off campus. During the ‘nomadic’ studio session students were expected to:

- Be online via MSN or following their tutor and classmates on Twitter
- Make at least one relevant Blog post summarising their work
- Upload some multimedia content capturing what they are doing, for example: a Qik or Flixwagon video stream, a recorded VODCast, geotag and upload a photo to Flickr.

6.3.2 Second Year Product Design Mlearning Projects 2009

The 2008 mlearning project within the second year Bachelor of Product Design course was a voluntary project undertaken by a small group of students within the course, and was not integrated into the course assessment or appropriated (Davis, 1989; Delaney, Timbrell, & Chan, 2008) by the main course lecturer. While they enjoyed the experience, students' feedback indicated their preference for integration into the course assessment and modeling of the use of the technology by the course lecturers. Thus several brainstorming sessions were held between the researcher and the main second year course lecturer to identify appropriate projects and assessment strategies for integrating mobile web 2.0 into the course for 2009. The second year Product Design 2009 mlearning project is outlined in Table 16, section 4.4.5.

While the third year mlearning projects aimed to move students towards a heutagogy-based (self-directed) learning environment, the second year mlearning projects aimed to move students to andragogy (student-centred, adult learning). It was decided to stage the implementation of mlearning across semesters one and two, scaffolding students technical and pedagogical support via a weekly COP, this time involving the course lecturer as well as the students and the researcher.

6.3.2.1 Mammography Gown Design 2009

This second year project involved the students researching and designing a new ergonomic and patient-focused gown for mammography patients commissioned by the Auckland District Health Board. The project focused upon facilitating student personal reflection on the design process via individual Vox blogs, student peer group work via Vox groups, and sharing this design journey with the external client and stakeholders for real-world input and critique via a lecturer-created Ning social network. The project culminated with a cat-walk fashion-show presentation of the final student gown designs, and reflections on the process recorded via mobile video, uploaded to the students' blogs or YouTube channels. Students created their own blogs using Vox (or revived their existing Vox blogs that they had used in year one of the course during the 2008 mlearning project). Students then created groups within Vox and invited each other as group members as well as the researcher and the course lecturer. Finally the course lecturer created an invitation-only Ning social network, and invited the students, researcher, and external stakeholders to become members of the gowndesign Ning site (http://gowndesign.ning.com/).

6.3.2.2 CAD and MANTECH Projects 2009

The second year CAD and MANTECH projects utilized Google Docs (http://docs.google.com) for students to create and share collaborative reports of their work, and then embed these into their Vox blogs for feedback from the lecturer. Project outlines were collaboratively developed by the lecturer and the researcher using Google Docs. Thus the researcher modeled the use of the web 2.0 tools to the lecturer prior to rollout with the students. Students were also encouraged to use the affordances of the smartphones in enhancing these documents with geotagged images and QR Codes for mobile-friendly web links for reading the docs on their smartphones.

6.3.3 First Year Product Design MLearning Projects 2009

This section outlines the implementation of the mlearning model in the first year of the Bachelor of Product Design in 2009 that was informed and driven by social constructivist pedagogies, with a scaffolded approach to transform the learning environment from lecturer-centred (pedagogy) to student-centred (andragogy), while maintaining the critical pedagogical guidance of the lecturer as emphasized by Laurillard (2007) and McLoughlin and Lee (2007). The first year Product Design 2009 mlearning project is outlined in Table 17, section 4.4.5.

The first year implementation focused on the first stage in this transformation, facilitating student-generated content and collaboration (Bruns, 2007). Examples of assessment alignment and integration of the mobile web 2.0 tools within the course are outlined. The following provide practical examples of how the integration of mobile web 2.0 tools were achieved within the first year Product Design course in 2009.

Students and lecturers were provided with a WiFi and 3G capable netbook for the first semester (Dell Mini9). At the end of the first semester the students and lecturers were also provided with a WiFi and 3G capable smartphone that integrated a 3.2MP (megapixel) camera, video recording, GPS, touchscreen for text input, and multitasking operating system for a variety of Symbian based applications. Students and lecturers were encouraged to personalise the use of these mobile devices and treat them as if they owned them for the duration of the year. The 2009 first year mlearning projects focused primarily on students establishing and personalizing the use of core web 2.0 tools that could then be built upon more explicitly in the second year of the course where the focus moves to mobile specific affordances. The focus was therefore more upon the use of the netbook than the smartphones during the first year course, establishing students' web 2.0 eportfolios that are then built upon in the following year. The following sections outline the first year projects.

6.3.3.1 Semester1 Ergonomics Assignment (Year1, 2009)

The goal of this assignment was for students to take into account the user, the product and the context of use within a product design project. The project was designed to give students an introduction to conducting a controlled research project and prototyping test rigs to measure quantitative and qualitative data. Students used their supplied netbook to create and establish an online journal/blog (http://www.Vox.com) of their design investigation. Students invited their peers, lecturers, and the researcher (as the technology steward) into their 'neighbourhood' to facilitate sharing, commenting and critiquing, creating a virtual collaborative learning environment to augment the traditional face-to-face studio environment. Thus students used web 2.0 tools for social collaboration within their course, but also had the opportunity to share this process and content with a potentially worldwide audience. These blogs then become the core of students' online eportfolio that will be developed over the next three years of their course.

6.3.3.2 Semester2 PIC2 Assignment1, 2009

Practice and Context 2 (PIC2) introduces students to some of the key exponents in contemporary product and furniture design history that help make up the textural fabric within which they will operate as practitioners. This assignment was ideally suited to students using web 2.0 tools to explore and document key historical and current influences on their field of study. Students used their blog, accessed via the netbook, and uploaded photos (geotagged via the smartphone), video reflections and other original material captured using their smartphones. Thus the focus was upon shared student-generated content, as described by Bruns (2007), and critiques by their peers and lecturers.

6.3.3.3 Semester2 PIC2 Assignment2

The second assignment built upon the processes and affordances of web 2.0 that students built up during the first PIC2 assignment. This assignment focused upon student-generated content (Bruns, 2007; Evans, 2005; Johnson, et al., 2007), and the students used web 2.0 tools to present to the rest of the class and the course lecturers, leveraging collaborative presentation tools to promote student engagement as recommended by Lomas et al. (2008).

6.3.4 Themes Arising

A comparative analysis of student activity and feedback across the three year-groups of the 2009 Product Design course provides a basis for critiquing the staged implementation of mlearning integration into the course in 2009.

6.3.4.1 WMD Appropriation and Lecturer Modeling

The following three graphs (Figure 18 to Figure 20) represent the mobile usage surveys that students in each of the courses submitted.

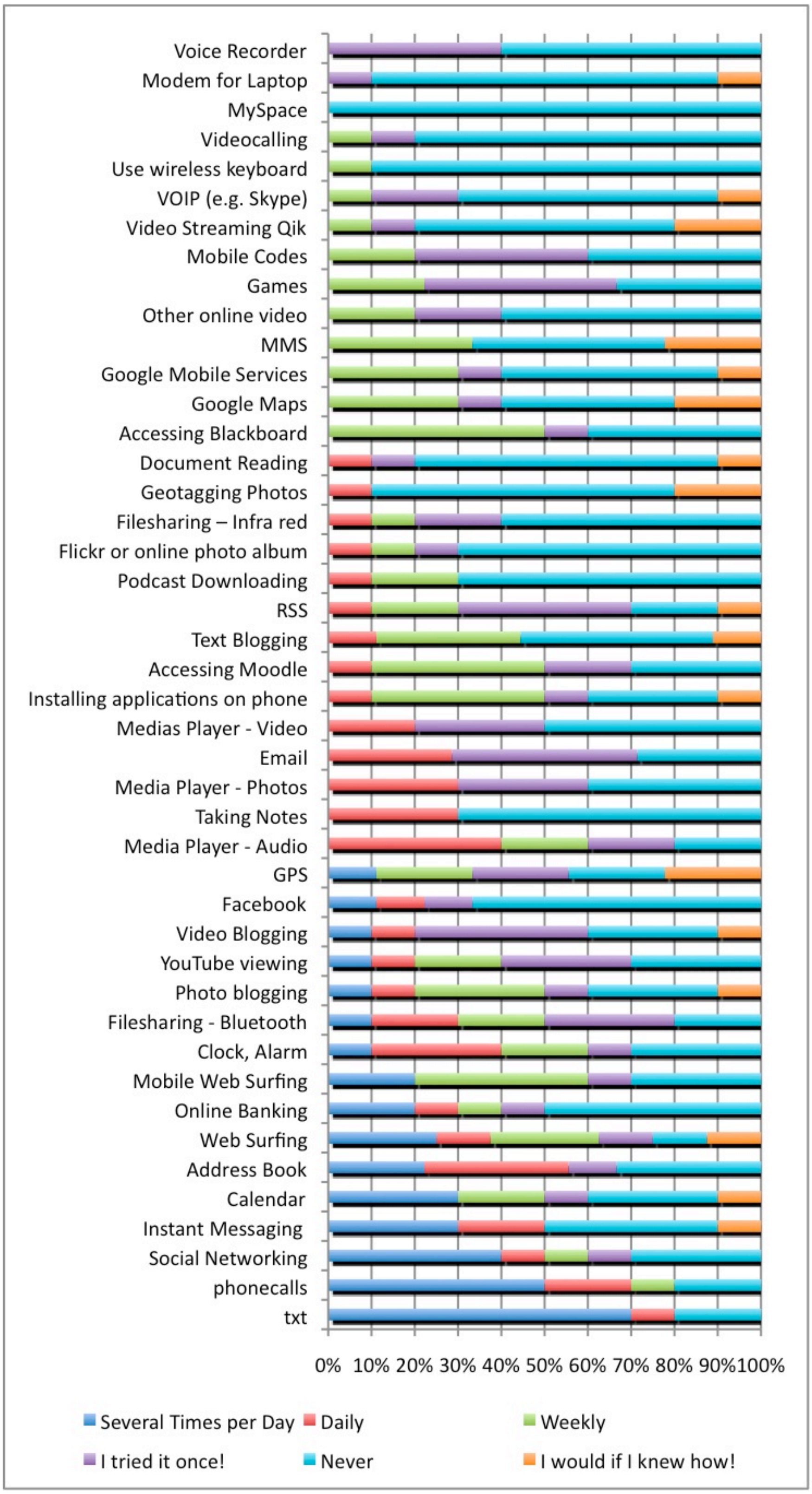


Figure 18: First year Product Design student mobile usage 2009.

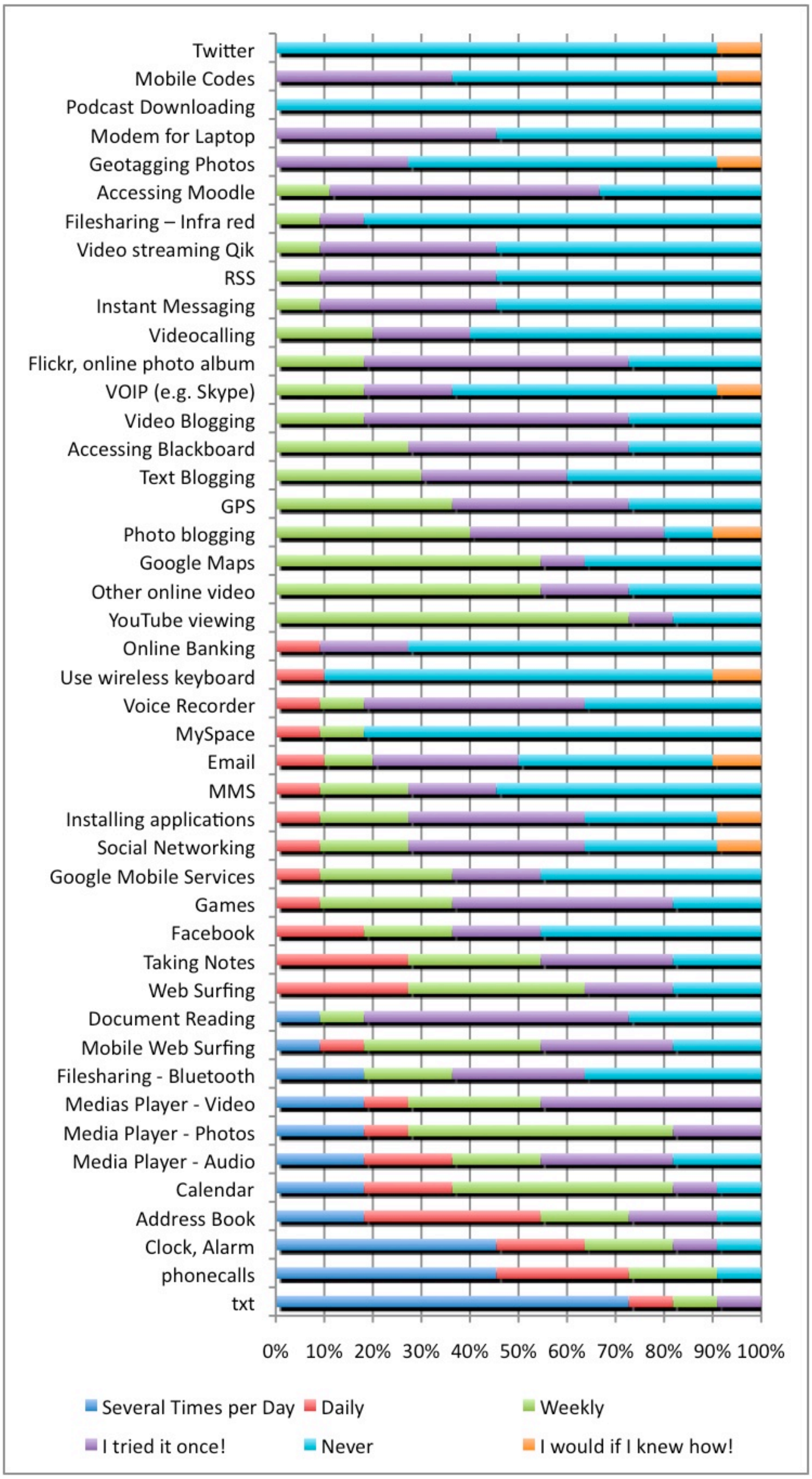


Figure 19: Second year Product Design student mobile usage 2009.

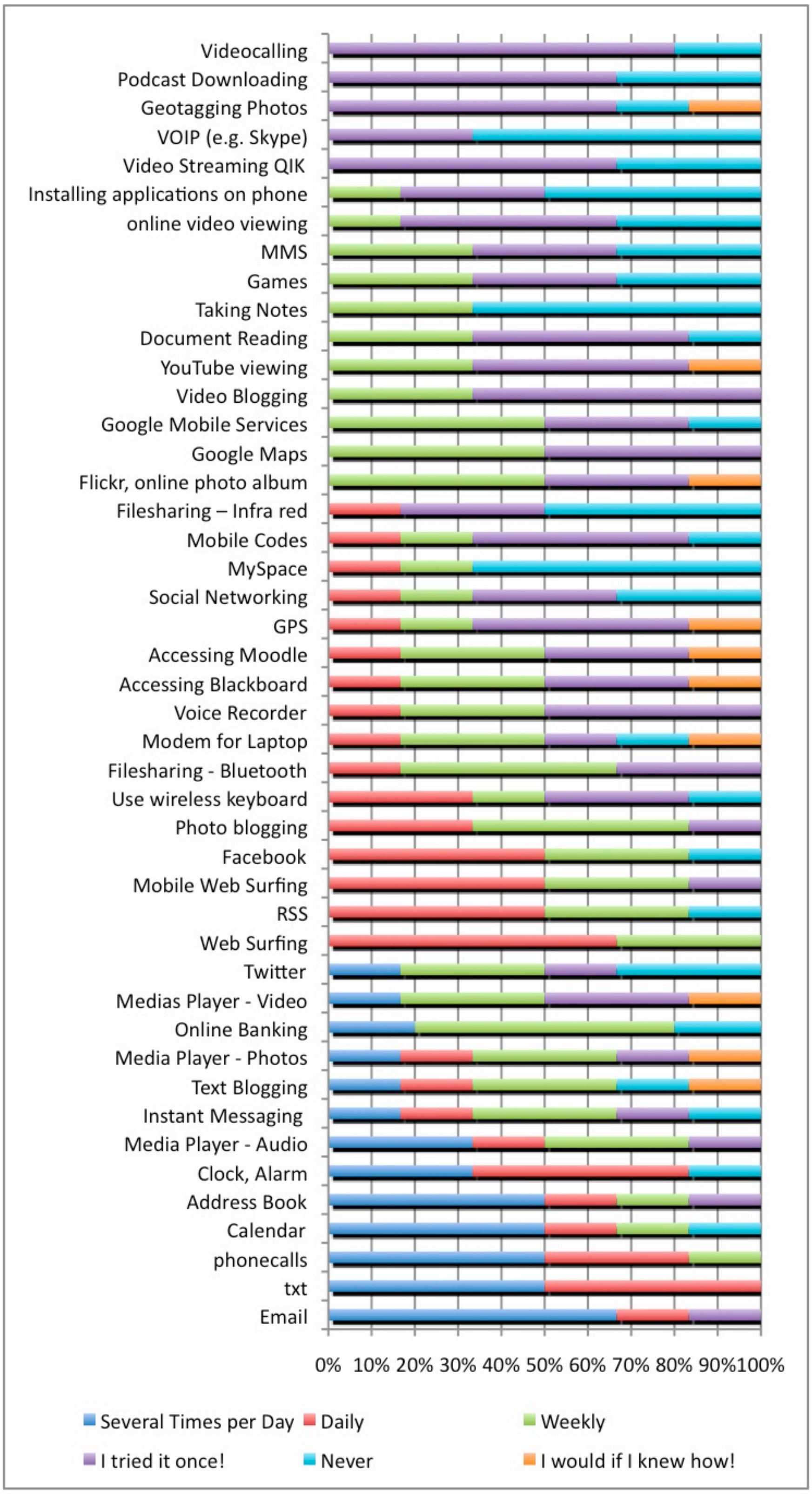


Figure 20: Third year Product Design student mobile usage 2009.

A comparison of the three mobile usage graphs (Figure 18 - Figure 20) indicates important average smartphone use differences between the three years of the course. This is partly accounted for by different smartphones being used by the first and second year students (Nokia XpressMusic 5800) compared to the third year students (Initially Nokia N95, followed by Nokia N97 in semester2 2009). The first year project's main focus was upon developing students use and integration of web 2.0 tools (facilitated by the netbook and the smartphone), rather than upon the unique affordances of the smartphone, this being the focus of the second and third year projects. Thus Figure 18 indicates that while the first year students experimented with the unique multimedia affordances of the smartphones they did not (in general) as a group socialize the everyday use of these unique affordances into their course. The use of the unique affordances of the smartphones was encouraged, but was optional in their projects. Also the structured nature of the first year projects followed a more teacher-directed pedagogical learning environment than the second and third years.

As shown in Figure 19 the second year students, in general, socially rejected the unique affordances of the XM5800 smartphone (with the exception of image and video blogging) and tended to revert to standard use of the phone. Many of the second year students reported in the final student survey and focus group that they found the XM5800 too complicated for these general activities. While the unique affordances of the smartphone were introduced by the researcher it was observed that they were not modeled by the second year lecturer within authentic contexts as recommended by Herrington and Herrington (2007), and therefore students struggled to conceptualise the use of these affordances within their course. Most of the second year students expressed their engagement with the mlearning project, but rejected the XM5800 as a device. Their feedback indicated that they preferred the 2008 use of the iPhone 3G when they were first year students. “The Nokia’s UI was so bad and non-intuitive that I didn’t use the phone as much as I wanted to – I really like the whole idea – just not this phone” (example second year student feedback). In comparison many of the students in the other second semester mlearning projects (Architecture and Performing and Screen Arts) expressed strong personal appropriation of the XM5800, with most reluctantly returning the device at the end of their 2009 projects. The researcher observed that social non-appropriation of the XM5800 by one or two vocal students appeared to have been very influential in the second year Product Design project. This illustrates the influence of the social construction of technology (Bijker, 1995) on technology appropriation, when a specific social group’s use of a technology determines it’s uptake and evolution.

Figure 20 shows that in contrast the third year students appropriated the multimedia and communications capabilities of the N95 and N97, using a wide range of mobile web 2.0 affordances including instant messaging, Twitter, and QR Codes. The GPS and maps integration of the smartphones was also highly rated by the students, but used most frequently by third year students. The third year students maximized the use of the unique affordances of the smartphones within authentic contexts as recommended by Herrington and Herrington (2007) provided by their unstructured final year design projects that followed the development of a heutagogical learning environment (Cook, et al., 2007; Cook, et al., 2008; Luckin, et al., 2008) modeled by the use of the mobile web 2.0 tools by their course lecturer.

6.3.4.2 COP Formation

All three courses explicitly timetabled weekly face-to-face mlearning community of practice support sessions throughout the length of the course in 2009.

This involved the students, course lecturers, and the researcher as the technology steward guiding the groups in the appropriate use of the mobile web 2.0 tools. The three groups met together with the researcher as a participant in each group around a table in each of the three Product Design Studios, with their WMDs and a portable video projector for demonstrations and student presentations. These COPs were cultivated beyond the face-to-face sessions via the use of the mobile web 2.0 tools for communication and collaboration between the participants. The face-to-face weekly mlearning COP support sessions were highly valued by the first and third year students and lecturers, who scheduled the COP sessions as regular events within the courses studio time encouraging high levels of student participation, and formed the basis of engaged and sustained learning communities around the mlearning projects. However, unlike the first and third year projects, the second year lecturer did not place as much value on the weekly face-to-face COP sessions, often postponing them, double-booking with guest lecturer sessions, or simply forgetting about them and did not regularly attend the COP sessions himself, leading to weak learning community formation around the mlearning project in the second year.

6.3.4.3 Context Bridging Scenarios

This section briefly outlines several context-bridging mlearning scenarios illustrating their use within the Product Design course in 2009.

During 2009 two of the course lecturers travelled to several national and international conferences, presenting collaborative papers with the researcher in Spain, Germany, and Dunedin. The lecturers modeled the use of mobile web 2.0 technologies to their students by utilizing moblogging and mobile video streaming (using QIK and Flixwagon) from their smartphones to share these experiences with their students back in Auckland, New Zealand. During a three week trip to Spain in June-July of 2009, one course lecturer created an embedded Picasaweb slideshow in their Vox blog from uploaded photos taken with their smartphone, and also recorded and shared over a dozen live streamed (and geotagged) videos of their experiences. Students replied to the lecturer's postings and videos via email and blog comments.

The smartphone's image and video recording capabilities were used extensively by students to record aspects of field trips and site visits, which were then uploaded to either YouTube or their Vox blogs for sharing and critiquing. Mobile video streaming was also used for quickly sharing experiences, trading off the lower video recording quality for ease of automatic uploading and sharing of the video.

As part of their COP, third year students were asked by the researcher to create outlines of mlearning scenarios for their course workflows. The resulting scenarios illustrated how the students appropriated the unique affordances of the smartphones. Examples of these scenarios can be seen at:

1. http://mydesignprojects.Vox.com/library/post/m-learning-scenario-posted-via-n97.html
2. http://prezi.com/iz5slerkjcgk/
3. http://prezi.com/mumufntncphh/

During semester two of 2009, an overseas student joined the third year student cohort as part of his final year learning experience. The international student joined the third year mlearning COP and used the mobile web 2.0 tools to share his overseas experience with his fellow students and family back home in Germany. The use of web 2.0, and in particular mobile web 2.0 was a completely new experience for this student that he found very empowering. Feedback from this student included: "Thank you Thom, for showing me a completely new insight in how to use Web 2.0 for supporting my future projects. That's one of the unforgettable things" (Third year international student 2009).

The third year students featured the QR Code capabilities of their smartphones as a theme in their final graduation show. Each student created a QR Code that linked their final design project presentation to a Wordpress blog site providing visitors with more information on the students and their projects. The students demonstrated how to use the QR Codes on their smartphones to the Grad show visitors, decoding the QRCode URLs and showing the mobile version of their showcase blogs. Figure 21 illustrates the use of QR Codes within the third year Grad Show advertising flyer. QR Codes were also used to theme the grad show booklet that was printed and made available to the show visitors.

Figure 21: 2009 Third year Product Design student Grad Show invitation flyer.

The final student surveys and focus group questions provided further data on student feedback on the three 2009 Product Design mlearning projects used in the analysis of the projects. Indicative data analysis can be viewed at https://docs.google.com/fileview?id=0B9kx7n-UKqvBNzg4MGQxMDctOWUyMy00NWM3LWI0YmEtZGM3YjYwMzc3M2Vh&hl=en_GB.

6.3.5 Implications for the Next Research Cycle

The 2009 mlearning projects within the Bachelor of Product Design illustrated the potential for full integration of mlearning, with all of the students and lecturers in the three year classes of the course participating (to varying degrees) in a staged and scaffolded mlearning project. The two main limitations identified by this project were: the critical pedagogical design and modeling input from the lecturers, and the sustainability of providing institutionally loaned WMDs to students. Future research will focus upon bringing all course lecturers into the core of the supporting mlearning community of practice surrounding the project, and utilizing student-owned WMDs.

6.4 Case Study 2 Critical Success Factors

This section brings out some of the key themes highlighted by the mlearning integration into the Bachelor of Product Design programme.

6.4.1 Pedagogical Change

Over the course of two years the integration of mobile web 2.0 tools into the Bachelor of Product design programme has been a catalyst for pedagogical change in the programme, facilitating a staged pedagogical integration across the three years of the course that reflects a move from pedagogy (first year) to heutagogy (third year), mapping the pedagogy, andragogy, heutagogy (PAH) continuum proposed by Luckin et al. (2008; 2010) and McLoughlin and Lee (2008b). As a result of this, a major task for the lecturer then became teaching and facilitating the students' learning of the process of integration rather than delivering course content. This presented a marked conceptual shift for many lecturers.

The progressive integration of mobile web 2.0 has facilitated a shift away from the default Atelier 'private method' of instruction that the course had previously followed to new more fluid and dynamic pedagogies, as advocated by Herrington et al. (2008), and McLoughlin and Lee (2008b). This project has deliberately disrupted (Sharples, 2000, 2001) the timetabled instructivist studio learning that was frequently used and placed the student groups in a social constructivist framework. The use of web 2.0 technologies has literally become an everyday occurrence in the Bachelor of Product Design, as evidenced by all three years of the programme becoming engaged in a staged development of mlearning projects using different types of WMDs during 2009.

6.4.2 Sustained Engagement Facilitating Ontological Shifts

Some students have not willingly taken part in the blogging aspect of their project and the participating lecturers observed that some of those who do not wish to participate make this decision because of a general lack of interest and self-confidence. For some students the pedagogical approaches taken in the mobile web 2.0 projects are beyond their prior experience and comfort zones, requiring significant reconceptualisation on their roles as students (Chi & Hausmann, 2003). However, the researcher has observed that providing a regular COP facilitated by a technology steward, and finding an appropriate 'hook', such as showing how the technology can further a particular interest, or make a particular task easier, invariably breaks down any barriers. The sustained engagement of a supporting community of practice provides both a catalyst and a supportive environment facilitating participants' ontological shifts. Lecturer and student feedback on the project are available on YouTube:

- Lecturer feedback: http://www.youtube.com/watch?v=mmTI7F_2tiU
- Student feedback: http://www.youtube.com/watch?v=X1Sb-tvXrvA

The researcher has published two collaborative papers with the third year Product Design lecturers that outline the significant events representing ontological shifts that facilitated the pedagogical development of these two core participating Bachelor of Product design lecturers over the length of the research project (Cochrane & Bateman, 2010a; Cochrane & Flitta, 2009). These papers illustrate the level of collaboration and trust developed between the participants through the sustained engagement of involvement in the cycles of action research embodied in the mlearning projects between 2008 and 2009. Critical Incident Analysis (Sharples, 2009b; Vavoula, et al., 2009) was used to identify significant 'eureka' moments for the participating lecturers in their mlearning journeys. Several 'lenses' were used to bring into focus themes that emerge upon reflection over this period, including: Communities Of Practice, the Social Construction of Technology, Actor Network Theory, Activity Theory, and Social Constructivism.

6.4.3 Creating a Supportive Learning Community

The Bachelor of Product Design mlearning projects have illustrated the potential to create increased student engagement with the learning environment. Higher levels of student reflection and critique were achieved compared to that previously seen with more traditional assessment procedures. Anywhere, anytime learning (context independent and context bridging) was facilitated and made use of in student-generated scenarios.

6.4.4 The level of lecturer modeling of the pedagogical use of the tools

Tutor engagement with the technology was essential for students to value its use and to gain an understanding of its pedagogical usefulness beyond social activities. “It is vital that staff participate in the blogging process and run their own blogs alongside the student ones. Students want to see that staff are visiting their blogs and commenting on posts as well as offering information that might assist them with their projects” (Cochrane & Bateman, 2010c, p. 184). Therefore the integration of the mobile web 2.0 technologies into the assessment (Both formative and summative) was critical for student motivation, and ensured that the lecturer input and modeling of the tools was recognized as course activity rather than extra work. The integration of mobile web 2.0 facilitated a change in pedagogical approach that needed significant scaffolding for both students and lecturers. This made supporting the project via a community of practice, and sound pedagogical design essential.

6.4.5 Technical and pedagogical support

Lecturers and students emphasized the importance of the input of the researcher as the technology steward supporting the technological and pedagogical integration of mlearning into their courses. “A regular technology update is also required and we have found that the most effective way for this to occur is in a community of practice form with participation from a technology steward” (Cochrane & Bateman, 2010c, p. 184).

6.4.6 Appropriate Choice of Supporting Technologies

Access issues must be considered carefully when planning to integrate the use of mobile web 2.0 technologies. The sustainable provision of hardware, software and connectivity (3G data plans and WiFi availability) must be thought through. Various models for achieving this sustainability with a focus upon supporting student-owned WMDs will be brainstormed for the future of this project.

6.5 Chapter Summary

Chapter six overviewed and analysed the Bachelor of Product Design mlearning projects from 2008 to 2009 using the identified critical success factors (section 3.8) as a critical framework, and illustrates the influence of the 2006 trials and 2007 Diploma of Landscape Design project on the Product Design projects' implementation. The success of the initial third year mlearning project in semester 1 of 2008 lead to the integration and staging of mlearning across all three years of the Bachelor of Product Design programme from semester 2 in 2008 and was refined in 2009. The sustained engagement of an intentional community of practice supported each of these projects. The case study highlights the potential of mlearning integration as a catalyst for pedagogical change and enabling context bridging learning scenarios beyond the face-to-face classroom.

7 CASE STUDY 3: DIPLOMA OF CONTEMPORARY MUSIC, 2008 TO 2009. (COURSE INTEGRATION AND LECTURER ONTOLOGICAL SHIFTS)

This section describes and analyses the third case study of mobile web 2.0 projects as part of the research. The context is within the Diploma of Contemporary Music course based at the Waitakere Unitec campus. The case study describes two iterations of mobile web 2.0 projects from 2008 to 2009, including: the Diploma of Contemporary Music using the iPod Touch, and the iPhone 3G in 2008 (Project outline shown in Table 11, section 4.4.4), and 2009 (Project outline shown in Table 19, section 4.4.5).

The project implementations were informed by the results and reflections on the Landscape Design and Product Design mlearning projects. The case study follows the transformation of pedagogy within the course from an initial exploratory project in 2008 to the integration of the affordances of mobile web 2.0 tools within the course in 2009. The Contemporary Music mlearning project iterations illustrated the critical nature of integration of mobile web 2.0 into the course curriculum and assessment.

This case study serves to illustrate one of the identified critical mlearning implementation issues in particular: the need for explicit planned course integration and assessment. A second critical issue identified by the participants was the affordance of ubiquitous wireless connectivity.

The chapter is structured into a description of each project, followed by the identification and discussion of themes arising from each research cycle, and the design implications identified for the following cycle. This is repeated for each of the

2008 and 2009 projects. The chapter then draws together these themes to identify critical success factors related to the implementation of mobile web 2.0.

7.1 Background

The Diploma of Contemporary Music is a newly established two-year 240-credit Level 5 programme (equivalent to first year University), made up of fifteen compulsory courses at levels 4 and 5, usually taken over two years of full time study. Its unique elements include a focus on the local community, a broad overview of music performance, theory, composition, and technology within a relatively broad scope of musical styles (from classical to contemporary). Traditionally music education focuses upon a pedagogical model that is similar to apprenticeship, with an expert teacher and performer providing mainly one-on-one training and guidance to the student. However, with the researcher's input, the course curriculum was written to allow for the embedding of new technologies with a focus on student-centred, social constructivist pedagogies, and group performance. 2008 was the second year of the programme, and the course was in the process of building up a profile and student numbers within the local region. Compared to national statistics, the region is under-represented in tertiary education achievement; therefore most students enrolled in the course were classed as under-achievers or second-chance tertiary students. The use of mobile web 2.0 technologies within the course was investigated for pedagogical reasons, to facilitate the move from instructivist pedagogies to social constructivism, as well as a way to establish the programme as innovative and engaging to students. Contestable funding for innovation in programme delivery was made available for 2008, and a proposal from the researcher for funding to implement mobile web 2.0 within the programme was accepted. This allowed for the purchase (in February

2008) of a class set of iPod touch's, and funding to purchase a class set of 3G iPhones when they became available in New Zealand in July 2008.

The programme director was a member of a Community of Practice established by the researcher in late 2007 at Unitec's Waitakere Campus to explore the educational potential of web 2.0 tools alongside of the addition of the Campus Pack to the institutional Learning Management System (adding Blog, wiki, and podcast tools to Blackboard). Including other lecturers on the Music programme in a Community of Practice was logistically problematic, as all lecturers except the programme director of the course were part-time. Hence the other two lecturers involved in the 2008 iPod/iPhone project did not have the previous experience of the 2007 Community of Practice or the educational use of web 2.0 tools before the start of the project. This markedly impacted the ability of these lecturers to conceptualise the integration of the mobile web 2.0 tools into the course curriculum during 2008, as they learnt the affordances of the mobile web 2.0 tools during the COP sessions at the same time as the participating students.

7.2 2008 Project: Mlearning Exploration

The iPod Touch was chosen as the wireless mobile device (WMD) for the Contemporary Music project after discussions with the lecturers at the end of 2007 as it aligned closely with the curriculum and delivery choices of the programme. The course was based around Apple Macintosh computers and software, providing close integration with Apple software such as iTunes and Garageband. Students and lecturers were provided with an iPod Touch (16GB) for the duration of the 2008 project. Participants signed an acceptable use policy, agreeing to look after and return the device at the end of the project, and were encouraged to treat the device as if it were their own for the period of the project, including customisation, downloading of media, and installation of third party applications. Internet connectivity was available via Unitec's WiFi network while on campus. This provided free web access for both students and lecturers while on campus. An intentional Community of Practice model was once again used to create a collaborative learning community between the lecturers, the students, and the researcher as the technology steward supporting the COP (Cochrane, 2007j; Cochrane & Kligyte, 2007a; Wenger, et al., 2005). The community of practice enabled the project to be driven by the participants including the students, the course lecturers and the researcher, and focused by a weekly community of practice session creating sustained engagement that was reified by participant created artefacts such as regular VODCast reflections shared on participants' Blogs and YouTube channels. These weekly sessions were held in the course's dedicated Apple Macintosh music lab, as none of the participating students or lecturers (except for the researcher) initially had access to their own wireless laptops for synchronizing to the iPods. The institution's Learning Management System (Blackboard in this case) was used to provide scaffolding and support for both lecturers and students, while externally hosted web 2.0 tools were used to create a more customisable and flexible personal learning environment for the students' work.

Students volunteered to participate in the iPod project from across the Diploma of Contemporary Music programme. As a pre-requisite, students were required to have already passed two of the introductory core papers of the course. An overview of the project and participants is given in Table 11 in section 4.4.4 of the thesis.

7.2.1 Mobile Web 2.0 Pedagogies

The core activity of the project was the creation and maintenance of a reflective Blog as part of a course group project, creating a collaborative context independent learning environment. The blog host chosen (http://www.Vox.com) provided free creation of a blog, an eportfolio (collections of student media), and social networking (via Vox's 'neighbourhood' feature), and provided access to a potentially worldwide peer learning community. The community of practice explored the potential of the iPod to enhance almost any aspect of the course, including communication, access to online content, and reflective and collaborative web applications. The project was centred on preparing students for the music technology paper of the Diploma of Contemporary Music, which was scheduled to run for the first time in semester one of 2009. In this course students experiment with and evaluate current music creation and delivery technologies, including podcasting and sharing via blogs, eportfolios, and social networking. The goal of the project was to illustrate the potential of a PLE (Personal Learning Environment), facilitated by mobile web 2.0 technologies, that was unconstrained by the limitations of the institutional LMS. For semester one of the project lecturers and students were provided with an iPod Touch (16GB) each, which was to be replaced by a 3G iPhone in semester two when they became officially released in New Zealand. While the iPod Touch was not a smartphone, it had WiFi connectivity and was essentially an iPhone without the phone or camera capability, thus it provided a limited connectivity version of the iPhone until they were made available. Although the first generation iPod Touch had limited content creation capabilities (no camera for still image or video capture, no microphone input for audio recording, and no built-in GPS for geotagging or geolocation) it was a powerful mobile internet device suited to text-based input and one of the best mobile media viewing devices available at the time. User content creation was thus facilitated by using the Apple iMac computers in the Music Lab, using their built-in webcams, microphone, and the use of external audio and midi equipment attached to the iMacs, and then synchronised to the students' iPods.

The project initially focused on investigating the use of the iPod Touch synchronized with iTunes software on desktop computers (Apple iMacs) for the following activities:

- A reflective Blog (http://www.Vox.com)
- An eportfolio (http://www.Vox.com)
- Email (Gmail)
- RSS (Google Reader)
- Shared Calendars (Google Calendars)
- Image Blogging (Flickr)
- Video Blogging (YouTube)
- Podcasting
- Instant Messaging (http://www.mundu.com)
- Accessing the Course Management System (Blackboard http://bb.unitec.ac.nz)
- Document reading (Word, Excel, PowerPoint, PDF using email attachments and Google Docs)

Lecturers were encouraged to model the use and integration of mobile web 2.0 in their own daily workflows and to provide regular formative feedback to students via posts on their blogs and other media. Figure 22 provides a concept map outlining the integration of the key mobile web 2.0 tools used in the project. The iPod Touch (or iPhone) was used to provide a bridge between learning contexts as a media synchronization and collaborative communications device. A variety of mobile friendly web-based tools were used to host, record and share the participants learning experiences. The iPod/iPhone provided a link between learning contexts, course content, user-generated content, peers and teachers, facilitating an interactive learning environment similar to Laurillard's (2001) conversational model of learning.

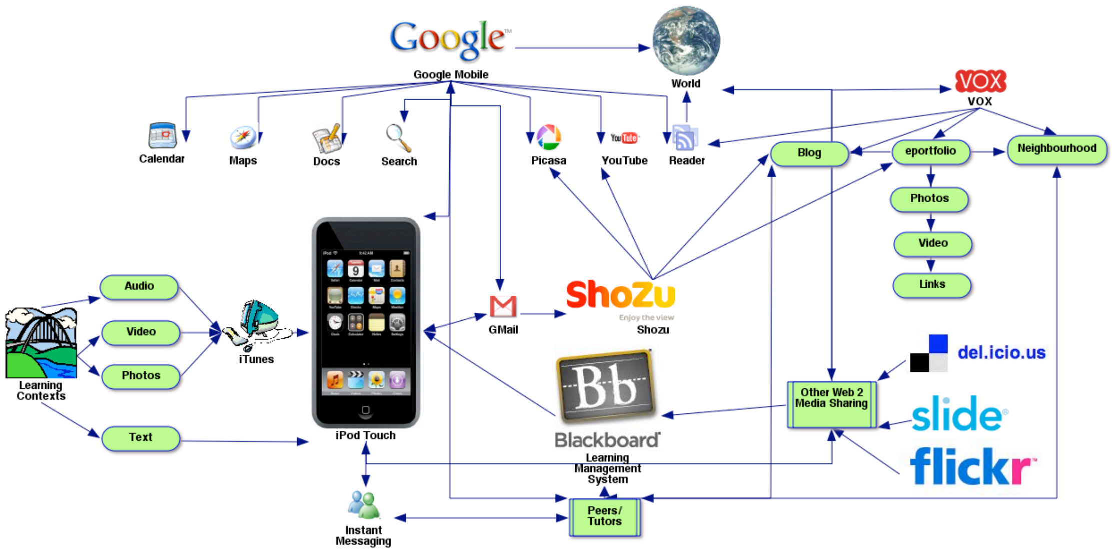


Figure 22: Mobile web 2.0 concept map (iPod Touch).

The main limitation of the iPod Touch was the WiFi only wireless connectivity. During the project the iPod Touch was updated to the 1.1.4 software allowing the iPod Touch to became a capable wireless Internet PDA (Personal Digital Assistant). The software update removed the reliance upon web-based tools (web apps) by including an email application, a calendar, Google maps, notes, a YouTube player, and stocks. The following version 2 software update opened the iPod Touch to the vast array of third party applications available through the iTunes application store. Thus the project was continuously reinvigorated by the iPods developing affordances. Similar mlearning affordances to those explored in the other mlearning projects using other WMDs were explored in the iPod/iPhone project, for example the

WMD affordances listed in Table 25 and Table 35. In addition to these affordances, the unique music sharing and creation capabilities of the iPod and iPhone were explored.

The second semester introduction of the iPhone significantly improved over the iPod Touch's limited content creation capabilities, including a built-in camera for still image capture, a built-in microphone for recording audio, a built-in speaker for audio and video playback, and a GPS (for geotagging and various geolocation applications). Participants who were upgraded to an iPhone when they became available were also reimbursed the cost of a 200MB per month 3G data plan, but paid for their own accompanying voice and txt plans. The iPhone's 3G cellphone connectivity reduced the reliance of connectivity and communication via WiFi hotspots. The iPhone reduced the dependence on a computer for media creation, and added the dimension of context bridging and location-awareness for capturing, reflecting, geolocation and collaborating on learning experiences. The main limitations of the iPhone 3G for this project were its lack of video recording capability and lack of multitasking. Multitasking was especially important for using synchronous communication tools such as instant messaging, as the instant messaging application typically runs in the background while the user goes about other tasks on the device. The iPhone's lack of multitasking meant that only one application could run at a time, limiting the usefulness of instant messaging.

7.2.2 Mobile Web 2.0 Scenarios

The following section outlines some of the key mobile web 2.0 scenarios developed by the 2008 Diploma of Contemporary Music mlearning project participants. These were captured as Vox blog posts and YouTube channel subscriptions by the researcher, as well as in class observations and discussions, and focus group feedback.

7.2.2.1 YouTube:

The YouTube application on the iPod and iPhone made searching and viewing YouTube videos over a wireless connection simple. Students were encouraged to create YouTube video reflections of their course and performances and subscribe to each other's YouTube channels in iTunes, and view them anywhere using their iPod/iPhone. In the process of doing this, both course lecturers discovered YouTube videos of some of their previous performances and MTV videos. One MTV video in particular that had been recorded in 1992 was found uploaded to YouTube, giving the lecturer's music a new lease of life and an example of the musical contextual potential of the medium for their students.

7.2.2.2 Vodcasting:

Participants were asked to regularly post short video recordings of themselves to their Vox blogs reviewing their thoughts on the use of the iPod/iPhone and later to provide reviews of music apps downloaded from the iTunes store to their iPod/iPhone. The VODCasts were recorded using the built-in webcams and microphones of the iMacs in the Music lab, then uploaded to students' YouTube accounts, and finally they were embedded into the student's Vox blog posts. The VODCasts were fun and engaging and generated collaborative peer reviews in the form of Vox blog comments. A compilation of example student VODCasts was created by the researcher and made available on YouTube at http://www.youtube.com/watch?v=IXUekj8c86k.

7.2.2.3 Communication:

Students and staff were encouraged to use instant messaging (IM) on the iPod or iPhone as a way of establishing a context independent collaborative learning environment. Email and instant messaging were used on the iPod/iPhone for communication between students for social activities and help with assignments, and between the students and the technology steward asking for help with software and hardware issues, and between the students and course lecturers for clarifying assessment requirements. Lecturers were reticent to engage with instant messaging as they had not appropriated it as a useful communications tool and had yet to be convinced that such communication was not merely "phatic" as described by one lecturer, implying such communication is facile and lacking in depth or critique and requiring 24/7 commitment from the lecturers to answer student requests. However the use of instant messaging for communication with the technology steward was particularly useful for supporting the students, as the technology steward was based on a separate campus from the students and encouraged the students to contact him that way. An example chat session between the technology steward and a participating student is shown in Figure 23. The student was using IM on their iPhone.

Figure 23: Example instant message chat session with technology steward and student.

7.2.2.4 Student and staff performances:

Notifications of student performance venues and times were posted to students' blogs, informing other students' in their Vox neighbourhood via email or RSS to their iPhones of these upcoming events. Students videoed each other performing live with their bands, subsequently uploading the videos of the performances and shared via students' blogs.

Lecturers also used their Vox blogs to advertise their upcoming performances, and provide reviews of these performances, including uploading photos and video clips. This enabled shared experiences and expert performance modeling by the lecturers beyond the confines of the classroom, as recommended by Herrington and Herrington (2007) who identified student access to expert performances as one key principle of authentic mlearning.

7.2.2.5 Mobile Web:

Students reported in focus group feedback that they regularly used the iPod/iPhone for basic web activity, particularly for finding information relevant to their course. They valued the portability of the iPod/iPhone and the immediacy of accessing the Internet on it. Students were also shown (by the researcher) a variety of ways to moblog directly from the iPod/iPhone to their Vox blog, and how to subscribe to each other's various online media site RSS feeds using Google Reader on the iPod/iPhone. With the update to the iTunes application store part-way through the project, the free MySpace and Facebook iPod/iPhone applications became popular among students for updating and following their personal online social networks. However, some students commented that the size of the virtual keyboard for text entry on the iPod/iPhone limited the speed at which they could enter text for applications such as moblogging and emailing.

7.2.3 Themes Arising

The 2008 Contemporary Music mobile web 2.0 project presented a steep learning curve for most participants, both technically and as a reconceptualisation of the teaching and learning approaches they were used to. The introduction of innovative new technologies in the 2008 mlearning project required ontological shifts of the participants. These ontological shifts took time particularly for the lecturers in conceptualizing how to integrate the tools into the curriculum, as highlighted in research by Barbaux (2006) and Chi and Hausmann (2003). Figure 24 summaries the participants' responses to the initial survey question on their previous use of wireless technology and popular web 2.0 tools. The results show that the students did not fit the net generation profile proposed by Prensky (2001). Virtually all participants were consumers of web 2.0 content, but prior to the project few had ever created and uploaded their own content to web 2.0 sites. None had previously attempted mobile blogging. Cellphone ownership was almost ubiquitous, but no participants had previously owned an iPod touch or a 'smartphone'.

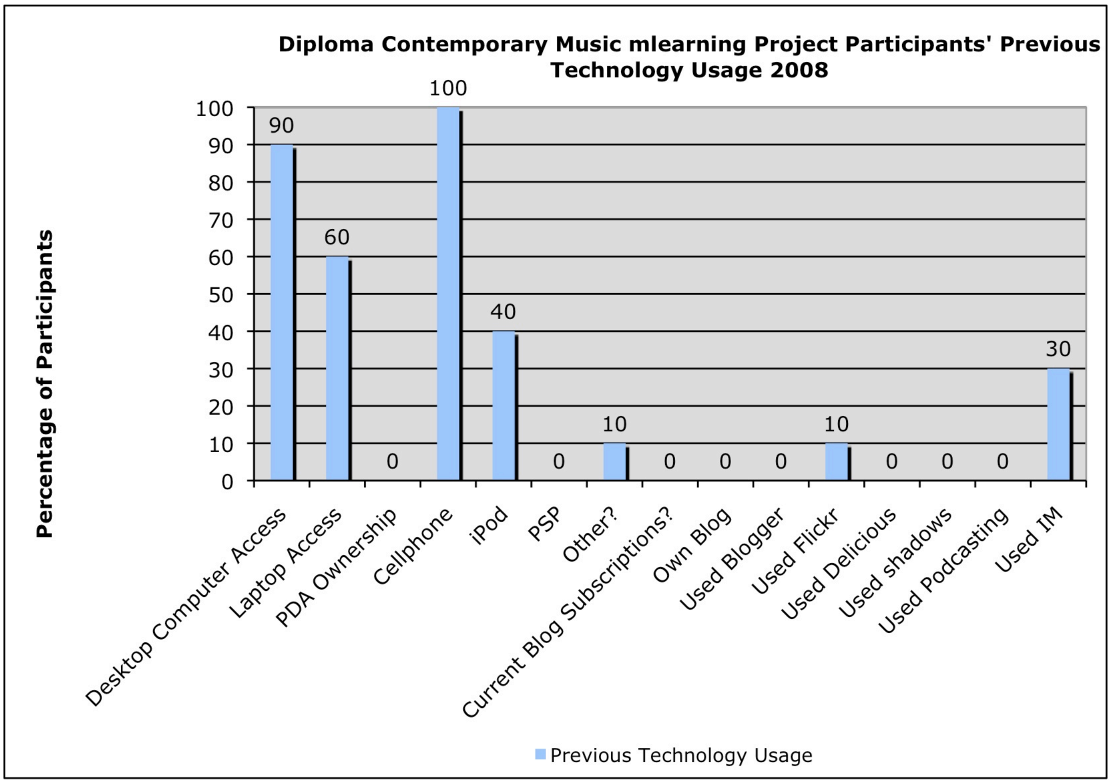


Figure 24: Diploma Contemporary Music 2008 mlearning project participants' previous use of wireless technology and web 2.0.

The novelty of the iPod Touch initially captured the imagination and attention of the participants, but later in the year as the pressure of course assessments mounted many participants' interaction reduced.

Although students' survey and focus group feedback indicated that they loved the iPod Touch as a focal point of their personal multimedia collections, for media playback, web connectivity and messaging, there was limited buy-in from the majority of students for Vox blogging. The researcher observed that this was due to several factors. Students participating in the 2008 project volunteered from across the entire Diploma of Contemporary Music programme and were not necessarily in the same classes, therefore there was little cohesion within the group and a lack of a sense of a collaborative learning community. The project was viewed as an optional extra to the curriculum, as an investigation of how the tools might be integrated into the course delivery and assessment in the future. Therefore there was no summative assessment associated with the project, and when the pressure of formal assignment deadlines approached engagement in the optional Vox blogging died away.

The Blackboard Campuspack was used within the course by the lecturers as the default blog for the course. However this was used as an individual student learning journal and virtual helpdesk system rather than a collaborative social constructivist environment as was the aim of the Vox blogs. Lecturers struggled to conceptualise the potential of creating social constructivist learning environments for their students, relying rather upon a model of one-to-one apprenticeship and instruction. Lecturers were also wary of any potential copyright issues with student's blogging or uploading versions of music they learnt to public web spaces. This and the fact that the Campuspack blog was not easily accessible via mobile devices led to very low student engagement in the official assessed Blackboard blogging activities. In comparison, those students (and staff) who used the Vox blog found it to be very mobile friendly, fun and generated a collaborative environment, however it was not a formally assessed activity. Consequently, exploring how Vox mobile blogging could replace the Campuspack blogging activities was explored more explicitly by the researcher with the lecturers for the 2009 project.

With the release of the iPhone 3G in New Zealand in July 2008 there was an opportunity to reinvigorate the project and motivate students and staff to engage in a more ubiquitously connected collaborative environment. To encourage the use of the Vox blogs, it was decided to offer the iPhone upgrade to students who met the following requirements:

> To be eligible for an upgrade to the iPhone 3G you must fulfill the following over the next month (13 June to 13 July 2008, mid-year Semester break):
>
> 1. Regularly (at least two times per week) post to your VOX blog and comment on other students' blog posts.
>
> 2. Upload a weekly Podcast (audio) or VODCast (video) recording to either your VOX collection or YouTube (1-2 minutes each). Listen/watch each other's 'shows' and comment on them!
>
> * These posts and Podcasts/VODCasts should reflect on aspects relevant to your DipMus course - for example: a critique of musical works, comments on local musicians/bands, reflections on your assignments, interviews with local musicians. (Announcement to student participants, June 2008)

However, only five participants (3 students and 2 lecturers) fulfilled these requirements. Therefore only five of the thirteen project participants were upgraded to iPhones for semester two. This meant that the second half of the 2008 project was comprised of a mixed group of iPod Touch and iPhone users. The weekly face-to-face COP sessions in semester two were targeted to be as relevant as possible to both groups of users, but inevitably the iPod Touch users felt left out and disengaged. The introduction of the iPhone for select participants effectively became a rite of passage into the core of the community of practice supporting the project, and side-lined the iPod users to the periphery of the COP. Participant survey feedback from the end of the project confirmed that the iPhone users were more engaged and enthusiastic about the project than the iPod Touch users, and the iPhone users' satisfaction with the project increased from their mid project survey feedback.

The following sections summarise example student and staff responses to the mid and end of project surveys and focus groups.

7.2.3.1 Student Feedback

The benefits of mobility and context independence facilitated by the iPod Touch and iPhone were key themes identified by students. For example typical student feedback included: "When away from the classroom it was easy to keep up to date" (Student focus group feedback, 2008). "It was a good way to communicate with the other students. It was excellent that I could ask questions of lecturers when I needed to know something – it's a fast way of communicating" (Student focus group feedback, 2008). An example student YouTube VODCast (video cast) show can be seen at http://www.youtube.com/rimzcoop/. By default the more motivated students became the iPhone users. They were differentiated from other students by their ability to take responsibility for their learning and ownership of developing a personal learning environment using the mobile web 2.0 tools. These students identified a lack of 'community' as a critical factor limiting the engagement with the Vox blogging and the uptake of the mobile web 2.0 tools. This community could be better achieved by locating the project within a specific class group of the programme, which would also provide an environment to scaffold the less independent learners in the class via peer support. This course integration was achieved in the 2009 implementation of the project.

7.2.3.2 Staff Feedback

Focus group feedback from the course lecturers indicated that they were just as enthusiastic about the personal use of the iPod Touch as the students, and they integrated the use of the device into their own personal daily routines. The main limitations identified by lecturers of the iPod Touch were its limited wireless connectivity (WiFi only), and getting used to the virtual keyboard for text entry. An example lecturer YouTube VODCast (video cast) show about the project can be seen at http://www.youtube.com/ipodtrial/.

The lecturers were also asked by the researcher to reflect on four questions related to the main research questions:

1. What potential benefits do you see for mobile web 2.0 to enhance teaching and learning?
2. Have you (so far) seen increased engagement in the course from students when using this technology?
3. What are the key issues for integrating this technology into your courses?
4. In what ways has (or will) your teaching approach changed by using these tools?

Their answers to these questions are available on YouTube as VODCasts at http://www.youtube.com/watch?v=g52Jv_LmDbk. Their responses indicated that although they were enthusiastic about the personal use of the iPod/iPhone, they struggled to conceptualise the affordances of the devices for integration into the course curriculum. They did however agree that course integration of the tools was critical for the future. The researcher observed that there was a perception among the lecturers that the Vox blogging was fun, but ‘real’ blogging within the course curriculum should be conducted using the Campuspack Blog tool within the institutional LMS, Blackboard. This was identified by the researcher as a key issue that became the focus of discussions between the researcher and the course lecturers at the end of the 2008 course and before the start of the 2009 course to investigate ideas for course integration and appropriate assessment activities for 2009. The initial inability of the course lecturers to see how to integrate the tools into the curriculum was symptomatic of the need for ontological shifts to occur alongside the introduction of innovative technologies, as described by Chi and Hausmann (2003). Upon reflection, the researcher identified two key issues surrounding these ontological shifts within the Diploma of Contemporary Music:

1. The lecturers needed new ideas, and time for reflection and guidance on how to integrate the mobile web 2.0 tools into the curriculum.
2. The disruptive nature of introducing mobile web 2.0 into the course created an ideological clash of pedagogical approaches, with lecturers unable to see how they could move students’ learning experiences from pedagogy to andragogy and eventually self-directed learning (heutagogy). The mlearning project focused upon facilitating a social constructivist environment, whereas the course lecturers were used to an instructivist, apprenticeship model of teaching and learning.

This issue framed the core discussions of planning for the 2009 projects between the researcher and the course lecturers.

7.2.4 Implications for the Next Research Cycle

Final survey feedback indicated that everyone on the project in 2008 found the iPod Touch effective for increasing communication, and responded that they would be willing to purchase their own iPod Touch in the future. However, the comparatively high cost of the iPhone was a deterrent to students considering purchasing their own iPhone. Student blogging made slow progress without specific integration into the course in 2008, discussions with the lecturers led to a commitment to place a higher focus on Vox blogging in 2009. The main perceived limitations of the iPod Touchs' were the reliance upon WiFi hotspots, and the slow speed of the Unitec WiFi network at Waitakere. The introduction of the iPhone 3G effectively solved this issue. The ubiquitous 3G connectivity of the iPhone better facilitated personalised learning environments enabling bridging multiple learning contexts. Project aims for 2009 included: course integration, focusing the project within a particular student course group, and wider use of the iPhone by an entire class.

The iPod Touch and iPhone version 2.0+ software coupled with the opening of the iTunes application store opened the potential of the iPod Touch and iPhone platform to a vast array of applications that are very relevant to the music industry and music education. The potential for using some of these available and emerging applications within the course was investigated in 2009. The iPod Touch and the iPhone demonstrated a new level of integration between wireless mobile devices and web 2.0 services. However, every wireless mobile device has strengths and weaknesses. The lack of video recording and multitasking of the iPhone in 2008 were its key weaknesses in supporting mobile web 2.0 student-generated content. These weaknesses were addressed by 'jailbreaking' the iPhone in 2009 to enable a wider range of affordances, including: video recording, video streaming, browsing and accessing the files on the iPhone without restrictions, and enabling sharing of the iPhones 3G internet connection with a laptop computer. The implications of jailbreaking were explored in the Diploma of Contemporary Music mobile web 2.0 projects in 2009.

Considering the issues raised in the previous paragraphs, discussions between the researcher and the course lecturers at the end of 2008 led to an mlearning implementation plan for 2009. This plan included the use of the iPods within the first year of the course in 2009, as part of the performance course 4006, while the iPhones were to be used within the second year of the course, as part of the new technologies course 5011 that investigated the use of web-based tools in music production and dissemination. The goal was to facilitate a stronger sense of development of a learning community that was staged and scaffolded across the two years of the programme.

7.3 2009 Project: Mlearning Integration

The 2009 mlearning project within the Diploma of Contemporary Music was informed by the lessons learnt from the 2008 project, as well as reflections upon the 2007 and 2008 Landscape Design and Product Design mlearning projects. During 2008, no assessment tasks were directly related to the use of the iPhones or iPod Touch's, and the researcher observed that this contributed to varying commitment to the project by the students. While all iPhone recipients regularly used the device, there was limited use for directly course-related activities. This suggested to the researcher that while the students appropriated the use of the tools into their personal and informal learning, they had not been convinced (neither modeled by the lecturers) of the potential for the iPhones and associated activities to be useful in their formal learning environment. It also suggested that students were more likely to respond to tasks for which they received course credit. As evidenced in their 2008 focus group feedback and subsequent discussions with the researcher, course lecturers came to the realization that the iPhone project needed to be embedded in a course, with clearly related assessment tasks, for the students to participate more fully in the project. The lecturers were concerned that the integration of mlearning into the course be appropriate and authentic rather than a gimmick. In particular 2009 mlearning projects were designed to investigate the use of MySpace, student created podcasts, and microblogging as authentic mobile learning activities within the context of music delivery, promotion and critique.

The 2009 project (See Table 19 in section 4.4.5 for the project and participant overview) was explicitly linked to two courses, one within the second year of the Diploma of Contemporary Music, the other within the first year of the course with second year students as peer mentors. Thus the integration of mlearning was staged across the two years of the course, and the use of mobile web 2.0 tools were integrated into the course assessment. MLearning was explicitly integrated into the Web Technologies paper (PASA5011) during semester one of the second year of the Diploma of Contemporary Music course. All students in the paper were issued with iPhones for use within the course throughout 2009, and were also encouraged to personalise the use of the iPhone into their daily routines. Internet access was available for free via the campus WiFi network, but students and staff were responsible for any voice and 3G data costs accrued. The focus of the semester one project was on the Contemporary Music students using iPhones as tools to record and share environmental sounds from a variety of off-campus contexts, as well as creating online profiles on Vox (http://www.Vox.com) and MySpace (http://www.myspace.com), evaluating the use of new technologies for music generation, sharing, marketing, and distribution. Thus the iPhones facilitated both learner-generated content (Bruns, 2007) and learner-generated contexts (Cook, et al., 2007; Luckin, et al., 2008). Several assessed projects within the course involved the direct use of the iPhone and web 2.0 tools, as described in the summarised course outline (section 7.3.1):

7.3.1 Project Outline Semester1: PASA5011 Music Technology and the Web

Using the iPhone with an audio recording application (or another approved device), record a series of environmental sounds, and use these to create a piece of 'organised sound' in Logic Pro. Your work should be at least 3 minutes long.

You must produce the following:

- Your piece of 'organised sound', saved as both an audio file and a Logic Pro project.
- A compilation of your source material, with audio commentary on each sample, saved as both an audio file and a Logic Pro project.
- A series of geo-tagged pictures, posted to your VOX blog (or through other approved means), identifying the locations of your source recordings.
- Blog postings outlining the progress on your work, including at least one video.
- A written outline of the steps you undertook in creating the work, a discussion of any technical and artistic difficulties you faced, and an explanation of what you were trying to do in your composition.

Figure 25 illustrates the relationships between the various elearning and mlearning tools used in the project. The arrows indicate the flow of collaborative interaction between the project participants, forming an enhanced learning community similar to Laurillard's (2001, 2007) conversational framework.

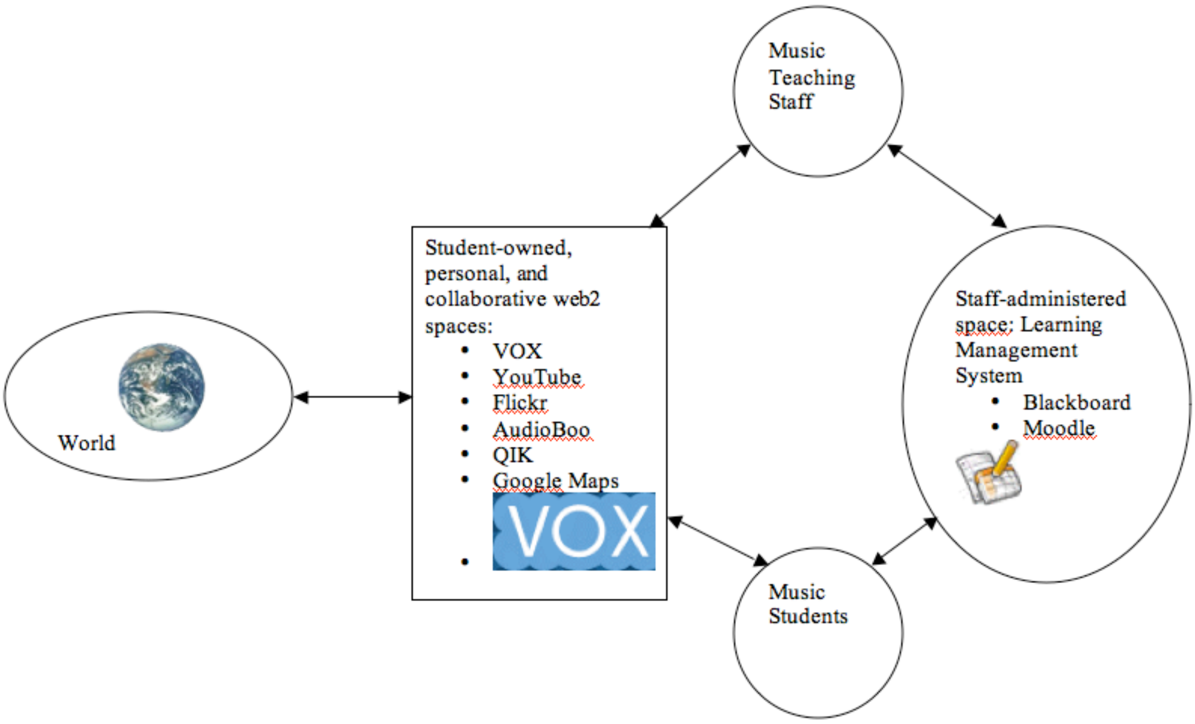


Figure 25: PASA 5011 mobile recording project concept map.

The institutionally owned tools (LMS) were mainly used to scaffold the mlearning projects, providing a centralized repository for student web 2.0 site addresses and tutorial notes on how to set these sites up. Students created their own pages on a variety of mobile friendly web 2.0 sites and then invited the lecturers, the researcher (as the technology steward) and their student peers into these spaces as 'neighbours' and subscribers, thus creating a virtual learning community that was also accessible beyond institutional membership. A second assessed activity within this paper (30% of the course) involved the use of the iPhone for setting up and maintaining a MySpace profile for each student, using the free iPhone MySpace app to upload samples of their original music compositions, and create a promotional online profile.

The second 2009 mlearning integrated paper (PASA4006) was introduced in semester two, and focused upon facilitating peer critique and sharing of student group live performances. This project involved both the semester one iPhone students, and a second group of first year students supplied with iPod Touches. The following section provides a brief outline of the project requirements.

7.3.2 Project Outline Semester2: PASA4006 Collaborative Performance

- Each performance group will have at least one student with an iPhone, the rest of the group will use iPod Touches.
- Each student will still have their own blog inside Blackboard. This is for their reflective e-journal and contributes to their grade.
- Each student will also have their own individual Vox blog / each group will make a group within Vox, and all the groups will be connected via a neighbourhood. Each student invites each other into their neighbourhood. The Vox group discussions will also contribute to each student's final grade.
- The iPhone students will be the technical support, helping the other students to set up the Vox groups etc.
- There will be two COP slots every 2nd week from 20th August: Thurs 4pm with Lecturer1 and students Fri 4pm with Lecturer2 and other students
- The iPhones will be used to record rehearsals etc., and to upload the footage to YouTube where the other students can access and critique it.

> The iPhone users will show the others in the group what they're doing and how.

The mlearning integration was supported by a weekly community of practice (in the semester1 project, and fortnightly in the semester2 project) involving: the students, tutors, and the researcher (as the technology steward for the project). Technological and tutorial support was also provided via the Blackboard Learning Management System (LMS) and a regularly updated wiki page (http://ctliwiki.unitec.ac.nz/index.php/IphoneTutorials). Topics covered during the COP included support for jailbreaking the iPhones to allow video recording and easier sharing of media files with desktop computers.

7.3.3 Themes Arising

The 2009 mobile web 2.0 projects were focused upon the unique affordances of the chosen mobile devices (in this case the iPhone 3G and the iPod Touch) rather than an exploration of a wide range of unique and general affordances, as was the approach in 2008. Narrowing the focus helped scaffold students' learning of these new technologies that most had little or no previous experience of (see Figure 26). Scaffolding is an important aspect of social constructivism (Vygotsky, 1978) and is recommended by Koohang et al. (2009) to support mlearning.

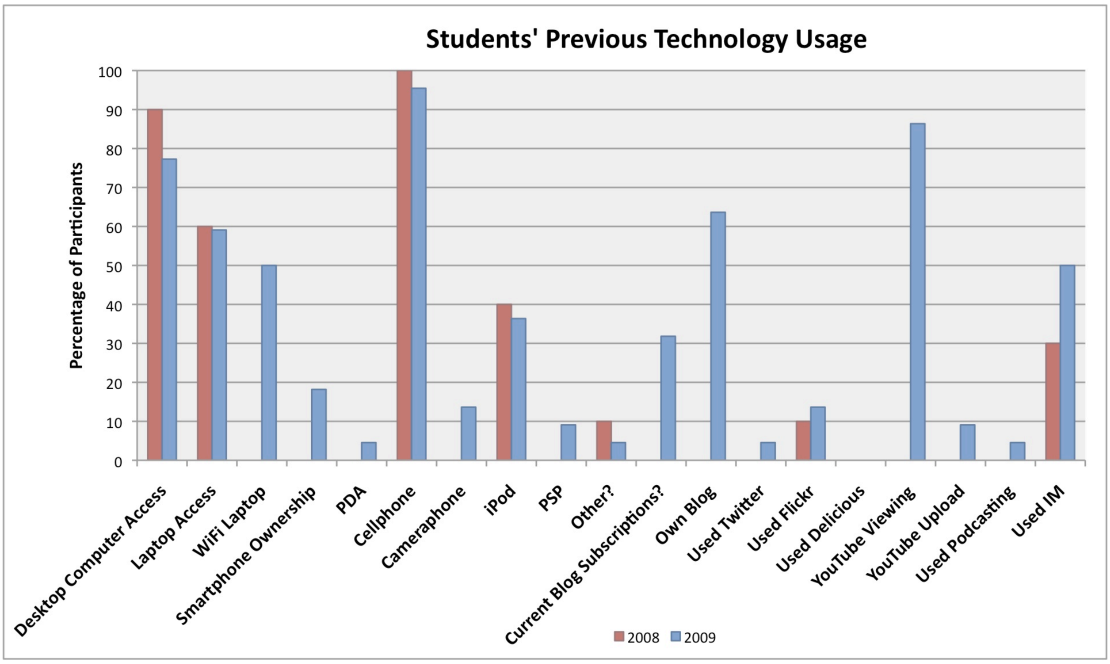


Figure 26: Comparison of 2008-2009 Diploma Contemporary Music students' previous technology experience.

Figure 26 compares the responses of the 2008 and 2009 Diploma of Contemporary Music students to the initial project survey that was used to identify students' previous technology experience prior to the mlearning project. As Figure 26 indicates, students had good access to computers, virtually all owned a basic cellphone (without a built-in camera), and virtually all students' prior experience of web 2.0 had been as consumers rather than producers of web 2.0 content, although an increased percentage of 2009 students had online profiles with either: MySpace, BeBo or Facebook. Twitter, asynchronous microblogging, was introduced as a communication and collaborative mlearning tool for the 2009 project. Students found Twitter more convenient for communication via the iPhone than instant messaging (IM) as the asynchronous checking and sending of 'tweets' suited the non-multitasking iPhone better than synchronous IM. Another key mobile affordance introduced into the 2009 project was video recording via the built-in camera of the iPhone. As the iPhone 3G did not natively support video recording, to achieve this, the iPhones were ‘jailbroken’ to allow the installation of third party applications such as Cycorder for video recording, Qik for live video streaming, and Netatalk to facilitate transfer of the recorded videos to desktop computers for editing and uploading.

There were unforeseen setup issues that were creatively overcome, for example: the activation of the iPhones via an online iTunes account required the user to have a credit card account. However, many of the Music students did not have credit card accounts, therefore a workaround had to be found. Students quickly found tutorials on how to create iTunes accounts without a Visa card account on YouTube. Overall, no technological issues proved insurmountable.

Students were observed by the researcher to be highly motivated and engaged by the project, finding creative ways to meet the project requirements, and they established a more collaborative learning environment than during the 2008 mlearning project.

7.3.3.1 Student Feedback

Students were asked to record VODCast reflections throughout the course and upload these to their blogs, as well as answer survey and focus group questions. A compilation of 2008 student reflections as VODCasts (Online video recordings) of the 2009 Contemporary Music mlearning project created by the researcher is available on YouTube: http://nz.youtube.com/watch?v=0It5XUfvOj.

Students’ appropriated a wide range of the iPhone’s affordances both into their daily lives and into their course workflow. The portability, connectivity, and wealth of music-related applications for the iPhone were all highly rated by students. Table 37 compares the end of project survey feedback from the 2008 and 2009 mlearning project students. Table 37 shows that the 2009 students were much more enthusiastic about the impact of mlearning within their course.

Table 37: Comparison of Contemporary Music student satisfaction 2008 and 2009,

End of project Survey Question	**Percentage Student agreement/satisfaction with statement (strongly agree plus agree)**		
	2008	**iPhones 2009**	**iPods 2009**
4. What has been your experience of group work facilitated by Blogs and RSS?	67%	89%	100%
6. It was easy to use the smartphone?	83%	89%	75%
7. This mobile learning experience was fun.	100%	89%	75%
8. Based on my experience during this project, I would use a smartphone in other courses	50%	89%	75%
9. I would be willing to purchase my own smartphone?	33%	100%	75%
11. In your opinion, does mobile learning increase the quality of learning?	33%	100%	25%
12. Mobile blogging helped create a sense of community (group work)?	33%	89%	38%
13. Accessing your course blog was easy using the mobile device?	67%	78%	75%
14. Mobile learning increases access to education?	50%	89%	38%
15. Communication and feedback from the course tutor/lecturer were made easier?	50%	78%	38%
16. Mobile learning is convenient for communication with other students?	67%	89%	88%

What Table 37 does not show is that the 2009 iPhone students responded ‘Strongly agree’ far more than the 2008 students or the 2009 iPod students. This is due to the establishment of a more explicit and scaffolded learning community than 2008, facilitated by the weekly COP sessions as part of a specific course during semester one of 2009. However, the COP for the second semester project in 2009 (including the iPod students) was voluntary and scheduled late in the afternoons; therefore students did not value participation in this COP, with little sense of learning community formation occurring as a result.

7.3.3.2 Staff Feedback

Lecturers were asked to record VODCast reflections on the impact of the mlearning project within the course for 2009. Examples of these VODCasts can be viewed on YouTube: http://www.youtube.com/watch?v=o9p4i23CsPE and http://www.youtube.com/watch?v=n1jyNcRRFsw. Overall the 2009 lecturer feedback was very positive and evidenced a progression in their understanding of the pedagogical potential of mlearning within their courses in comparison to the 2008 project.

The Contemporary Music lecturers recognised the increased engagement and collaboration among their students as an outcome of the mlearning project, however a key issue indicated in Table 37 was the lack of engagement by the lecturers in using the iPhone to communicate regularly with the students, or to give regular formative feedback on the students' blogs and other web 2.0 sites. While students interacted by peer commenting, collaboration and a variety of forms of mobile communication, the course lecturers preferred to limit their student interaction to the face-to-face classes and tutorials. The main issue was that all of the course lecturers (except the course coordinator, who did not take part in the 2009 projects) were part-time (Between 20% and 50% weekly allocations), and instead of conceptualizing the mobile web 2.0 tools as facilitators of flexibility (Time and physical space) they tended to see them as intrusions upon their other responsibilities and their roles as professional artists and performers themselves. Thus a conceptual shift by the lecturers was required but not fully achieved. As Chi and Hausmann (2003) argue, the introduction of innovative technology requires ontological shifts, but Hameed and Shah (2009) argue that for these shifts to occur a cultural shift must occur within the organization that supports these shifts. Thus in the case of the Diploma of Contemporary Music lecturers, a change in their time-allocation is needed for these predominantly part-time lectures to engage with the new pedagogies that mlearning facilitate.

7.3.4 Implications for the Next Research Cycle

The integration of mlearning into the Diploma of Contemporary Music programme needs to move beyond the two courses achieved so far. In order to do this more of the course lecturers need to be brought from the periphery into the mlearning community of practice and experience the pedagogical potential of these tools. This will require a time allocation and timetabling commitment from the course director, as currently all but one of the course lecturers are part time, making it very difficult to facilitate a regular face-to-face COP involving more than one or two lecturers. Another key issue is facilitating student-owned WMDs to make the mlearning integration sustainable in the long term beyond institutionally loaned WMDs.

7.4 Case Study 3 Critical Success Factors

The integration of mlearning into the Diploma of Contemporary Music programme began as an initial investigation of the potential in 2008, and was followed by an integrated approach informed by the 2008 experience in 2009 into two courses. The initiative allowed the integration of context bridging learning and flexible access to computing for students whose bottleneck had been a single Macintosh computer lab across all of the courses within the Diploma. While students evidenced significant change in their coneptualisations of learning and collaboration, the researcher observed that the course lecturers' need to develop further conceptual changes to maximise the unique affordances of mobile web 2.0 beyond specific assignments within the course.

7.4.1 Pedagogical Change

The 2008 Diploma of Contemporary Music project served as an initial investigation of some of the potential of mobile web 2.0 within the course. The project highlighted the need for lecturer appropriation of the tools and identified the key issue of course integration including summative and formative assessment. Student engagement simply on the basis of using the 'coolest' phone or media player in the world is not sustainable when the pressures of course deadlines for assessments loom. Following the 2008 mlearning project, the Contemporary Music course lecturers' experience with mobile web 2.0 tools enabled them to be better equipped for developing new pedagogical approaches for future projects that facilitate the establishment of personal learning environments for students beyond the confines of the institutionally hosted learning management systems. In particular the 2009 projects investigated the use of MySpace, student created podcasts, and microblogging as authentic mobile learning environments, as recommended by Herrington and Herrington (2007), within the context of music delivery, promotion and critique.

7.4.2 Community Formation

Contemporary Music students demonstrated creative use of the mobile web 2.0 tools within their courses in 2009, and evidenced increased engagement, particularly with group work and the levels of reflection on their blogs. Peer support for negotiating technical issues was also evidenced (as illustrated by peer support for re-jailbreaking the iPhones after firmware updates), and student feedback illustrated how the students used the iPhones to increase access to learning materials, and revision and critique of rehearsals and performances. The indications are that students benefited from the mobile web 2.0 projects by developing collaborative and teacher independent learning skills in a wide variety of contexts mediated by the iPhone (Cook, et al., 2007; Uden, 2007). However, the mobile web 2.0 integration was most successful when scaffolded and supported by a regular intentional COP embedded into a course facilitated by the researcher as the technology steward in semester one 2009. When this was made optional in the second semester 2009 the project suffered from a lack of a sense of learning community and students tended to use the iPod Touches mainly for their default affordances (media players and web device) rather than leveraging the potential of the devices that the COPs investigated. A commitment needs to be made by the course lecturers to embed the COPs within the course and assign them as much authenticity and importance as the rest of the course requirements.

7.4.3 Lecturer Modeling

Course lecturers need to appropriate the mobile web 2.0 tools into their own daily routines and gain an understanding of the affordances of these tools for their pedagogical toolkits. This requires sufficient time for exploration of the affordances of the mobile web 2.0 tools, and lecturer professional development, and should be factored into such projects.

7.4.4 Ontological Shifts

The Contemporary Music lecturers have yet to fully realize the potential of the mobile web 2.0 tools for providing students with regular formative feedback on their learning progress. Being part-time lecturers, they conceptualise themselves first as artists and performers rather than teachers, and invariably revert to an apprenticeship model of teaching. Thus the disruptive nature of mlearning that can facilitate a move from teacher-centered pedagogy to student-centered andragogy and even self-directed heutagogy has yet to be fully realized or appreciated within the course. However, the dawning's of lecturer awareness of this potential are beginning to be visible, even though they are still skeptical as illustrated by the lecturer feedback from 2009. The process of lecturer ontological shift (Chi & Hausmann, 2003; Hameed & Shah, 2009) with regards to pedagogical reconceptualization is lengthened within a part-time lecturer environment.

7.5 Chapter Summary

Chapter seven overviewed and analysed the Diploma of Contemporary Music mlearning projects from 2008 to 2009 using the identified critical success factors (section 3.8) as a critical framework. The case study highlights the importance of course integration of mlearning and the sustained engagement of a supporting community of practice to bring about lecturer ontological shifts reconceptualising pedagogy.

8 CASE STUDY 4: BACHELOR OF ARCHITECTURE, 2009. (LECTURER DEVELOPMENT AND COURSE INTEGRATION)

This section overviews and critiques the 2009 mobile web 2.0 project within the Bachelor of Architecture year two course, which drew upon the lessons learned from the Landscape Design, Product Design, and Contemporary Music mlearning projects. The Bachelor of Architecture 2009 project used the Nokia XM5800 smartphone and the Dell Mini9 netbook. Table 20 in section 4.4.5 provides a project and participant summary.

The chapter is structured into a description of the project, followed by the identification and discussion of themes arising from the first research cycle, and the design implications identified for the following cycle. The chapter then draws together these themes to identify critical success factors related to the implementation of mobile web 2.0.

8.1 Background

With the opportunity of funding for an additional two hundred smartphones in 2009, larger projects beyond the three established case studies described in chapters 5 to 7 were achievable in 2009. Having heard about the previous mlearning projects, lecturers within the school of Architecture at Unitec had expressed interest in exploring the potential of mlearning within their courses. Thus the researcher brainstormed the possibilities with the architecture technology lecturer who then partnered with the researcher to facilitate the instigation of an architecture-based mlearning project in 2009. The Architecture technology lecturer identified the second year architecture course with 115 students as a potential host for the proposed 2009 mlearning project. The architecture mlearning project was an opportunity to take the mlearning projects to an order of magnitude larger than previously implemented, and thus provide feedback on the scalability of the mlearning design, implementation, support and evaluation processes. The architecture technology lecturer therefore invited his peer second year architecture lecturers to form a COP investigating the potential of mlearning to enhance the course, facilitated by the researcher in semester one 2009.

8.1.1 Architecture Lecturer COP 2009

Architecture lecturers were asked to identify needs within the course that WMDs could meet (See using the “Wireless Mobile Device Need Analysis” form found in Appendix 13.5). Key issues identified by the lecturers included: facilitating connectivity for communication and access to online course material, and providing this connectivity and access to enhance the architecture studio environment that spanned four separate lecture spaces with no computer access. Lecturers also responded to the questionnaire that they believed that their students would be more familiar with computing and mobile technologies than themselves. This provided a basis on which to establish an architecture lecturer mlearning COP, which was formed during the second half of semester one 2009, facilitated by the researcher as the technology steward, to investigate the potential of mobile web 2.0 tools to enhance the course, and to familiarize the lecturers with these tools. The approach developed for the previous mlearning COPs and projects was used to guide the implementation of this COP, with the architecture project instigating lecturer inviting other lecturers to become participants in the COP. Participants were each provided with a Nokia

XpressMusic 5800 smartphone and a Dell Mini9 3G netbook. The Architecture mlearning COP was cultivated by a weekly meeting of the participants at one of the Campus Cafés. Participants brought along their WMDs and discussed pedagogical and technical issues around the use of the mlearning tools facilitated by the researcher. The architecture lecturer COP was scaffolded by the use of a Moodle course created by the researcher; with a variety of mobile web 2.0 affordances investigated and experimented with, including the establishment of participant Vox blogs, YouTube accounts, and mobile video streaming via Qik. An example compilation of participant COP activity was uploaded for viewing on YouTube http://www.youtube.com/watch?v=cj20YUisVBM and used to encourage other lecturers to join the COP or at least participate on the periphery of the COP virtually.

As the COP progressed, the lecturers began to gain insights into the potential of mobile web 2.0 to enhance the course, as illustrated by the following lecturer blog post reflection.

> MLearning presents immense possibilities in the field of Architecture, particularly in the student crit area I believe. For example, facilitating the recording of crits and student feedback – they often say they can't remember what they said or did during the crit. This would enable them to record their crits and even for them to do their own pre-crit recording in order to gain some confidence in this area. (Architecture lecturer, May 2009)

The goal of the Architecture mlearning COP was to develop lecturer competency with the tools and establish a plan for mlearning integration into the second year studio course in semester 2 of 2009.

8.2 2009 Project: Mlearning Exploration

As reflections on the previous mlearning projects had established that critical success factors for implementing mlearning included the level of integration of the technology into the course and assessment, the negotiated plan was to include the use of moblogging within the second year Architecture compulsory Studio course as a new form of documenting, sharing, and critiquing students' individual and group design projects. However, the studio-coordinator lecturer responsible for setting the assessments for the course declined to be involved in the lecturer COP and decided not to allow the integration of mlearning into the course assessment. Discussions held between the researcher, the COP participants, and the studio coordinating lecturer did not mange to bridge this impasse. The reasons cited by the coordinating lecturer were: "Architecture is not interested in process, only the final design, and therefore design journaling will not benefit the course", and secondly "In the Studio course the face-to-face interaction is of primary importance". While both of these assumptions were hotly debated, the coordinating lecturer refused to be persuaded. From the researcher's perspective, it appeared the root of the dispute was really about the threat of the project to the centralized control imposed upon the course by the coordinating lecturer. Within the context of the research, the ontological leap (Chi & Hausmann, 2003) from lecturer-focused pedagogy to a social constructivist student-centred pedagogy facilitated by mobile web 2.0 was too much for the coordinating lecturer to bridge. Also the potential for mobile web 2.0 to create or enhance context-independent learning communities (Cook, et al., 2007; Cook, et al., 2008) was beyond the lecturer's experience and ability to conceptualise. Thus the 'disruptive' nature of mlearning (Sharples, 2001; Stead, 2007) was viewed by the coordinating lecturer in a negative light, rather than positively as it had been found to be within previous projects. However, the lecturers who had been involved in the COP were keen to continue the project. Thus the mlearning project became a voluntary option for the second year Architecture students rather than integrated into the course assessment as had been planned, but was promoted and supported by the lecturers involved in the architecture COP (six of the nine second year lecturers). While this was a definite setback for the project, it was decided to go ahead as a proof-of-concept exploration anticipating that the student response would be positive and facilitate a re-think by the non-participating lecturers for 2010.

8.2.1 MLearning Project Outline

An initial overview of the mlearning project was presented to all of the second year architecture students by the researcher and one of the COP Architecture studio lecturers who had become an 'evangelist' for the project. An outline of mobile web 2.0 affordances chosen to enhance student collaboration, sharing and critique was provided to the students to provide a framework for the project (See http://docs.google.com/View?id=dchr4rgg_87d83pvddq "Architecture MLearning Project Outline 2009"). Subsequently, all of the second year Architecture students volunteered to take part in the mlearning project, and were supplied with a Nokia XpressMusic 5800 smartphone and a Dell Mini9 3G netbook for the duration of the second semester 2009 (http://www.youtube.com/watch?v=sBp3dKbbmuA). Feedback from the Architecture lecturers indicated that this was the first time that all of the second year Architecture students had ever turned up for the Studio session.

Students were surveyed to determine their previous technology usage prior to the mlearning project (See Figure 27).

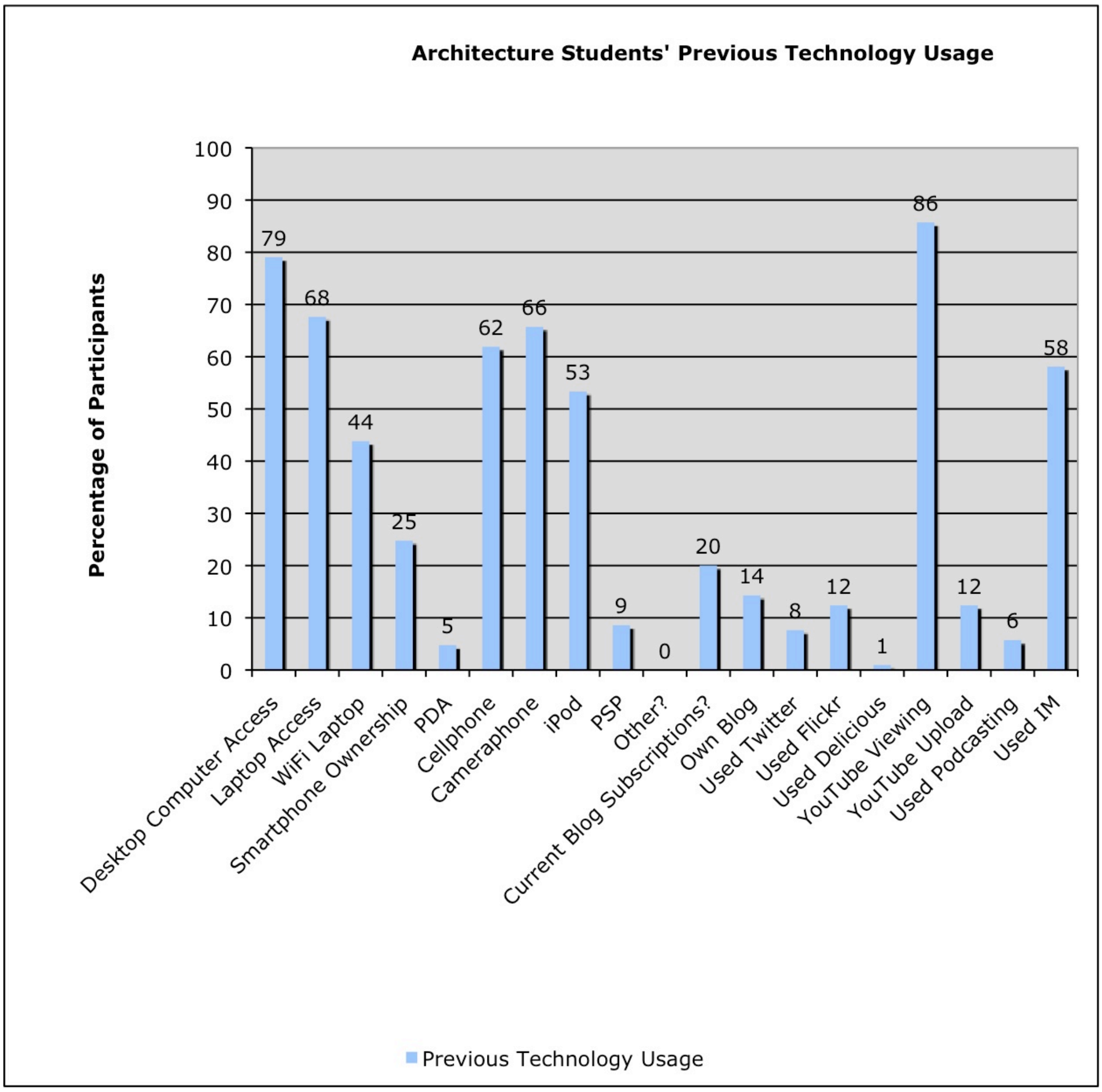


Figure 27: Architecture student previous technology usage.

Contrary to the notion of "digital natives" (Prensky, 2001) the 2009 students technology usage as shown in Figure 27 indicates that they were predominately consumers of web 2.0 rather than producers. Social communication was relatively common, and the number of iPod owning students was higher than the earlier mlearning projects.

8.2.1.1 Mobile Web 2.0 Scenarios

Participating students and lecturers found a variety of uses for the smartphones. Some example mobile web 2.0 scenarios are outlined in this section.

As a fun and engaging way of capturing students' attention, QRCodes were created by the lecturers, printed on A4 paper and taped to the Studio doors as 'secret' notices that students had to decode using the smartphone's camera and QRCode reader application. QRCodes were also posted to discussion forums on the supporting Moodle course, and a QRCode 'joke' competition was established.

The use of live video streaming via Qik on the smartphones was demonstrated to the students. Several students then used Qik to stream lectures and project updates while on campus over the free WiFi network.

Capturing still images and video via the smartphones built-in camera was a favourite student activity. These were then uploaded directly to their blogs, or transferred to computers for later uploading and viewing.

Students created a smartphone game ladder competition, with four students able to play wireless multiplayer car racing over bluetooth at a time. Students also used bluetooth file transfers, utilizing the smartphones as wireless memory cards and backup storage.

Two students created Vox groups and most of the blogging students joined these groups to share their group work as part of their group design project. Media items were uploaded to the groups using the smartphones.

8.2.2 Themes Arising

This section is a short summary of the student feedback from the end of project survey and focus group, and blog analysis available at https://docs.google.com/fileview?id=0B9kx7n-UKqvBMTEyNTJlMzgtZjE0My00MThjLTgzNDgtN2ZjOGY0YTFlZDg3&hl=en_GB. While only 30 percent of the students actively participated in voluntarily blogging about their course projects, virtually all of the students enjoyed the mlearning project experience (88 percent). The main reason cited by students for not getting involved with the optional blogging was the lack of any course credit attached to the activity. Indeed several of the student bloggers requested that course credit be associated with blogging for 2010 to encourage wider participation and value to be associated with the activity. Many students were highly enthusiastic about the mlearning project (80 percent would like to see mlearning integrated into more of their courses), with a variety of opinions given regarding the capabilities of the smartphone and the netbook. The small size of the netbook tended to polarize student opinion; they either loved its portability or hated the small screen and keyboard. Those most disenchanted by the netbook already had their own full size laptop that they preferred to continue using. Feedback on the smartphone was mostly positive, with only a small group of students experiencing problems with learning the smartphone's interface. Invariably these students were the ones who did not attend the optional COP sessions. Students particularly liked the camera integration with the smartphone, and the ability to be connected to the Internet anywhere, anytime.

While the majority of the students were very enthusiastic about their first use of Moodle within the Architecture course, the introduction of moblogging via Vox also provided a catalyst and vehicle for students to independently create learning communities beyond the physical studio space, and beyond institutional control.

8.2.2.1 Scaffolding the mLearning Project

A positive side effect of the mlearning project was the development of the integration of the use of Moodle as an LMS for Architecture courses. Moodle courses grew from one at the start of the mlearning Lecturer COP in semester one 2009 to nineteen during semester two of 2009. The use of Moodle as a scaffold for the lecturer mlearning COP in semester one was modeled by the researcher and introduced the lecturers to the potential of using Moodle as an LMS for their own courses with their students. Moodle was also used to scaffold the semester two mlearning project with the students, which was students' first experience of using an LMS within the context of their Architecture course. A weekly COP involving the volunteering students and lecturers facilitated by the researcher as the Technology Steward (Wenger, et al., 2009; Wenger, et al., 2005) was established as a face-to-face focus of the mlearning project, with a Moodle course, discussion forums and students' own Vox blogs forming virtual interactive spaces beyond the face-to-face studio sessions. Approximately thirty students attended these COP sessions, leading to an uptake of almost 30 percent of the students' voluntarily blogging as part of the mlearning project. The student-focused COP mainly explored technical support issues regarding mobile blogging, video streaming, QRCodes and other mobile web 2.0 affordances of the smartphones.

8.2.2.2 Course Integration and Community Building

The lecturer mlearning COP (Begun in semester one) continued throughout the length of the project implementation with the architecture students, forming a vehicle for supporting, reflecting and evaluating the project as it progressed. Discussions with the architecture lecturers and part-time tutors highlighted an interesting comparison of perspectives on student learning between the lecturers' conception and student realities. The lecturers conceptualised the face-to-face Studio environment as extremely important for facilitating learning in the discipline of Architecture. However, discussions between the researcher and two of the part-time Architecture tutors who were also Masters students revealed that these tutors believe the Studio face-to-face environment is not working. They commented that with 115 students spread across four Studio spaces there were too many students to efficiently create a face-to-face learning community. The reality was that very few students' regularly attended the weekly timetabled Studio sessions. The tools investigated by the mlearning project could potentially produce a learning community where one did not currently exist, providing students with a flexible environment for creating a learning community, as evidenced by those students who voluntarily used Vox groups to develop a learning community independently of the lecturer-generated face-to-face Studio environment. Approximately 30 percent of the students created Vox blogs, and the majority of blogging students also created and participated in two student created Vox 'Groups' focused around the two main projects for the Studio course in the second semester. The student interactions and tutor feedback in the Vox groups created a sense of community. This is supported by Brown's exposition of the architecture studio as a model for interactive learning environments in the digital age using social software:

> This is Dewey for the digital age: a profoundly social construction of understanding enabled by the Internet. The demand-pull approach draws students into a rich (sometimes virtual) learning community built around a practice. It is passion-based learning, intrinsically motivated by either wanting to become a member of that community of practice or just wanting to learn about, make, or perform something. Formal or informal, learning happens in part through a kind of reflective practicum, but here the reflection comes from being embedded in a social milieu supported by both a physical and virtual

presence and inhabited by both amateurs and professionals. (Brown, 2006, p. 23)

8.3 Implications for the Next research Cycle

Building on the lessons learned from the staged and scaffolded approach to mlearning integration into the Bachelor of Product Design course in 2009, a similar approach will be adopted for future mlearning integration within the Bachelor of Architecture course. As students indicated in their feedback in the final survey and focus group, the length of the project was too short to achieve its goals, and would be better spread over at least the entire second year course rather than a single semester. Rather than an isolated project within the second year of the course, mlearning integration into the programme will be better achieved by being staged and scaffolded across all four years of the course, and bringing all of the Architecture lecturers into the supporting community of practice. This will facilitate integration of mlearning into the course assessment and also scaffold the change in pedagogical approaches required by the lecturers. This approach will facilitate the integration of innovative mlearning as recommended by Chi and Hausmann (2003), and Hameed and Shah (2009).

8.4 Case Study 4 Critical Success Factors

Mlearning case study four highlights two of the identified critical success factors for mlearning integration: the level of pedagogical integration within the course, and allowing time for developing ontological shifts among the participants – in particular for the course lecturers that determine the pedagogical integration. The 2009 Architecture mlearning project was the first attempt at integrating mlearning into the architecture curriculum, and as has been found with each mlearning case study throughout the length of the research, the impact of the first mlearning project within a new context is predominantly in creating awareness of the pedagogical potential of mlearning and awakening the lecturers and students to the necessary ontological shift towards social constructivism that mobile web 2.0 facilitates. As Herrington and Herrington (2007) have observed, when introducing the use of new technologies into a course, “educators revert to old pedagogies as they come to terms with the capabilities of new technologies, referred to by Mioduser, Nachmias, Oren and Lahav (1999) as ‘one step forward for the technology, two steps back for the pedagogy’ (p. 758).” The non-participating lecturers reacted by strongly asserting the appropriateness of the traditional architectural design studio. However the mlearning project did present a window into the potential of a design studio pedagogy that was not bound by a predetermined physical space. So while the first mlearning project implementation did not transform the pedagogy of the course, it set the foundation on which to build this transformation in subsequent iterations. Although voluntary establishment of a supporting virtual learning community was achieved involving almost a third of the architecture students, the lack of integration into the course assessment limited the impact of the mlearning project. Key lecturers who did not engage with the pre-project mlearning COP presented a gap that could not be bridged during the implementation stage of the project. Finding an appropriate way of bringing these lecturers from the periphery of the mlearning community of practice and into the core of the COP will require some creative thinking. The subsequent 2010 Architrecture mlearning project focused upon developing a core group of lecturers and students within the programme to become a hub of technology stewards (both lecturers and students) from which others will be drawn in from the periphery.

8.5 Chapter Summary

Chapter eight overviewed and analysed the 2009 Bachelor of Architecture mlearning project using the identified critical success factors (section 3.8) as a critical framework. In guiding and designing the project the researcher drew upon the lessons learnt from the preceding 2007 and 2008 mlearning projects within the Diploma of Landscape Design, the Bachelor of Product Design, and the Diploma of Contemporary Music. However, for the participating lecturers this was their first foray into mlearning integration, and crucial lecturers remained on the periphery of the supporting community of practice, limiting the impact of the project. The case study highlights the critical factor of getting lecturers on-board with a supporting community of practice scaffolding the implementation and pedagogical integration of the mlearning projects within a course.

9 CASE STUDY 5: PERFORMING AND SCREEN ARTS, 2009 (COMMUNITY BUILDING).

This chapter overviews and analyses the 2009 mobile web 2.0 project within the Bachelor of Performing and Screen Arts Film and Television third year course, which was based upon the lessons learned from the Landscape Design, Product Design, and Contemporary Music mlearning projects. The 2009 Bachelor of Performing and Screen Arts project used Dell Mini9 netbooks and Nokia XM5800 smartphones. See Table 21 in section 4.4.5 for a project and participant summary.

The chapter is structured into a description of the project, followed by the identification and discussion of themes arising from the first research cycle, and the design implications identified for the following cycle. The chapter then draws together these themes to identify critical success factors related to the implementation of mobile web 2.0.

9.1 Background

The Performing And Screen Arts (PASA) mlearning project was born out of the relationship developed between the researcher (as an academic advisor) and one of the PASA lecturers who was passionate about integrating the use of new technologies into the PASA courses. Discussions led to the development of a series of lectures for third year PASA students based around the third year New Technologies course. The researcher participated in this lecture series in 2007 presenting overviews of current and emerging web 2.0 and mobile web 2.0 technologies relevant to the students' future professions in film, television, performance, and audio. In particular, the focus was upon new media distribution and delivery methods and the growth of user content creation sites such as YouTube. The researcher's previous teaching practice was in the field of audio engineering and music production, and thus the researcher was passionate about the integration of new technologies for enhancing student-centred learning in these contexts. Involvement in the PASA new technologies lecture series then led to the researcher and the course lecturer establishing a lecturer COP within the PASA department in 2008 and 2009 to increase awareness of and create momentum for integrating mlearning into the PASA curriculum in 2009. Discussions between the researcher and the PASA course lecturer allowed the researcher to make a general profile of the PASA course. The predominant pedagogy in the PASA department was based upon an apprenticeship model, with very high staff to student ratios, expensive computer-based video and audio editing equipment, and therefore high costs and low profit margins. These factors had led to low investment in the supporting technologies for the courses: there were no dedicated general purpose computer facilities for students, expensive video and audio computer editing suites were not networked, and the school had no wireless network coverage. Consequently teaching methods were face-to-face instruction with no integration of the wider institutions online LMS into the courses, as students had little opportunity to access online material. The researcher and PASA course lecturer therefore saw the introduction of mlearning into the department as an ideal opportunity to disrupt the status quo (Sharples, 2001; Stead, 2006), introduce ubiquitous wireless connectivity and facilitate a move to social constructivist pedagogies using cost-effective mobile web 2.0 technologies.

9.1.1 Lecturer COP 2008

The 2008 PASA lecturer COP was established as a partnership between the researcher as the COP technology steward and the course lecturer as the local context coordinator or convener. The course lecturer invited his peer lecturers to participate in the COP that ran weekly face-to-face over a semester. Participants were supplied with wireless netbooks by the researcher and the COP investigated the potential of the netbooks, web 2.0, the institutions LMS, and mobile web 2.0 to enhance teaching and learning within the department. At the same time, the researcher worked with the institutions IT department to provide WiFi coverage for the PASA department. This lecturer COP set the groundwork for the 2009 mlearning project.

9.1.2 Lecturer COP 2009

Institutional funding provided the opportunity for the PASA department to establish an mlearning project in 2009, providing students and lecturers within the Film and TV course (as identified by the researcher and the course lecturer) with both wireless netbooks (Dell Mini9) and smartphones (Nokia XM5800). The project began with the re-establishment of a lecturer COP in semester one of 2009 (See the following QIK videostream for an example COP session http://www.youtube.com/watch?v=y3x4Bzm-RbY) whose purpose was to plan the integration of the mlearning project into the course in the second semester of 2009. Key aspects of the lecturer COP included the lecturers, guided by the researcher as the COP technology steward, defining their pedagogical approaches and a mobile web 2.0 needs analysis (Appendix 13.5), which then led to the assessment integration design for the second semester mobile web 2.0 project with the students. This intentional

COP meet weekly in one of the campus cafés with the seven participants using the WMDs supplied by the researcher.

PASA lecturers defined their pedagogical approaches in two main categories: "social constructivist, experiential learning" (PASA lecturer1, 2009), and "socratic questioning" (PASA lecturer2, 2009). They were unanimous in their belief that mlearning could enhance both their teaching and their students' learning experiences. This provided a good basis upon which to build the student mlearning project in semester two of 2009.

9.2 2009 Project: Mlearning Appropriation

Unlike the other mlearning projects, the PASA mlearning integration was focused on the context of the mlearning tools themselves as key new technologies that were becoming important in reinventing and democratizing the recording and distribution of film that was having significant impact on the film and television industry. The WMD tools themselves were thus the focus of learning rather than being used as mediators (Uden, 2007) and bridges of external learning contexts (Vavoula, 2007a) as in the other mlearning projects. However the researcher was hopeful that both students and lecturers would see the potential of mlearning to impact and enhance the pedagogical foundations of the course beyond this specific context.

9.2.1 MLearning Project: Third Year New Technologies Course 2009

The outcome of the lecturer COP in 2009 was the development of an ambitious mlearning project within the third year New Technologies course in semester two. The researcher and the lecturers met to critique the proposed mlearning plan, and with the researchers guidance decided to reduce the scope of the project to a smaller set of outcomes that would be more achievable within the allocated timeframe for the course. The resulting project focused upon an investigation of the potential of mobile web 2.0 technologies within the field of Film and Television. Table 21 in section 4.4.5 outlines the project participants and the project design.

9.2.1.1 FTV Year3 New Technologies Assignment

The following is a brief summary of the assignment outline for the course (Table 38). The full course assignment outline is in the "Bachelor in Performing and Screen Arts 2009 mLearning Outline" http://docs.google.com/View?id=dchr4rgg_92hjs77jvf.

Assignment Brief:

> Research developing trends in new and emerging technologies and critically reflect on [anticipate / predict / evaluate] its impact on your specialist area and career path. (Course outline, 2009)

Table 38: New and Emerging Technologies Assignment 2009.

Assignment 2:	**New & Emerging Technologies - Presentation** With modern connectivity tools, create an integrated media presentation which examines an emerging technology within your specialty and which projects the students' possible career path involving that technology. for example: Create & present/share/critique a YouTube video Picasa Slide Show, including geotagging

Topics covered by the mlearning project included: mobile video streaming and sharing, collation and broadcasting mobile video using Livestream or UStream, creating an online identity, and associated business practices. The course lecturer created a Vox group, and all resources for the project were shared with the class via this group page (http://unutechsy309.groups.Vox.com/), including links to several Google Docs.

9.2.2 Scaffolding mLearning

Because the focus of the project was a very specific niche market use of the mlearning tools, the course lecturer organized a specialist new media guest lecturer to facilitate the introduction of the mlearning technologies within this context. So while the researcher again took on the role of the technology steward (Wenger, et al., 2009; Wenger, et al., 2005) within the project he had less direct input into the direction of the project with the students than in the other mlearning projects. However the researcher was still involved as an active participant in the project with the students. This combined with timetabling pressures led to a rather different mlearning project COP formation scenario than previous projects. The project consisted of an introductory session by the researcher (http://www.youtube.com/watch?v=8YugBJz4-no, http://www.youtube.com/watch?v=Ct5iBSz8ai4) where the students were supplied with the netbooks and smartphones and given an overview of their use and the web 2.0 applications, followed by a gap of two months, then five guest lecturer facilitated COP sessions covering the Film and TV context affordances of the smartphones within a period of two weeks (http://www.youtube.com/watch?v=00d-t0F9AzY). The COP timeframe was therefore far more compressed and intense than in the other mlearning projects. This structure is outlined in Table 39.

Table 39: PASA mlearning project outline 2009.

Project activity	Date	Scaffolding tools	Pedagogical Focus
New Technology mlearning overview	June 2009	Wiki	Pedagogy, introductory overview
Mlearning project initiation	July 2009	Moodle Vox	Andragogy, student content creation
Video Streaming	7 September	Vox Group Mindmeister Google Docs	Andragogy, student content creation
YouTube Remixing	9 September	Vox Group Mindmeister Google Docs	Andragogy, student content creation
Live Streaming	11 September	Vox Group Mindmeister Google Docs	Andragogy, student content creation
Online identity formation	15 September	Vox Group Mindmeister Google Docs	Metacognitive
Crowd sourcing and web 2.0 business models	18 September	Vox Group Mindmeister Google Docs	Metacognitive
Final student project presentations	16th and 17th November	YouTube	Metacognitive

The researcher observed that the compressed nature of the project did not facilitate the sustained engagement and sense of learning community formation that the other 2009 mlearning projects had, which were distributed over at least a semester with regular weekly face-to-face sessions.

9.2.3 Mobile Web 2.0 Scenarios

The following section outlines examples of the students' mobile web 2.0 usage during the project.

The researcher participated in critiquing the students' final mobile video presentations, and questioned the students regarding the impact of the mlearning project on their learning. In general the students were very positive about their experience of using mobile technology to record their final presentations. The quality of the audio and video produced by the smartphones were considered acceptable for web distribution, however most students expressed preference for a higher quality built-in camera. The supplied Nokia XM5800 smartphones had a modest 3.2MP built-in camera. The following are links to example student final mobile-recorded presentations (Table 40):

Table 40: Examples of PASA student final mobile presentations.

Topic	Video Links
Peer to peer file sharing	http://rockjonny.Vox.com/library/video/6a0110183b8030860f0123ddead755860d.html
Mobile video editing	Screenshots: http://www.youtube.com/watch?v=jKjTMFsFFdc Overview: http://www.youtube.com/watch?v=O8s7tqMkkGQ Example: http://www.youtube.com/watch?v=iv6pLJ8qmmc
Falling in love with the smartphone	http://www.youtube.com/watch?v=iM8e9ToLOVA
Skype communication for actors	http://www.youtube.com/watch?v=mcHciU9X0OA
Mobile Interviews	http://www.youtube.com/watch?v=THczDgoMl_E

Beyond the specific mobile presentation assessment for the course, students and lecturers experimented with a range of mobile web 2.0 affordances that enhanced their personal workflows throughout the rest of their courses.

PASA students appropriated (Carroll, et al., 2003; Davis, 1989; Delaney, et al., 2008) the use of mobile video streaming via QIK on the smartphones in a variety of ways. For some students video streaming became their preferred way of documenting ideas and reflections rather than Vox text-based blogging. Qik was also used to share learning experiences with students who could not physically get to some classes. An example Twitter screenshot is shown below in Figure 28, where a student slept-in missing one of the mlearning COP sessions, however as she announced her predicament on Twitter, the researcher was able to video stream the COP session live for her to follow along with and also archive the session for later viewing. Twitter became a favourite virtual community-building tool for the PASA students, compensating for the lack of regular face-to-face COP community formation in comparison to the other 2009 mlearning projects.

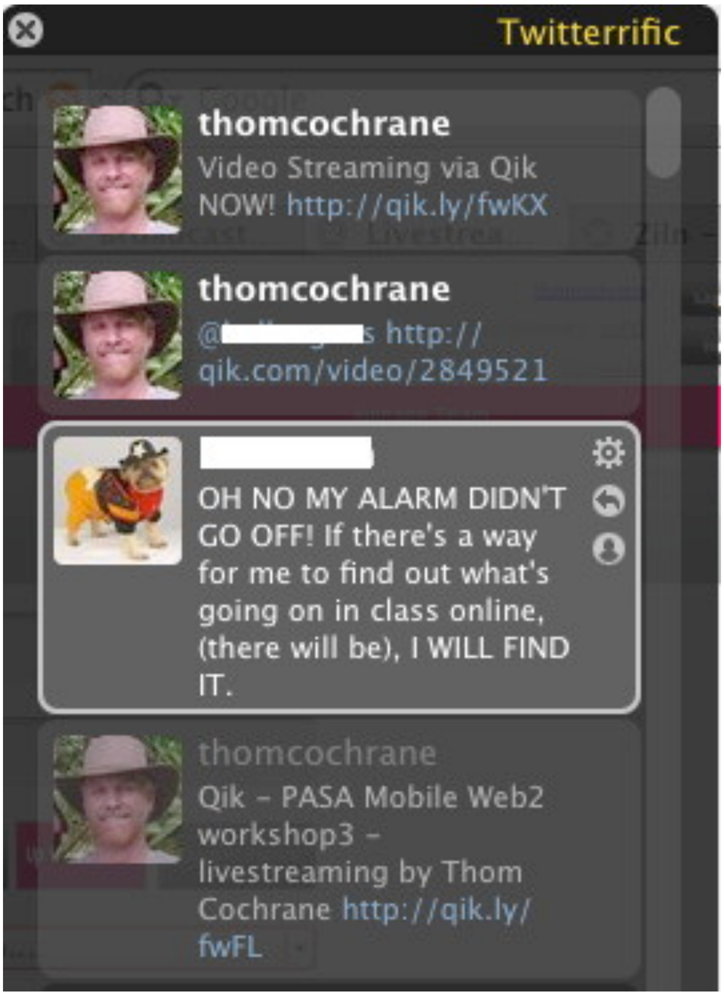


Figure 28: Twitter screenshot of Qik streaming announcement.

A lecturer from the Performing and Screen Arts COP experimented with using QIK via the supplied smartphone to record and share pre-class introductions to students (http://qik.com/miltonjustice). He also used GoogleTalk (http://www.google.com/talk/) video conferencing on his wireless laptop to bring an expert film scriptwriter into the classroom live to debate script and directorial issues with PASA students. A snapshot of the resulting learning scenario is available on

YouTube at http://www.youtube.com/watch?v=oQM9kOBpDEk. This example illustrates the use of web 2.0 to bridge learning contexts (Cook, et al., 2008; Herrington & Herrington, 2007; Vavoula, 2007b).

A survey of PASA student WMD usage shown in Figure 29 indicates PASA students personally appropriated the use of the WMDs and web 2.0 technologies in a wide range of daily activities, and when compared to the results of the same survey of the other mlearning projects, the PASA students experimented with the unique affordances of the WMDs more than the other 2009 mlearning project student groups.

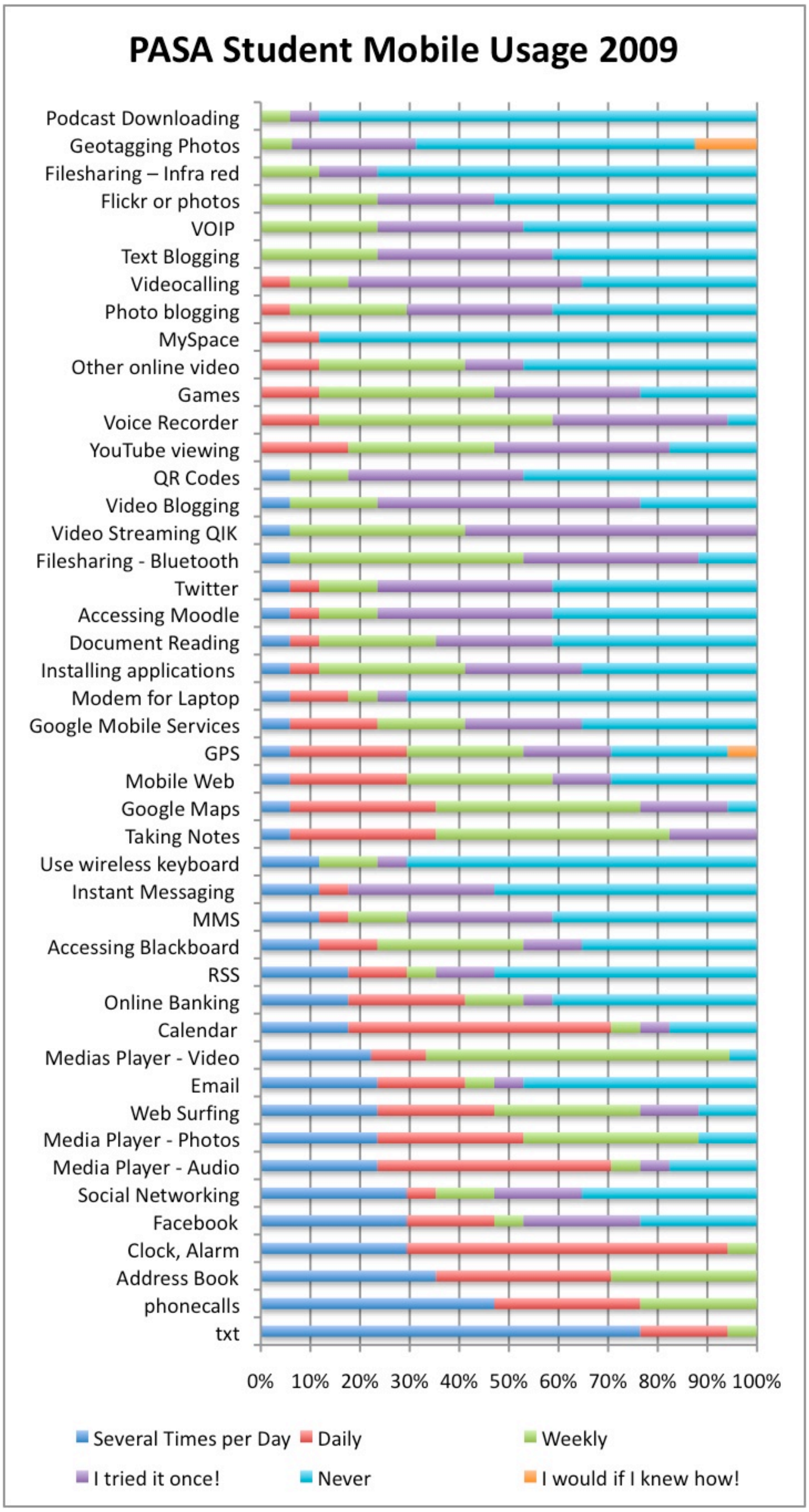


Figure 29: PASA third year students' mobile usage 2009.

Student usage of the smartphones included a variety of contexts beyond the classroom, as indicated by the following student survey feedback: "I use the Nokia to view my timetable or crew call sheets, which became very handy being so mobile. The netbook is not something I'd carry around as the phone offers everything that has and more" (PASA student survey feedback, 2009).

9.2.4 Themes Arising

A comparison of the three mlearning project groups that used the combination of both the Dell Mini9 netbook and Nokia XM5800 smartphone in 2009 is useful to identify emergent themes.

Figure 30 gives a comparative overview of the PASA students' previous technology experience in relation to the two other mlearning project student groups that were also supplied with the Dell Mini9 netbooks and Nokia XM5800 smartphones in 2009 (First year Bachelor of Product Design, and second year Architecture).

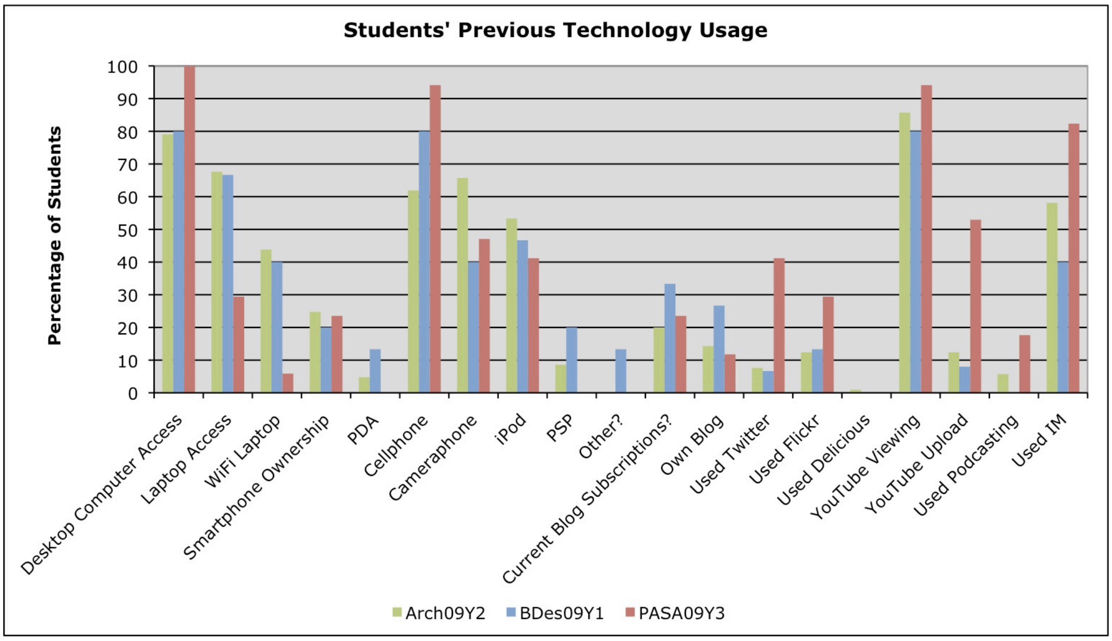


Figure 30: Comparison of students' previous technology usage 2009.

Most notably, the PASA students personal wireless laptop ownership was much lower than that of both the Architecture and Product Design students. Possibly as a consequence of a previous (before the mlearning project) lack of wireless connectivity in the department. This appears to have been influential in the PASA students' personal appropriation of the netbooks and smartphones, which was much higher in general than that of the other two student groups. The flexibility of WiFi Internet connectivity established as part of the mlearning project and afforded by the WMDs was greatly appreciated by the PASA students. Another difference between the PASA students to the other two 2009 mlearning student groups indicated by Figure 30 was their level of engagement with Twitter and YouTube content creation, which was higher than the other student groups. The context of their studies being Film and TV made their engagement with YouTube contextually relevant, whereas their appropriation of Twitter appeared to be a convenient way of forming student learning and social community with the connectivity and technology they had available before the mlearning project (cellphones rather than laptops).

Student survey and focus group feedback indicated that in comparison to the other two student groups, the majority of the PASA students found the interface of the smartphone easy to use with little problems encountered. "It was so quick and easy and made me access my blog more often than I would have without it" (PASA student focus group feedback). This may have been due to a more recent version of the smartphone's firmware being installed, or a difference in socially determined technology expectations between the groups. As Bijker et al. (1987) argue, the social determination of technology strongly influences its uptake and development. The researcher's experience with a variety of mlearning projects (2006 to 2009) has shown that a strong vocal student proponent or opponent of the project or technology can influence the student groups, particularly when lecturers are ambivalent or not acting as strong pedagogical modelers of the technology. This was the case with the 2009 second year Product Design mlearning project, where the lecturer was ambivalent about the project, and an older (mature) student in the group was vocally negative of the project. In comparison there were several vocal student proponents of the mlearning project in the 2009 PASA group. Further student comments and feedback are available at http://docs.google.com/fileview?id=0B9kx7n-UKqvBY2ExYWVmZWMtMzgwNy00NTExLThjNjAtZGU5YWY5MTg0M2Zm&hl=en_GB.

Table 41 provides a comparison of the final student survey feedback from three of the 2009 mlearning projects.

Table 41: Comparative student satisfaction with mlearning projects 2009.

End of project Survey Question	**Percentage Student agreement/satisfaction with statement (strongly agree plus agree)**		
	ArchY2_09	**BDesY1_09**	**PASAY3_09**
4. What has been your experience of group work facilitated by Blogs and RSS?	42%	100%	51%
6. It was easy to use the smartphone?	92%	58%	88%
7. This mobile learning experience was fun.	88%	86%	88%
8. Based on my experience during this project, I would use a smartphone in other courses	80%	56%	77%
9. I would be willing to purchase my own smartphone?	62%	43%	88%
11. In your opinion, does mobile learning increase the quality of learning?	62%	43%	53%
12. Mobile blogging helped create a sense of community (group work)?	53%	43%	29%
13. Accessing your course blog was easy using the mobile device?	52%	56%	71%
14. Mobile learning increases access to education?	75%	70%	82%
15. Communication and feedback from the course tutor/lecturer were made easier?	64%	43%	59%
16. Mobile learning is convenient for communication with other students?	91%	42%	88%

As Table 41 indicates, virtually all of the students enjoyed the mlearning project and valued the connectivity afforded by the WMDs. However, the PASA project returned the lowest satisfaction score for the facilitation of a learning community, due to the lack of regular weekly COP formation. A lack of regular formative feedback and engagement with the WMDs for communicating by the course lecturers were also noticed and missed by the students. However, in general, the PASA students were more positive about their mlearning experience than the

Architecture or Product Design students, who had previously had alternative access to wireless connectivity as many of these students owned wireless laptops and had WiFi coverage of their learning spaces for longer than the PASA students.

Figure 31 indicates that there were not too many significant differences between the three different student mlearning groups appropriation of the affordances of WMDs.

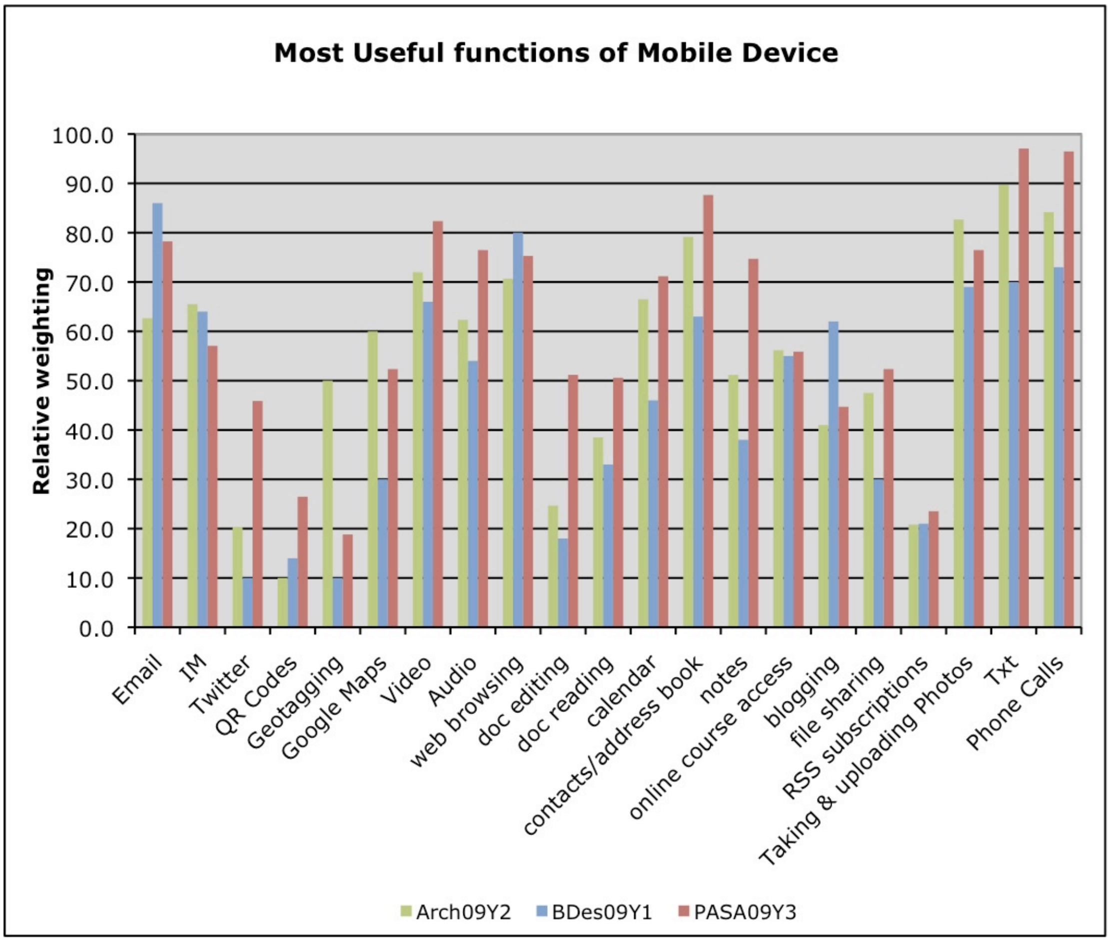


Figure 31: Comparison of 2009 student perceptions of the most useful functions of WMDs.

Interpreting the differences in the differences between student groups shown in Figure 31, the main differences are those that related specifically to each learning context: the Architecture students appreciated geotagging for building location, the PASA students enjoyed Twitter for virtual social and learning community formation, and the Product Design students appropriated blogging as a form of learning community formation. This supports the identification of the appropriate choice of supporting technologies as a critical success factor for mlearning.

9.3 Implications for the Next Research Cycle

After two years of lecturer preparation (2008 to 2009) via the establishment of a lecturer mlearning community of practice the majority of PASA lecturers have either been drawn into the mlearning COP or have been observing its impact from the periphery of the mlearning COP and appear ready to undertake the journey of pedagogical transformation within the programme that mlearning can facilitate. For 2010 the beginnings of integration of mlearning across all courses in the PASA department will be planned, using a similar staged and scaffolded approach from first year to third year of the course that has been developed in the other longer running mlearning projects, in particular the model developed within the Bachelor of Product Design in 2009. This will facilitate a commitment to the building of sustained student engagement through establishing collaborative learning communities across all three years of the Bachelor of Performing and Screen Arts programme.

9.4 Case Study 5 Critical Success Factors

Of the identified critical success factors for mlearning integration, the PASA 2009 project achieved all except creating a supportive learning community around the project. The case study highlights the importance of creating a supportive learning community around the mlearning project via the establishment of a longitudinal sustained community of practice involving the students in the project.

The integration of mobile web 2.0 into the PASA Film and TV course positively disrupted (Sharples, 2001, 2005; Stead, 2006) the established pedagogy of the department, providing ubiquitous student connectivity enabling communication and context bridging (Cook, et al., 2008; Vavoula, 2007a). The project enabled lecturers to employ new pedagogical strategies such as bring in international experts into the live classroom setting via Google Talk, and highlighted the potential of unique mobile affordances for creating authentic learning experiences (Herrington & Herrington, 2007) with a focus upon student-generated content (Bruns, 2007) and student-generated contexts (Luckin, et al., 2010) leading to a progression from teacher-directed pedagogies to student-centred pedagogies (Andragogy).

However, while personal appropriation of mobile web 2.0 affordances by the students was very high there was limited evidence of the establishment of a supportive community of practice around the mlearning project. The course lecturers created scenarios for students to create relatively complex mlearning presentations focusing on the unique affordances within authentic contexts, but did not establish a regular longitudinal learning community supporting the mlearning project. The guest lecturer focus and compressed COP timeframe also resulted in compressed student engagement with the technology within the wider context of the course itself.

The researcher’s role as technology steward for the project was highly valued by the course lecturer. The researchers role in facilitating pedagogical change by taking on and modeling the role of the technology steward (Wenger, et al., 2009; Wenger, et al., 2005), a role that the researcher appropriated and continually developed throughout the research process, within the lecturer and student communities of practice has been essential. The following lecturer feedback illustrates their understanding of the researcher’s role in the mlearning project:

> I can’t say enough about your contribution to our Year 3 New Technologies mobile learning project this year. You facilitated it seamlessly, laying the initial groundwork by up-skilling the staff – all the while imbuing your training with the social-constructivist applications of the gear. This provided an initial context for these new communication tools, with which the Screen Arts staff involved shall always associate and use them. Next, you rolled-out the mobile tools to the students – well in advance of the actual classes (your suggestion) - and provided hands-on training (for the 19 students) in a very caring manner. At the end of their online presentations, you debriefed them in such a way as to allow them to look inside and assess the substantial value they derived from the project. Your attentiveness to the entire process demonstrates to me a thorough practitioner who cares very much about innovative facilitation and student outcomes. (PASA lecturer, 2009)

This illustrates the researcher’s participation in the community of practice supporting the mlearning project.

As a first iteration of mlearning integration the PASA project was both typical of the demonstration of the need for time for lecturer ontological reconceptualisation of technology and pedagogy as emphasized by Chi and Hausmann (2003) and Hameed and Shah (2009), and yet adventurous in its scope of the use of the unique affordances of the technologies. The pre-project lecturer mlearning COP was effective at preparing the participating lecturers for the project implementations. The researcher observed that many students also demonstrated a need for more time to reconceptualise their learning experiences within a more collaborative learning environment than they were previously used to.

9.5 Chapter Summary

Chapter nine overviewed and analysed the 2009 Bachelor of Performing and Screen Arts mlearning project using the identified critical success factors (section 3.8) as a critical framework. In guiding and designing the project the researcher drew upon the lessons learnt from the preceding 2007 and 2008 mlearning projects within the Diploma of Landscape Design, the Bachelor of Product Design, and the Diploma of Contemporary Music. The project achieved significant buy-in from the course lecturers and the subsequent integration of mlearning into the course delivery and assessment, focusing upon student-generated content using the smartphones. The case study illustrates the importance of building and sustaining a supportive learning community around the mlearning projects.

10 DISCUSSION

This chapter brings together the findings of the five mlearning case studies from 2007 to 2009, exploring the implications of each of the case studies, drawing together the identified critical success factors, and describing how the research has influenced the development of the institutions new elearning strategy through the development of transferable implementation and pedagogical strategies based upon the unique pedagogical affordances of mobile web 2.0.

The research involved a series of reflective action research projects (2007 to 2009) using WMDs to harness the potential of current and emerging social software web 2.0 tools. The case studies included: the Diploma of Landscape Design, Bachelor of Product Design, Diploma of Contemporary Music, Bachelor of Architecture, and Bachelor of Performing And Screen Arts. Explicit social constructivist pedagogies underpinned each project and formed the basis for the technology adoption decisions. Specifically, this research was interested in appropriating the benefits of web 2.0 and pedagogy 2.0 (McLoughlin & Lee, 2008a) anywhere anytime (context bridging) using mobile web 2.0 and wireless mobile devices (or WMDs), in particular WiFi (wireless Ethernet) and 3G (third generation mobile 'broadband') enabled smartphones. The research also provides a unique window into the journeys of the participants and the researcher via authentic video reflections (VODCasts) and blog journals captured along the course of the research and made available on YouTube and various web 2.0 social software sites. Examples of these are collated in three overviews:

1. 2008 Overview http://www.youtube.com/watch?v=FcwL8kQoRSI
2. 2009 Documentary

   http://www.youtube.com/watch?v=5vGNWMwEypY

3. 2009 Overview http://prezi.com/kr94rajmvk9u/mlearning/

These provide rich media snapshots recording the story of the key participants' longitudinally throughout the research, and are archived on the DVD accompanying this thesis (See Appendix 13.14).

Soon after the start of the research project, it became obvious to the researcher that a key to the project's success was the development of a new model of supporting pedagogical and technological professional development for the course lecturers involved, and also a new model for scaffolding student understanding of a new way of learning and appropriation of new tools to facilitate this learning. Consequently an intentional Community Of Practice (COP) model was developed for pedagogical and technical support for each of the projects, described in sections 4.7 and 10.2.3 and also outlined in section 10.3.3. A key participant in these COPs was the researcher as the 'technology steward', a role identified for supporting communities of practice by Wenger et al. (2009; 2005).

Participatory action research, as defined by McLoughlin and Lee (2007), and Wadsworth (1998), has been a useful methodology for this research, allowing the researcher to take on the key role of the 'technology steward' as a participant in the supporting community of practice established for each mlearning project. In this role, the researcher guided the projects technically as well as pedagogically. As a common participant in all the mlearning projects the researcher effectively acted as a boundary object linking each mlearning project community of practice across a variety of disciplines and contexts, channeling findings and reflections between each project.

One of the goals of action research identified by researchers such as Ellis and Kiely (2000), Greenwood and Levin (2005), Holian (1999), and Wadsworth (1998), is to produce beneficial transformation for the participants and stakeholders. Significant beneficial change has been achieved for the various participants and stakeholders involved in the research, including demonstrable transformation in pedagogical strategies and pedagogical reconception from participating lecturers (for example full integration of mlearning across all three years of the Bachelor of Product design programme), increased engagement and collaboration from participating students (for example the SHaC09 collaborative mlearning project), and strategic input into the institution's new elearning strategy, reified by several collaborative research publications and presentations reflecting upon the impact of the mlearning projects (Cochrane & Bateman, 2009e, 2010a, 2010c; Cochrane, Bateman, Cliffin, et al., 2009). While requiring time-intensive input from the researcher, the outcomes have been very rewarding, with the development of a sense of trust and collaboration between all the participants, and between the researcher and the course lecturers in particular. The use of an action research methodology has led to the emergence of several key implications from the mlearning projects:

- The context bridging affordances of mlearning, as particularly evidenced in the Bachelor of Product design mlearning projects.
- The disruptive nature of mlearning technologies, most markedly demonstrated in the Diploma of Landscape Design mlearning projects.
- The importance of learning community formation among the participants, identified as a critical success factor in mlearning implementation.
- The importance of professional development strategies for the course lecturers, which was found to be a critical success factor for the mlearning projects.
- The importance of focusing upon the unique affordances of mlearning, a common theme in all the mlearning projects.

The implications of the mlearning case studies are explored further in the following section.

10.1 Implications of the MLearning Case Studies

The thirteen mlearning projects recorded herein each represent an action research cycle within the five case studies providing rich examples of practical pedagogical integration of mlearning across a variety of tertiary education courses. This section provides a summary the main lessons learnt from each project.

10.1.1 Implications of Case Study 1: Diploma of Landscape Design 2007 to 2009

Beginning in 2007, the first mlearning project paved the way for the following projects, highlighting a range of technical and implementation issues that could be improved upon. The project also emphasized the disruptive nature of mlearning, highlighted in earlier mlearning studies by Sharples (2001) and Stead (2006), illustrating the process of lecturer pedagogical reconceptualisation of teaching, and the process of student reconceptualisation of learning required as the course moved from teacher-centred (pedagogy) to social constructivism (andragogy to heutagogy). The introduction of mobile web 2.0 facilitated a move along the Pedagogy-Andragogy-Heutagogy (PAH) continuum, as proposed by Luckin et al. (2010) and McLoughlin and Lee (2008a). The importance of a robust yet flexible technical and pedagogical support strategy was highlighted. The unique student profile (all the students were aged between 43 and 69) of the 2008 iteration of the Landscape Design mlearning project highlighted the importance of choosing appropriate WMDs for the needs of each unique student group. In response the 2009 Landscape Design mlearning project used netbooks to minimize the cognitive load for the students, identified as a common flaw of social constructivist learning by Kirschner et al. (2006), and highlighted the importance of learning community formation to be integrated into the course.

10.1.2 Implications of Case Study 2: Bachelor of Product Design 2008 to 2009

The Product Design mlearning projects achieved demonstrable progress in course integration, pedagogical reconceptualisation, and development of a staged and scaffolded implementation model for developing learning communities facilitated by intentional communities of practice across each year of the course (Cochrane & Bateman, 2010c). The community of practice established in the third year of the course during 2008 effectively drew in the other lecturers within the department who were brought into the project from the 'periphery' of the COP. This aligns with Lave and Wenger's (1991) concept of 'legitimate peripheral participation'. This led to the use of mobile web 2.0 tools and supporting COPs being integrated across the entire Bachelor of Product Design course in 2009. The case study illustrated the potential to stage and scaffold mlearning integration across all three years of a Bachelor level course, based upon establishing an intentional community of practice involving both the students and the lecturers in each year supporting the mlearning projects. The progression of moving teaching from pedagogy to heutagogy (referred to as the PAH continuum by Luckin et al. (2008)) was mapped with the progression of mobile web 2.0 course integration from student web 2.0 appropriation in first year (pedagogy) to student mobile facilitated content creation (andragogy), as characterized by Bruns (2007) and JISC (2009a), in second year, and finally learner-generated contexts (heutagogy) leveraging the context bridging affordances of mlearning (similar to the recommendations of Luckin et al. (2010) and Vavoula (2007b)) leveraged in the third year ‘nomadic studio’. This is illustrated in Table 51 section 10.3.3.

10.1.3 Implications of Case Study 3: Diploma of Contemporary Music 2008 to 2009

The Diploma of Contemporary Music mlearning project developed from an initial exploration of the potential of mlearning to engage students and enhance the course to an example of successful course integration and student adoption and appropriation of mlearning. During the first iteration of the mlearning project students and lecturers were enthusiastic and engaged by the tools, but skeptical as to the potential impact on the course and learning outcomes. The 2008 mlearning project was critiqued by the researcher in a peer-reviewed book chapter (Cochrane, 2009a). The second iteration of the mlearning project integrated the mlearning tools into the course assessment leading to adoption and appropriation by the students beyond personal and social use, leveraging the learning context bridging affordances of mobile web 2.0 for facilitating authentic learning environments beyond the classroom. Herrington and Herrington have conceptualized authentic learning as a pedagogical foundation for mlearning (2007). This case study also demonstrates the need for sustained time for lecturer pedagogical reflection for the necessary ontological shifts, as highlighted in research by Chi and Hausmann (2003) and Hameed and Shah (2009), in the lecturers pedagogical conceptions to be able to integrate mlearning authentically.

10.1.4 Implications of Case Study 4: Bachelor of Architecture 2009

The architecture mlearning project was the largest in terms of student numbers, encompassing the entire second year of the Bachelor of Architecture (115 students). However the project was a first implementation within the school, and formed an exploratory initiation into the potential of mlearning for both the lecturers and the students. This illustrates a consistent theme in all of the mlearning projects, that the first implementation of an mlearning project breaks new ground, and while not necessarily producing significantly transformed pedagogy due to a lack of course integration, the first iteration creates the groundwork for the ontological shift required by the course lecturers to conceptualise the potential to integrate the technologies into the course in subsequent iterations of the mlearning project. Key lecturers declined to be involved in the establishment of the initial lecturer investigative community of practice, leading to a lack of willingness to integrate the project into the course assessment. This case study therefore highlights the critical importance of lecturer professional development and subsequent course integration of the mlearning tools. This is the first significant step in the journey of ontological reconceptualisation of teaching by the lecturers, and the ontological reconception of learning by the students that the mobile web 2.0 projects have been explicitly designed to facilitate. As emphasized by Laurillard (2007) the lecturer's input into the design of mlearning is critical.

10.1.5 Implications of Case Study 5: Bachelor of Performing And Screen Arts 2009

The Performing and Screen Arts mlearning project was one of the most ambitious of the mlearning implementations with regards to the use and exploration of the mobile technologies. However, its implementation suffered from the relatively short time the lecturers had for personally appropriating the mlearning tools themselves, and timetabling limitations led to a significant change in the community of practice support model. While not personally modeling (Herrington, et al., 2009;

Herrington & Oliver, 2000) the use of the mobile web 2.0 tools to a high level, the course lecturers nevertheless created an atmosphere of high expectations of the students that created an energetic 'buzz' among them, facilitating experimentation and collaboration around the use of the tools. Lecturer modeling of the use of innovative technologies has been identified as a critical success factor by researchers such as Herrington and Oliver (2000) and Herrington et al. (2009). While there was a lack of course-focused community facilitated by the WMD implementation, there was a very high level of personal appropriation of the WMDs by the participating students, similar to the experiences of other mlearning research projects (Carroll, et al., 2003; Cook, 2007b; Davis, 1989). Students found the portability and ubiquitous connectivity of the smartphones empowering for both accessing course content and their social networks. This case study highlights the importance of the development of a regular supportive learning community, and the positive impact of high expectations from the lecturers on the participating students.

10.2 Critical Success Factors

Based on the experiences gathered from the thirteen mobile learning projects between 2007 to 2009 the researcher has identified six pedagogical critical success factors as emergent themes for mobile web 2.0 integration (Cochrane, 2010b). These success factors were identified across the mobile web 2.0 projects by evaluating the following:

- The level of student engagement and satisfaction achieved – as evidenced in evaluative surveys and focus group feedback.
- The level of moblogging (mobile blogging) achieved by students in the courses.

- Lecturer reflective feedback.
- The researcher's observations as a participant in the action research.
- Evaluation of each of the action research cycles.

Four of these critical success factors are similar to the list of nine characteristics of authentic learning (Herrington & Oliver, 2000) used as a basis for the Wollongong mlearning projects (Herrington, Herrington, et al., 2009b) that led to the development of eleven design principles for mlearning. The correlation between these is compared in Table 42. Each of the mlearning case studies detailed earlier in this document highlight the impact of combinations of these critical success factors.

1. The pedagogical integration of the technology into the course and assessment.
2. Lecturer modeling of the pedagogical use of the tools.
3. Creating a supportive learning community
4. Appropriate choice of mobile devices and web 2.0 social software.
5. Technological and pedagogical support.
6. Creating sustained interaction that facilitates the development of ontological shifts, both for the lecturers and the students.

These are discussed in detail in section 10.2. These identified critical success factors can be compared against similar success factors identified by other research projects such as Barker et al. (2005), Herrington and Herrington et al. (2009b), and JISC (2009a), and the three supporting frameworks adopted by the research projects: Communities of Practice, Learner Generated Contexts, and the Conversational Framework. While each of these studies and frameworks emphasize different critical success factors for mlearning, in general they can be classified within the success factors identified by the research herein, adding validity and rigour to these findings.

Table 42 revisits and extends Table 4 (section 3.3) and Table 7 (section 3.8) comparing these critical success factors with those identified by the researcher throughout the five case studies, including the addition of the researcher's sixth identified critical success factor "Sustained interaction facilitating ontological shifts".

Table 42: Comparison of mlearning critical success factors.

The author's identified critical success factors	**Authentic mLearning Herrington et al. (2008)**	**mLearning Design Principles Herrington et al. (2009)**	**JISC (Knight, 2009)**	**Barker et al. (2005)**	**Communities Of Practice Wenger et al. (2005, 2009)**	**Learner Generated Contexts Luckin et al. (2008, 2010)**	**Conversational Framework Laurillard (2007)**
1. Pedagogical integration	1. Authentic contexts 2. Authentic activities 4. Multiple roles and perspectives 6. Opportunities for reflection 9. Authentic assessment	1. Real world relevance 2. Mobile contexts 4. Blended 5. Whenever 6. Wherever 11. Produse	1. Active participative learning 5. Benefits need to be clearly communicated to learners 6. Learning tasks and outcomes 7. Extends the potential for learning	1. Interactivity 2. Coordination 4. Organisation of material	Intentionality Domain	PAH continuum. Ecology Of Resources. Student generated	Design of learning activities
2. Lecturer modeling	3. Access to expert performances	10. Mediation	4. Look to their tutors for guidance	6. Motivation	The Practice	Obuchenie: teachers as learners and students as teachers	Dialogic interaction between students and lecturer
3. Creating a supportive learning community	5. Collaboration	7. Whomsoever	3. Learners can be active makers and shapers of their own learning. They should be supported in using technologies of their own choice where appropriate.	3. Negotiation and Communication 7. Collaboration	Shared repertoire Legitimate Peripheral Participation (LPP)	Assumed – focus is on providing the tools to enable learner-centered experiences	Continuing learning conversations
4. Appropriate choice of WMD and web 2.0	7. Opportunities for articulation	8. Affordances 9. Personalise	2. Selecting the most appropriate tools for the purpose	5. Mobility	Web 2.0 supporting COP	Student owned	Importance of communication and collaboration technologies
5. Technological and Pedagogical Support	8. Coaching and scaffolding				The Technology Steward		
6. Sustained interaction facilitating ontological shifts		3. Explore			Sustained activity Moving from LPP to full participation		

The comparison of the eight lists of critical success factors in Table 42 indicates that most research has been put into the area of pedagogical integration, with relatively little focus on the aspects of technological and pedagogical support, and only a hint of the need for sustained interaction for teaching and learning reconceptualisations. The emphasis of the critical success factors is on how to use the technology within pedagogical contexts with seventeen of the thirty-four factors (50 percent) related directly to pedagogical integration. These factors are about how to implement mlearning related to the curriculum content and assessment. These are crucial elements of pedagogical integration, however the case studies highlight that this can only occur after lecturers are willing and empowered to engage with mlearning in their teaching practice, and therefore are of most benefit to lecturers likely to appropriate new technologies in their teaching, or early adopters. The case studies have shown that the process of getting lecturers to this point is far from simple and can take a lot of effort on professional development to bring the majority of lecturers to this point, often requiring ontological shifts first. The researcher would suggest that this lack of emphasis upon the time required for the ontological shifts that these disruptive technologies facilitate is because typically mlearning projects are short-term projects and do not look at the longitudinal impact of mlearning. While there are exceptions and notable long-term mlearning projects have been established, for example: MoLeNET (Attewell, 2008), in general these projects have not focused upon facilitating a social constructivist pedagogy, or beyond early adopters. Most of the identified success factors include reference to the importance of lecturer modeling of the technologies, a focus upon facilitating collaboration, and leveraging the unique affordances of WMDs including mobility and student-owned devices.

After comparing these five sets of success factors the unique mlearning critical success factors identified by this research include:

1. The need for technological and pedagogical support for matching of the unique affordances of mobile web 2.0 with social constructivist learning paradigms.
2. The explicit scaffolding of the required ontological shifts in pedagogical transformation via a structured and sustained intentional community of practice model over a significant period of time.

The following sections further explore the six identified critical success factors.

10.2.1 Pedagogical Integration of the Technology into the Course

The WMD case studies indicated the critical role of the level of pedagogical integration of the technology into the course criteria and assessment. This involves scoping and planning appropriate course activities and assessments based upon the chosen pedagogical model (social constructivism) and creating pedagogical alignment as recommended by Biggs (2003). The point of acceptance into course integration of the mobile web 2.0 tools is typically reached as lecturers realize the flexibility of learning context and feedback that these tools facilitate. The first research cycle of each case studies confirms the observation of Herrington and Herrington (2007) that mlearning activities typically begin as translations of more traditional paper based activities into a mobile web 2.0 alternative. As lecturers become more acquainted with the possibilities afforded by mobile web 2.0 tools more creative learning activities are developed and integrated into the courses with a focus upon leveraging the unique affordances of mobile web 2.0. This is demonstrated by the Bachelor of Product Design case study where initial mlearning integration translated students' design portfolios, while 2009 projects focused on bridging learning contexts and student-generated contexts for learning. A key tool used to facilitate redeveloping course outlines was Google Docs (http://docs.google.com) for collaborative course and assessment planning between the course lecturers and the technology steward (researcher).

As a result, a design framework was developed to guide the integration of mobile web 2.0 tools into the courses (Outlined in Table 44). The framework was derived from mapping the social constructivist affordances of mobile web 2.0 with the Pedagogy-Andragogy-Heutagogy (PAH) continuum.

The appropriation of web 2.0 tools within a social constructivist pedagogy facilitates what has been termed "pedagogy 2.0" (McLoughlin & Lee, 2008a). McLoughlin and Lee advocate the exploration of the potential of the alignment of web 2.0 tools and emerging learning paradigms based loosely upon social constructivism such as 'navigationism' (Brown, 2006), and 'connectivism' (Siemens, 2004).

> The affordances of these technologies, coupled with a paradigm of learning focused on knowledge creation and networking, offer the potential for transformational shifts in teaching and learning practices, whereby learners can access peers, experts, the wider community and digital media in ways that enable reflective, self-directed learning. (McLoughlin & Lee, 2008a, p. 649)

Similarly, Herrington et al. (2008) have proposed that mobile technologies can facilitate 'authentic learning', another social constructivist framework based on situated learning theory. These support the approach to the development of the mlearning pedagogies used in this research.

Focusing even more explicitly on empowering independent learners, Luckin et al. (2008; 2010) propose the concept of Learner Generated Contexts (LGC) as a potential framework for technology based learning founded on the Vygotskian concept of 'Obuchenie' that encompasses both teaching and learning. Though not explicitly limited to mobile learning, the concept focuses upon learning within learners' own environments that new technologies facilitate. 'Obuchenie' blurs the distinction between teaching and learning, creating a two-way dyadic interaction within the Zone of Peripheral Development (Vygotsky, 1978). Luckin et al. (2008; 2010) see a reconceptualisation of the level of influence the teacher plays in these contexts, and attempt to breakdown the boundaries between learning and teaching implied in the PAH continuum (Pedagogy – Andragogy – Heutagogy) (see Table 43).

Table 43: The PAH continuum, from Luckin et al. (2008, p. 10).

	Pedagogy	**Andragogy**	**Heutagogy**
Locus of Control	Teacher	Learner	Learner
Educational sector	Schools	Adult education	Doctoral research
Cognition Level	Cognitive	Metacognitive	Epistemic
Knowledge Production Context	Subject understanding	Process negotiation	Context shaping

The concept of LGC breaks down the separation of pedagogies by educational sector shown in Table 43, proposing that heutagogy need not be the domain of doctoral research only.

The researcher sees similarities and useful alignment of the pedagogical approaches of 'pedagogy2.0' (McLoughlin & Lee, 2008a), 'authentic learning' (Herrington & Herrington, 2007) and the Learner Generated Contexts framework (Luckin, et al., 2010) principles. The key point of difference to that proposed by the

Learner Generated Contexts group is in the role that the researcher assigns to the lecturer within the formal and informal learning environments. The researcher views the input and facilitation of the lecturer as a critical success factor in implementing mobile web 2.0 technologies, and would agree with Laurillard's position that states "M-learning, being the digital support of adaptive, investigative, communicative, collaborative, and productive learning activities in remote locations, proposes a wide variety of environments in which the teacher can operate" (Laurillard, 2007, p. p172). However, the role of the lecturer is significantly changed. The focus moves from teacher-directed to student-centred, where students create accounts on free web 2.0 sites and then invite their lecturer and peers to collaborate within these environments, turning the control of the learning environment beyond the domain of the teacher-directed learning management system (LMS).

MLearning technologies provide the ability to engage in learning conversations between students and lecturers, between student peers, students and subject experts, and students and authentic environments within any context. It is the potential for mobile learning to bridge pedagogically designed learning contexts, facilitate learner generated contexts, and content (both personal and collaborative), while providing personalisation and ubiquitous social connectedness, that sets it apart from more traditional learning environments. Mobile learning, as defined in this research, involves the use of wireless enabled mobile digital devices (Wireless Mobile Devices or WMD's) within and between pedagogically designed learning environments or contexts (Cochrane, 2009c). From an activity theory perspective, WMD's are the tools that mediate a wide range of learning activities and facilitate collaborative learning environments (Uden, 2007).

The WMD’s wireless connectivity and data gathering abilities (for example: photoblogging, video recording, voice recording, and text input) allow for bridging the on and off campus learning contexts, facilitating “real world learning”, disrupting traditional instructivist teaching models and facilitating a move along the PAH continuum to social constructivist learning paradigms.

The pedagogical strategies developed for integration of mlearning in a course include: curriculum integration of mobile web 2.0 (Table 45), modeling the pedagogical use of the WMDs and social software (section 10.2.2), and staging and scaffolding the integration of mobile web 2.0 across the length of the course (Table 51 section 10.3.3).

A key strategy to facilitate a move along the PAH continuum is curriculum integration of mobile web 2.0. The case studies illustrate that curriculum integration must focus on the unique affordances of mobile web 2.0 in order to create authentic learning environments. To achieve this, curriculum integration must start with the learning practice that is to be achieved (As illustrated in Table 44), aligning and choosing appropriate mobile web 2.0 affordances with this goal. Following such a design framework will ensure that the technology is not the primary focus, or that good pedagogy is retrofitted to technology.

Table 44: MLearning project design framework.

Learning Practice	**Mediating Circumstances**		
Social Constructivism	**Context**	**Technology**	**Agent**
Lecturer Community of Practice	Lecturer professional development, pedagogical brainstorming	Face to face Scaffolded using LMS Smartphone Web 2.0 services	Lecturers as peers, with researcher as technology steward
Student and lecturer Community of Practice	Pedagogical integration and technical support	Face to face Scaffolded using LMS Smartphone Web 2.0 services	Students as peers, Lecturer as guide and pedagogical modeler, with the researcher as technology steward
Collaboration	Group projects	Social networking, Collaborative documents	Google Docs, student peers
Sharing	Peer commenting and critique	Web 2.0 media sites, eportfolio creation	RSS, student peers, lecturer
Student content creation	Student individual and group projects	Smartphone with camera and microphone, content uploaded to web 2.0 sites	Student and peers
Reflective	Journal of learning and processes, recording critical incidents	Web 2.0 hosted Blog	Personal appropriation, formative feedback from lecturer
Learning Context Bridging	Linking formal and informal learning	Smartphone used as communications tool and content capturing	Student interacting with context, peers, and lecturers

Mobile web 2.0 integration into a course produces and requires rethinking of lecturer pedagogies and assessment procedures. To minimise the level of technological load and scaffolding required by the students (and lecturers), the implementation of mobile web 2.0 should be staged and scaffolded using a select range of activities over manageable timeframes (Table 51 section 10.3.3). Thus beginning the introduction of web 2.0 integration into the first year of a course (in multi-year courses) will prepare students for higher-level context bridging in subsequent years of their course.

10.2.2 Lecturer Modeling of the Pedagogical Use of the Tools

The case studies demonstrated that lecturers must model the use of the mobile web 2.0 tools within their own daily workflows and within authentic course-related contexts. Modeling the pedagogical use of technology involves creating a Zone of Proximal Development.

> This theoretical construct states that learning occurs best when an expert guides a novice from the novice's current level of knowledge to the expert's level of knowledge. Bridging the zone of proximal development construct with legitimate peripheral participation construct may be accomplished if one thinks of a zone in which the expert or mentor takes the learner from the peripheral status of knowing to a deeper status… the expert scaffolds the environment to the extent in which the learner is engaged with the discourse and participants within the zone and is drawn from a peripheral status to a more engaged status. (Attwell, 2006, p. 6)

Without the modeling of an expert (or lecturer) the process of students' moving from a position of legitimate peripheral participation to full participation within a community of practice is hindered. For example, second year Product Design students missed the connection between technology use and pedagogy when their lecturer did not make these connections between the use of the technology and the learning context explicit in their own practice. Whereas reflections from the third year Product Design lecturers emphasized the importance of lecturer modeling of the use of technology on student engagement with the technology:

> It is vital that staff participate in the blogging process and run their own blogs alongside the student ones. Students want to see that staff are visiting their blogs and commenting on posts as well as offering information that might assist them with their projects. (Cochrane & Bateman, 2010c, p. 184)

Modeling involves socialising the everyday use of the technology, creating socially defined ways of appropriating the technology within each unique group of learners. Lecturers needed to feel supported in their attempts at technology appropriation without feeling overwhelmed by trying too many new tools at once. These issues therefore led to the staged integration of mobile web 2.0 and strategies for the integration of mobile web 2.0 into lecturers' daily workflows. The staged integration of mobile web 2.0 within the course closely follows the staged and scaffolded implementation of a learning paradigm that moves the students from highly teacher-directed (pedagogy) in first year to highly self-directed (heutagogy) in the third year. This was most clearly illustrated in the 2009 Bachelor of Product Design case study, where the first year mlearning project focused upon students' and lecturers' establishing online eportfolios, while the third year mlearning project focused upon bridging multiple learning contexts (for example the use of QR codes in the third year grad show) and student-generated contexts (for example the 'nomadic' studio).

10.2.3 Creating a Supportive Learning Community

The case studies demonstrate that those projects that succeeded in producing the most pedagogical change were supported by the strong sense of learning community created supporting the mlearning project. Each mlearning project involved the development and nurturing of a unique learning community. This was achieved through the iterative development of a supporting intentional community of practice model. This initially began as an exploration of alternatives to workshops for lecturer professional development by the researcher, and the realization that the researcher and a group of heads of departments had inadvertently created a community of practice, where the researcher had effectively taken on the role of the 'technology steward' as defined by Wenger et al. (2009; 2005). The results of the community of practice were witnessed in the ontological shifts achieved by the participants in their conceptions of the impact of web 2.0 tools on education, and in the interest generated from other lecturers around the institution who had followed the groups progress and effectively been drawn into the periphery of the COP. The researcher therefore began developing this approach for lecturer professional development and creating supporting communities of lecturers around each mlearning project (Cochrane, 2007h).

The model involved the identification of a lecturer in a department who wanted to explore pedagogical change, who then partnered with the researcher. Other lecturers in the department were then invited to form a community of practice investigating the use of mobile web 2.0 tools within their teaching, with the researcher invited into the group as the technology steward to support and guide the group. These were intentional communities of practice because they formed with a specific goal in mind that was to develop authentic mlearning projects for their students integrated into their courses. Each group would meet weekly face-to-face in one of the Campus cafes using the WMDs chosen as appropriate for their courses. These weekly sessions established the use of collaboration and social networking tools that then facilitated collaboration between the group members beyond the face-to-face meetings. The same model was then used to support the implementation of the developed mlearning projects with the students, their lecturers, and the researcher (as the technology steward) integrated into their courses effectively reproducing intentional communities of practice, as illustrated in Figure 32.

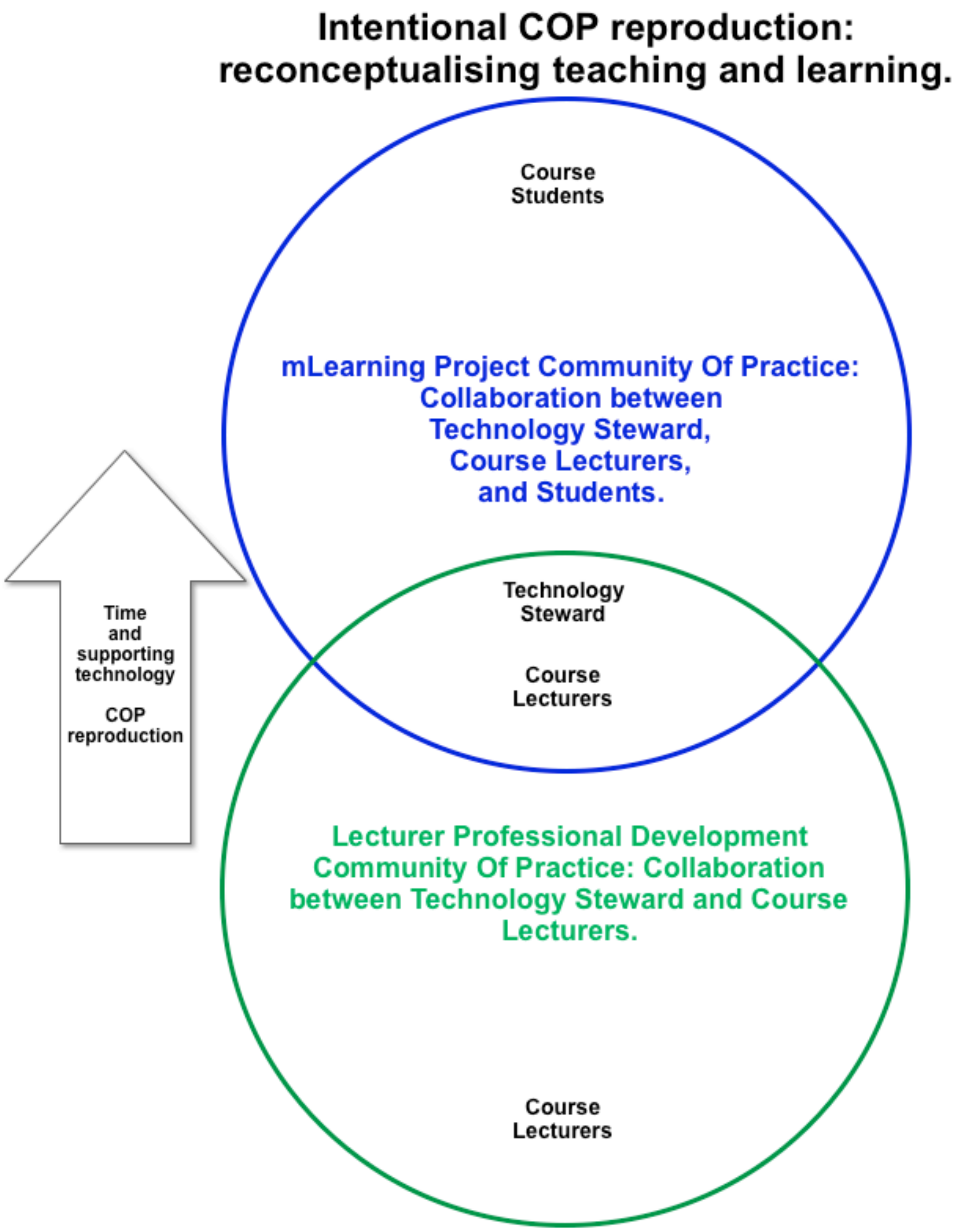


Figure 32: Reproducing intentional COPs, from Lecturer development to student projects.

Within the case studies, the mlearning communities of practice that made a commitment to sustained interaction produced the largest changes in pedagogy, and their collaborative practice became reified in the production of a variety of artifacts including: collaborative research papers, wiki pages, YouTube videos, Google Docs and other evidence of pedagogical integration. For example: the Bachelor of Product Design case study (apart from the second year lecturer) created a sustained commitment to the supporting mlearning COPs and produced twenty collaborative research papers and dozens of participant YouTube videos creating a large repertoire of shared resources, whereas with similar numbers of students to the Bachelor of Product Design the Diploma of Landscape Design case study maintained sporadic short-term commitment to supporting mlearning COPs and produced only two collaborative research outputs and only a few participant YouTube videos. These two contrasting case studies also illustrate the impact of sustained mlearning COPs on wider lecturer participation: the Bachelor of Product Design mlearning COPs drew in all of the Product Design lecturers from its periphery, while the Landscape Design mlearning COPs showed little evidence of drawing in Landscape Design lecturers beyond the two core members.

10.2.4 Appropriate Choice of Mobile Devices and Web 2.0 Social Software

To create authentic learning environments (A. Herrington & Herrington, 2007), the WMDs mlearning affordances must be mapped to the chosen pedagogy. A central focus of the mlearning projects was facilitating student-generated content and context bridging via the ubiquitous connectivity of smartphones. To reduce the cost of WMD Internet connectivity, dual WiFi and 3G WMDs were specified. To make this affordable for the participants, institutionally owned WMDs were supplied to the participants. Participants were encouraged to treat the WMDs as if they owned them, fostering a sense of personal ownership leading to appropriation (as described for example by Carroll et al. (2003), and Davis (1989)) and integration of the technology via socially constructed choices (as described for example by Bijker (1995)). This requires utilising the types of WMDs that students want to use and own. In most cases students personalised and socialised the everyday use of the smart phones beyond embracing them simply as tools to aid their learning. Student feedback from the mlearning projects clearly showed that the choice of smartphone was critically important in the acceptance of its use. This is a function of both the social acceptance (social construction) of a smartphone, and the smartphone's ability to enhance the specific requirements of a particular course's focus.

In response to this a smartphone evaluation rubric was developed for choosing or recommending an appropriate smartphone for each of the mlearning projects (See section 10.3.2). Secondly, the later mlearning projects focused upon mobile web 2.0 activities that made use of the unique affordances of the WMDs rather than replicating what could be achieved using a standard laptop or desktop computer.

10.2.5 Technical and Pedagogical Support

The research has shown that significant technical and pedagogical support is crucial for both the lecturers and students appropriating mlearning. Surveys of all the participants' previous usage of mobile and web 2.0 technologies revealed that they were in general consumers of these technologies but very few were producers. The integration of mobile web 2.0 within the courses disrupted both the lecturers' conception of teaching and the students' conception of learning, and these reconceptions required sustained interaction over time. The case studies illustrated that technological and pedagogical support for mlearning integration must be provided longitudinally during mlearning project planning (Lecturer professional development) and during its implementation with students. As demonstrated by the Diploma of Landscape Design case study, a short series of introductory support workshops is unlikely to achieve this. The establishment of supportive learning communities in the form of intentional communities of practice best met the need of this longitudinal support.

Initial pedagogical and technical support for each mlearning project began with the establishment of a lecturer COP focusing upon investigating the pedagogical use of the tools and developing lecturer competency and personal appropriation of the tools. This was then followed by the establishment of a combined lecturer and student COP for implementing the mlearning project. The projects highlighted the critical role of the 'technology steward' to guide the integration of mlearning within the COPs. A strategy for pedagogical and technological support for the integration and implementation of mobile web 2.0 was developed using an intentional COP model (Cochrane, 2007h; Cochrane & Kligyte, 2007c). Using this model, the mlearning projects were guided and supported by regular 'technology sessions' (COPs) facilitated by an appropriate technology steward who provided guidance to the group, while also interacting as a peer group member in this learning community. These mlearning projects therefore become collaborative projects between the 'technology steward', the course lecturers (one of whom may take on the role of technology steward), and the students on the course. The institution's LMS was then used to provide scaffolding and support for both lecturers and students. Lecturers were encouraged to model the use and integration of mobile web 2.0 in their own daily workflows and to provide regular formative feedback to students via interaction on their web 2.0 sites and eportfolios.

The role of the institutional LMS (Learning Management System) was changed in this approach. The LMS was used to provide scaffolding tutorials and initial guidance for students in setting up their web 2.0 environments from the technology steward and the course lecturer. This inverted the normal learning space ownership paradigm, with the students then inviting the lecturer and technology steward to participate in their learning spaces. The lecturer's role was to set guidelines and parameters around student learning space choices to make these manageable and appropriate collaborative learning spaces.

A limitation of the participatory action research methodology of the research was the significance of the input of the researcher as the technology steward for the projects. The researcher's mix of skills allowed him to provide the dual roles of both pedagogical and technological support. The partnerships developed between the researcher and the participants (particularly the lecturers) were critical in supporting and providing direction for the projects. In order to create a transferable model to other learning contexts involving different technology stewards the role of eLearning Community Coordinator (eLCC) has been established within each department of the institution as a core part of the new elearning strategy.

10.2.6 Creating Sustained Engagement Facilitating Ontological Shifts

The case studies have shown that creating sustained engagement around the mlearning projects supported by communities of practice can facilitate ontological shifts among the participants. The mlearning projects identified two key issues around reconceptualising teaching and learning representing ontological shifts in the participants' understanding:

1. Shifting lecturers from pedagogy to heutagogy, reconceptualising teaching as proposed by Luckin et al. (2008; 2010) and McLoughlin and Lee (2008b). This was most clearly illustrated by the Bachelor of Product Design case study, where the integration of the mlearning projects facilitated a move from

teacher-directed paper-based design portfolios and face-to-face studios to interactive online eportfolios and a flexible 'nomadic' studio that bridged multiple learning contexts.

2. Shifting students beyond their previous experience, reconceptualising learning, and using the WMDs to engage students via a focus upon student-generated content and student-generated contexts. This was illustrated by students in the Bachelor of Product Design 2008 mlearning case study (section 6.2.1.4) illustrating how WMDs can be utilized to facilitate reflection on 'threshold concepts'. Another identified example is group work, as students often struggle when presented with collaborative group work. The integration of mobile web 2.0 into their courses provided tools to facilitate collaborative projects in innovative and engaging ways. For example this was illustrated by the SHaC09 collaborative mlearning project between the Diploma of Landscape Design and Bachelor of Product design students.

Both lecturers (as illustrated by the Diploma of Contemporary Music case study) and students can struggle with the introduction of social constructivist pedagogies that shift the participants along the PAH continuum. A key strategy developed through the action research cycles to facilitate a move along the PAH continuum was staging and scaffolding the curriculum integration of mobile web 2.0. Staging involves spreading the integration of mobile web 2.0 across the length of a course and aligning the unique affordances of WMDs to the level of pedagogy at each stage, while scaffolding involves providing the support required for students to meet these goals. Staging the introduction of disruptive technologies minimises students' learning load and scaffolding maximizes the effectiveness of the zone of proximal development, similarly to the process described by Attwell (2006, 2007). Thus beginning the introduction of web 2.0 integration into the first year of a course with a focus upon pedagogy and student-generated content will prepare students for the integration of the unique context-bridging affordances of WMDs facilitating a focus upon andragogy to heutagogy and student-generated contexts in subsequent years of their course, as shown in Table 45.

Table 45: Mapping the PAH continuum to a staged and scaffolded course integration of mobile web 2.0

Stage	Web 2.0 Tools	MLearning Tools	Course Timeframe	PAH alignment
Level 1	Social Collaboration with peers and lecturer. Student generated content.	Use of student-owned netbook or mid-range smartphone, LMS and basic web2.0 sites	1 year Certificate programmes, or first year of longer programmes	Pedagogy (Lecturer directed)
Level 2	Social collaboration with peers and 'authentic environments'. Context Aware	Student-owned laptop and/or mid-range smartphone	Second year of two year or longer programmes	From Pedagogy to Andragogy (Students become the content creators)
Level 3	Context Bridging. Student generated contexts.	Student-owned laptop and/or high-end smartphone	Third year of programme	From Andragogy to Heutagogy (Students become independent learners)

Figure 33 provides a graphical representation of how the identified critical success factors combine to form the basis for facilitating ontological shifts, creating the foundation for lecturers to reconceptualise pedagogy, and for learners to reconceptualise their role as learners becoming co-creators of content and situated learning contexts facilitated by the integration of WMDs.

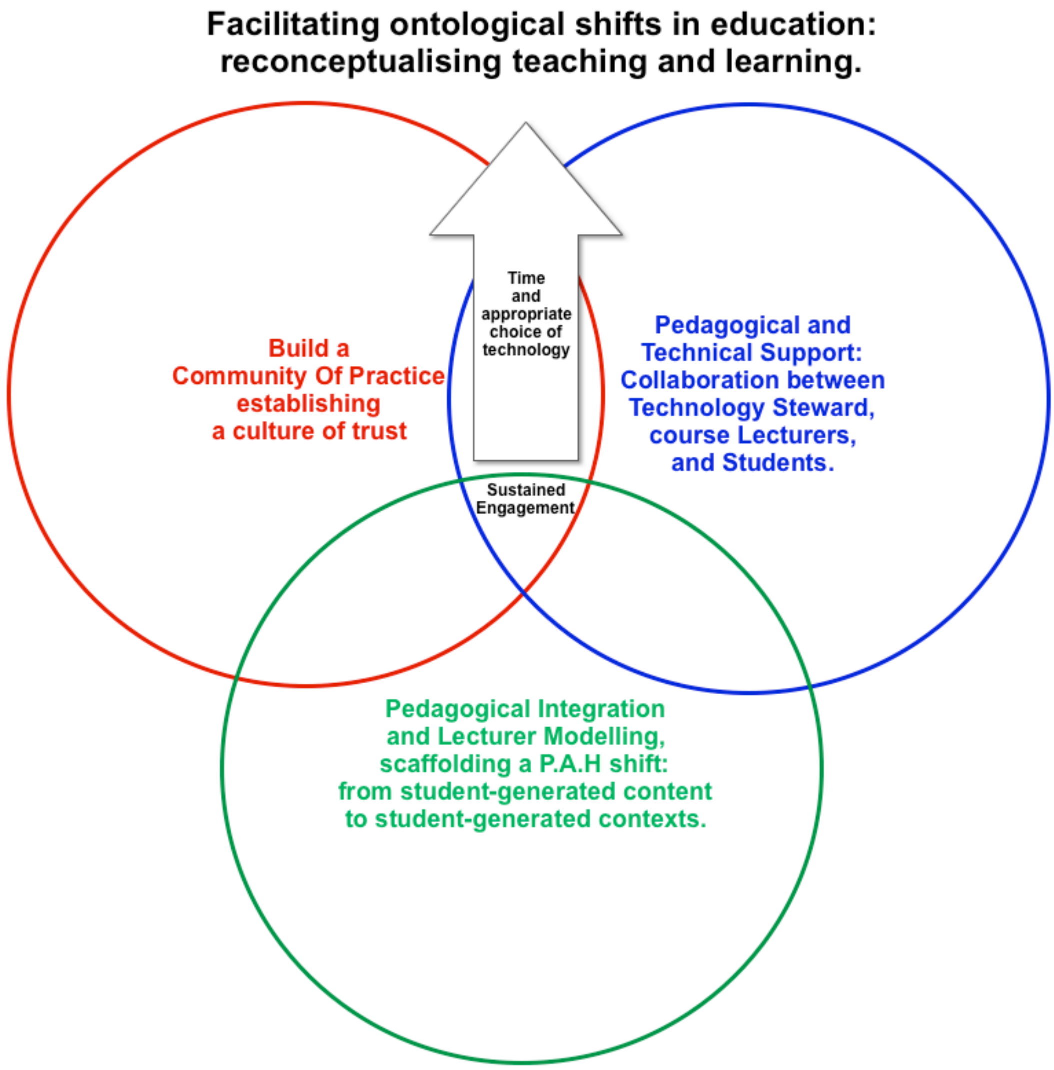


Figure 33: Critical success factors leading to ontological shifts.

Figure 33 illustrates that the sustained engagement of a supporting community of practice comprised of a collaboration between the course students, the course lecturers and a technology steward, focusing upon scaffolding the pedagogical integration of WMDs, creates the foundation for an ontological PAH shift among the participants.

The following sections illustrate how the critical success strategies from the findings of the mlearning research can be applied to other tertiary learning contexts, and have informed the development of the institution's new elearning strategy.

10.3 From Course Projects to an Institutional Strategy

What began as an investigation of the affordances of web 2.0 in 2007 developed into three mobile web 2.0 proof of concept projects within the contexts of the third year of the Bachelor of Product Design in 2008, the Diploma of Contemporary Music, and the Diploma of Landscape Design. These then quickly spread to projects within the first and second year of the Bachelor of Product Design programme in semester two of 2008. The success of these projects led to the implementation of integrating mobile web 2.0 technologies (based on an explicit social constructivist pedagogy) across all three years of the Bachelor of Product Design programme in 2009, and on wider scales into larger courses such as the Bachelor of Performing and Screen Arts, and the second year of the Bachelor of Architecture. The impact of the research was reflected upon in a collaborative conference paper (Cochrane & Bateman, 2010c).

The mobile web 2.0 projects that this research has used to illustrate implementation methodologies have so far used a model of providing a common smartphone for the students within a course. The students and staff involved have been encouraged to use the smartphones as if they owned them for the period of the projects. This approach was used to seed the concept and provide proof of concept results. Following the enthusiastic response from the students and lecturers involved in these projects, internal institutional funding was sought, and approved, for extending these small projects to a major large-scale mlearning project in 2009 involving the use of 250 smart phones, and 200 netbooks. This larger scale project was informed by the experiences of the previous projects and covered a wider range of courses and learning contexts. The findings from these projects (reported herein) were then used to inform the development of the institution's new elearning strategy (A summary of the 2009 elearning strategy is included in Appendix 13.13).

The research project brings together three keys to mlearning sustainability to inform the development of a new institutional elearning strategy including: the development of an institutional cultural and strategy shift (Hameed & Shah, 2009) that supports and facilitates a lecturer ontological shift from pedagogy to heutagogy (Luckin, et al., 2008; McLoughlin & Lee, 2008), and scaffolding student reconceptualisations of learning (Chi & Hausmann, 2003) from prior teacher-directed experiences to those based upon social constructivist paradigms.

Hameed and Shah (2009) describe the institutional shift process as a "cultural re-alignment" (p. 340). The institutional cultural and strategy shift is evidenced in the development of the new elearning strategy adopting the researcher's emphasis upon mobile web 2.0 integration supported by communities of practice facilitated by a technology steward.

The mlearning projects undertaken have illustrated that pedagogical integration of mlearning into a course or curriculum requires an ontological shift on behalf of the lecturers involved, and that this takes sustained engagement and time for reflection to re-envisage their role and developing a new focus upon learner-generated contexts as recommended by Luckin et al. (2008; 2010), and Pedagogy 2.0 as recommended by McLoughlin and Lee (2008b). Many of the identified mlearning scenarios were initially serendipitous rather than planned by the lecturers, and these experiences led to ideas for course integration in the following action research cycles.

This is illustrated by the Bachelor of Product design case study, where students in 2008 used the WMDs to bridge learning contexts while on vacation and this approach was then integrated into the 'nomadic studio' in 2009 by the lecturers.

Students also require sustained engagement to gain the skills required to maximise the potential of new and emerging web 2.0 tools. As the participating student pre-project surveys indicated, few students were already using these tools for their own content creation before the projects. Immersing students within a social constructivist pedagogical environment can be a new and challenging experience for the students, as Chi and Hausmann (2003) argue, the introduction of innovative technologies require ontological shifts of the participants, requiring planned staging and scaffolding to support student learning. This was evidenced by the difference in student uptake of mobile web 2.0 between the Diploma of Landscape Design case study with limited student scaffolding, and student uptake in the Bachelor of Product design case study with planned staging scaffolding of the integration of mlearning across all three years of the programme.

The institutions new elearning strategy focuses on four key areas: staff capability, student capability and access, and supporting infrastructure changes. The community of practice model developed during the mlearning action research projects forms a core element of the new elearning strategy supporting the required cultural shift. Staff capability is enhanced by the establishment of eLearning Community Coordinators (eLCCs) within each department who facilitate departmental communities of practice. The eLCCs take on the role of technology stewards within these COPs as modeled by the researcher within the mlearning projects. The eLCCs report to the institution's central professional development unit, of which the researcher is the elearning team leader. The establishment of the eLCCs role was launched in February 2010 with a weeklong workshop facilitated by Etienne Wenger and Beverly Traynor (http://www.youtube.com/watch?v=Ul8BbjfK4Iw), modeling a COP approach to staff professional development, and authenticating the researcher's model.

As part of the elearning strategy, student access to elearning is facilitated by the specification of appropriate student-owned WMDs and the integrated use of these for class, tutorial and study sessions. To create a sustainable model, the goal is to move to a student-owned model of WMD provision, where students purchase a smartphone that meets specifications outlined by the course requirements, this is similar to institutions requiring students to purchase a specifically specified laptop computer to ease support requirements. As the cost of appropriate smartphones and 3G data costs drop, the purchase cost may be sustainably subsidized by institutions in lieu of other course related costs that the mobile web 2.0 model replaces. Students with genuine hardships will be provided with institutionally owned WMDs for use in their courses. The use of WMDs within each course is led by an evaluation of the potential pedagogical benefits to each course and how the utilisation of various learning technologies will be scaffolded across the length of the course. Investment in wireless infrastructure is being made to improve coverage, capacity and connection speed, and the sequential movement of staff computers from desktops to WMDs will be undertaken.

10.3.1 Design Framework: Mapping Mobile Web 2.0 Affordances to the PAH Continuum

The research has identified the affordances of WMDs that are specifically useful within an educational context that support a social constructivist approach to teaching and learning. This section outlines these and provides details of the smartphone and netbook choice rubrics developed during the research that will have potential transferability to other mlearning projects.

A wide variety of affordances of the WMDs were investigated throughout the various projects, some with more success than others. Experience and feedback from participants has shown that the focus should be on the affordances of WMDs that are most suitable for their small screens and slower text entry, as well as those affordances that are unique to WMDs. For example: the built-in geotagging, geolocation, live media streaming, Mobile Codes, and communications tools. These affordances have been explored in a collaborative journal paper by the researcher (Cochrane & Bateman, 2010d). The researcher agrees with Cook et al. (2008), and Vavoula (2007b) who identify the potential of WMDs to bridge multiple learning contexts that facilitate rich interactions between formal and informal social constructivist learning environments (Cochrane, 2009c). As Laurillard notes: "The intrinsic nature of mobile technologies is to offer digitally-facilitated site-specific learning, which is motivating because of the degree of ownership and control" (Laurillard, 2007, p. 157). Figure 34 (reproducing Figure 1) shows the final version of a generic concept map that was developed during the research project to graphically illustrate the links between multiple learning contexts, and some of the chosen web

2.0 technologies that the smartphones afford. These affordances were explored in the research projects and are summarized in Table 46.

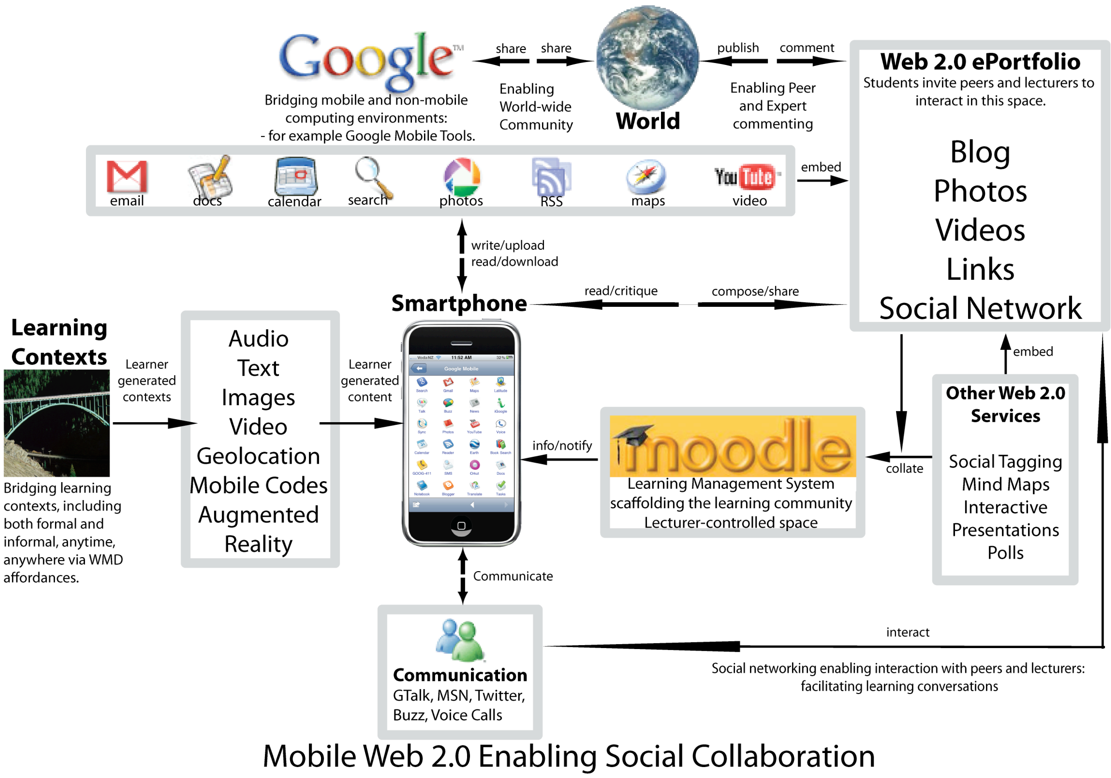


Figure 34: Mobile Web 2.0 concept map.

Several of the unique affordances of smartphones were very popular with the students participating in the mlearning projects. For example: the built-in microphone of smartphones can be used to record audio and then upload that audio file to an online Blog or other web 2.0 site that supports audio. This uploaded audio recording can then form the basis of an ongoing PODCast show. Students can record themselves reflecting or reporting on their progress in an assignment or project, or they can record an interview with an expert in the field, providing authentic situated learner-generated content and contexts. An example of an enhanced audio Podcasting service used in one of the research projects is Audioboo (http://www.audioboo.com), which is designed specifically for recording, uploading and sharing audio recordings from the iPhone. Audioboo was used to record environmental sounds as a project within the Diploma of Contemporary Music in 2009.

Table 46: Affordances of smartphones mapped to social constructivist activities for 2009.

WMD Affordance	**Overview**	**Examples**	**Social Constructivist Activities**
Video Streaming	Record and share live events	Flixwagon, Qik http://www.qik.com	Real-time Event, data and resource capturing and collaboration.
Geo tagging	Geotag original photos, and geolocate events on services such as Google Maps	Flickr, Twitter, Google Maps http://tinyurl.com/5a85yh	Group activities involving: Mapping, Geocaching, and Navigation, facilitating rich data sharing.
Micro-blogging	Post short updates and collaborate using micro-blogging services	Twitter http://tinyurl.com/2j5sz3	Asynchronous communication, collaboration and support.
Txt notifications	Course notices and support	Txttools plug-in for Moodle and Blackboard Txt and twitter polls: http://www.polleverywhere.com/ http://twitter.polldaddy.com http://twtpoll.com/	Scaffolding, learning and course administrative support
Direct audio, image and video blogging	Capture and upload audio, images and video of ideas and events	Flickr, YouTube, Vox	Student journals, eportfolios, presentations, peer and lecturer critique.
Mobile Codes	2D Codes scanned by cameraphone to reveal URL, text etc…	QR Codes, Datamatrix 2D Codes http://tinyurl.com/af2u6d	Situated Learning – providing context linking
Enhanced Student Generated Podcasts	Remote recording of audio, tagged with GPS and images etc…	AudioBoo	Situated and collaborative Learning – providing context linking and sharing of student generated content
Social Networking	Collaborate in groups using social networking tools	Vox groups, Ning, peer and lecturer comments on Blog and media posts http://tinyurl.com/4uz6rj	Metacognition Formative peer and lecturer feedback.
Augmented Reality	Overlaying the real world with digital information tagging	Wikitude http:/www.wikitude.org	Situated and collaborative Learning – providing context linking and enhanced data

The WMD affordances highlighted by Table 46 map to social constructivist activities that can be integrated into course assessments and student eportfolio creation. Table 46 illustrates that collaboration and communication with peers and tutors can be maintained across contexts using WMDs with a variety of communication technologies (such as: video streaming, microblogging, txt messaging, moblogging, social networking) thus linking multiple contexts (Vavoula, 2007a) into the learning environment, continuing learning ‘conversations’ via social presence and communication technologies (Laurillard, 2001, 2007). At the time of writing, new emerging mobile affordances include ‘augmented reality’, where the smartphone’s camera, GPS, ubiquitous Internet connectivity, and compass are used to overlay the real-world in real-time with digital information. There are over one hundred augmented reality applications available from the iTunes app store for the iPhone alone at the time of writing. The innovation wave of mobile affordances is just beginning, and new paradigms will emerge as the capabilities of the devices grow and innovative developers appropriate them. These unique mobile affordances provide rich possibilities for creating social constructivist learning environments, as has been illustrated by the various case studies recorded herein. For example: the facilitation of the ‘nomadic’ studio in the third year Bachelor of Product Design, and the collaborative SHaC09 project.

10.3.2 WMD Choice Rubric

Student feedback from the mlearning projects clearly showed that the choice of smartphone was critically important in the acceptance of its use. This was particularly evidenced in the Diploma of Landscape Design case study, where the Palm Treo680 smartphone was rejected by the students in 2007, and the 2008 students struggled with the Sonyericsson P1i smartphone. This is a function of both the social acceptance of a smartphone, and the smartphone's ability to enhance the specific requirements of a particular course's focus. In response to this a smartphone evaluation rubric was developed for choosing an appropriate smartphone for each of the 2009 projects. The rubric was used for comparative rating of several current (2009) and soon to be available smartphones according to their match with sixteen chosen affordances for mlearning and mobile web 2.0, identified by the researcher from the 2007 and 2008 project focus group feedback. An example rubric evaluation is given in Table 47 and Table 48. Table 47 provides a relative numeric rating for each smartphone, and Table 48 then compares the strengths and weaknesses of each smartphone, together giving an indication of which smartphone may be best for each different mlearning project's requirements. This uses a rating via 'unweighted' affordances. However, for some projects particular affordances will be more important than others, and therefore should be given higher rating factors. For example: video recording capability may be the most important for a particular project as in the 2009 Film and TV student project. Finally, the cost of the smartphone may be a key limitation, which will effectively narrow the list of choices available. The ranking of affordances (Ranked 0 (Not Available), 1 poor, 2 good, 3 excellent) was made by the researcher and is subjective, but was based on the experiences of the 2007 and 2008 mlearning projects and the smartphones' specifications.

Table 47: Rubric for ranking the affordances of example smartphones for mobile web 2.0.

Affordance	**Smartphone**								
0 = Not Available 1 = Poor 2 = Good 3 = Excellent	**iPhone 3G**	**G2 Android**	**Palm Pre**	**N97**	**E90**	**N95 + kbd**	**5800 XM**	**P1i**	**iPhone 3GS**
1. Image capture	1	2	2	3	2	3	2	2	2
2. Video capture	1	2	2	3	3	3	3	1	2
3. Video streaming	1	1	2	3	3	3	3	1	1
4. Mobile Web experience	3	3	3	2	2	1	2	1	3
5. Ease of Text entry	3	3	3	3	3	3	2	2	3
6. GPS integration	3	3	3	3	3	2	2	0	3
7. Touch screen	3	3	3	3	0	0	2	2	3
8. Application availability	3	2	2	2	3	3	2	1	3
9. Ease of User Interface	3	3	3	2	2	2	2	1	3
10. 3G connectivity	3	3	3	3	3	3	3	1	3
11. WiFi connectivity	3	3	3	3	3	3	3	3	3
12. Cost	2	1	2	1	1	3	2	3	2
13. Availability in NZ	3	1	1	3	3	3	1	3	3
14. Screen size	3	3	3	3	3	1	3	1	3
15. Video Output	2	3	3	3	0	3	3	0	2
16. Portability – size, weight	3	2	2	2	1	1	3	3	3
Score	**40**	**38**	**40**	**42**	**35**	**37**	**38**	**25**	**42**

Table 48 gives an example ranking of several smartphones current at the time of writing, with a brief outline of relative advantages and disadvantages of each device.

Table 48: Strengths and weaknesses of a range of smartphones.

Smartphone	Affordance Rank	Advantages	Disadvantages
Apple iPhone 3GS	42	UI, Web2, apps store	Limited video out
Nokia N97	42	Camera, all-in-one, video out	Cost, aging OS
Apple iPhone	40	UI, Web2, apps store	Jailbreak, camera
Palm Pre	40	UI, Web2	Unavailable, Cost? Apps?
Nokia 5800XM	38	Size, Cost, all-rounder, video out	Camera, plastic
Google G2	38	Google integration, OS	Cost, apps, availability
Nokia N95 + kbd	37	Cost, video out, apps	Screen, ext KBD
Nokia E90	35	Screen, built-in kbd, apps	Size, non touch, no video out, limited Multimedia
Sonyericsson P1i	25	Cost, handwriting	UI, no video out, screen size, UMTS

A similar ranking rubric model was used to inform the choice of netbooks used in the research. This is illustrated by an example rubric in Table 49.

Table 49: Example netbook choice rubric.

Feature 0 = Not Available 1 = Poor 2 = Good 3 = Excellent	**Netbook Model**			
	EeePC900 Linux	**EeePC901 XP**	**DellMini9 XP**	**Nokia Booklet 3G**
Size	3	3	3	2
Weight	3	3	3	2
Cost	3	3	3	1
Connectivity	2	3	3	2.5
Memory Card	3	3	3	3
HD/SSD	2	2	1	3
Style	1	2	3	3
Battery Life	1	3	2	3
OS	1	2	2	3
Applications	1	3	3	3
Web Camera	1	3	3	3
3G	0	0	2	3
GPS	0	0	0	3
Screen Resolution	1	1	1	3
Availability	3	3	3	0
SCORE	**25**	**34**	**35**	**37.5**

Using such rubrics for evaluating and specifying appropriate WMDs for the requirements of a particular course provides guidance in choosing either an institutionally provided WMD, or providing guidance to students as to what WMD purchase would be most suitable for them to purchase personally. The rubric also provides a clear outline of the WMD affordances that can then be integrated into the course assessment and activities. As the WMD market is rapidly changing, these rubrics will need to be regularly updated for each project implementation. An example is the 2010 introduction of the Apple iPad as a potential WMD between the smartphone and netbook markets.

10.3.3 Implementation Model

Based upon the experiences of the thirteen mlearning projects from 2007 to 2009, to achieve an explicit move to a social constructivist learning environment using mobile web 2.0 tools, a staged, and scaffolded approach has been adopted (illustrated in the 2009 Bachelor of Product Design case Study, section 6.3). This process begins with establishing a lecturer COP investigating the potential of integrating mlearning into their courses. Lecturer professional development and technological support has been found to be critical in facilitating the pedagogical focus of this roll-out.

Table 50: Example mlearning roll-out timeframe.

mLearning Project Stages	Timeframe	Outcome
Establish weekly COP with lecturers and technology steward. Establish support requirements (with IT Services and Telco)	Semester 1	Staff develop competency with mlearning. Staff develop pedagogical mlearning activities based on social constructivist pedagogies
mLearning projects with staff and students. Implementation of the mlearning activities within each course and assessment.	Semester 2	Increased student engagement. Flexible delivery. Facilitating social constructivist pedagogies and bridging learning contexts.
Lecturers publish and present case studies based on project implementation	End of Semester 2 and beginning of following Semester	Conference, Journal publications and symposia presentations

Table 50 shows that the second stage of an mlearning project is the project implementation with the students, involving the establishment of a supporting COP comprised of the students, the course lecturers, and a technology steward. The final stage is evaluation and reflection of the projects. This has been found to be particularly valuable for improving the projects, as evidenced in several collaborative research papers from the participating lecturers reflecting on the mlearning projects (Cochrane, 2007j, 2009e, 2010c; Cochrane & Bateman, 2009e, 2010a; Cochrane, Bateman, Cliffin, et al., 2009; Cochrane & Flitta, 2009).

The most benefit from mlearning integration can be achieved by staging mobile web 2.0 integration across an entire programme as shown in Table 51. This reduces students' cognitive load involved in learning, personally appropriating, and integrating these new tools. This staged approach allows the bridging of the PAH (Pedagogy, Andragogy, Heutagogy) continuum, and the embedding of mobile web 2.0 affordances that support each stage. Additionally, as the life-span of mobile computing is generally shorter than that of desktop computing, a staged roll-out of WMD computing for students involved in three year long courses can be achieved to minimise the redundancy of the student-owned WMDs. A staged integration of mlearning (mobile web 2.0) across the three years of a programme can be structured as indicated in Table 51 (The costs provided are indicative only, providing a guideline for spreading the cost of WMDs for students across each year and keeping within the allocation of allowed refundable annual course related costs in New Zealand in 2010).

Table 51: Staging the roll-out of mobile web 2.0 throughout various course levels.

Stage	**Web 2.0 Tools**	**MLearning Tools**	**Indicative Student course related costs**	**Course Timeframe**	**PAH alignment**
Level 1	Social Collaboration with peers and lecturer. Student generated content.	Use of student-owned netbook or mid-range smartphone, LMS and basic web2.0 sites	Netbook $700 Internet paid access $250	1 year Certificate programmes, or first year of longer programmes	Pedagogy (Lecturer directed)
Level 2	Social collaboration with peers and 'authentic environments'. Exploring context aware technologies.	Student-owned laptop and/or mid-range smartphone	Laptop cost $750 ($1500 spread over 2 years) And/or smartphone $750 Internet paid access $250	Second year of two year or longer programmes	From Pedagogy to Andragogy (Students become the content creators)
Level 3	Context Bridging. Student generated contexts.	Student-owned laptop and/or high-end smartphone	Laptop cost $750 ($1500 spread over 2 years) And/or smartphone $750 Internet paid access $250	Third year of programme	From Andragogy to Heutagogy (Students become independent learners)

An outline of the institutions' new elearning strategy integrating the use of WMDs based upon this implementation strategy is attached in Appendix 13.13. A generic WMD implementation plan for 2010 mlearning projects was also created based upon the research findings, and is available for viewing at http://docs.google.com/Doc?docid=0Adkx7n-UKqvBZGNocjRyZ2dfODMycGR4aGRmbg&hl=en_GB.

10.4 Chapter Summary

In this chapter I have discussed the implications of the five mlearning case studies, explored the significance of the six mlearning critical success factors identified throughout the research, and described the impact of the research findings upon the development of the institution’s new elearning strategy. Finally the mlearning design framework and implementation plan derived from the research findings are presented as a model for wider mlearning integration.

11 CONCLUSION

This section outlines the significance of the research, explains the research findings in relation to the research questions, acknowledges and addresses the research's limitations, and points to recommendations for further developing the mlearning implementation model.

The research began as an investigation of the educational potential of wireless mobile devices (WMDs) coupled with web 2.0 (mobile web 2.0). During the research design phase it became obvious to the researcher that to successfully integrate the use of these tools to enhance and transform pedagogy a new approach to lecturer professional development and student pedagogical and technical scaffolding was required. This then led to the development of an intentional community of practice model for pedagogical and technological support for the mlearning projects. Within this context, the researcher drew upon, appropriated, and developed the role of the technology steward initially defined by Wenger et al. (2005), which also created a close fit with a participatory action research methodology. These concepts were then further refined during three years of action research mlearning projects investigating the potential of mobile web 2.0 tools (with a focus upon smartphones coupled with mobile formatted web 2.0 social software) to facilitate social constructivist learning environments across multiple learning contexts. Thirteen mlearning projects undertaken between 2007 and 2009 refined and informed the development of:

- an intentional community of practice model for lecturer professional development and scaffolding student learning
- an underlying pedagogical design framework
- identified critical success factors

- and developed a transferable implementation strategy

The projects encompassed five different courses, forming five case studies spanning from one to three years of implementation and refinement. The thesis captures the learning journeys of the researcher and participants as they moved from personal appropriation of the new technologies to the ontological shifts required for integrating the unique affordances of these mobile web 2.0 technologies into their pedagogical practice and courses, enabling collaborative learning environments that bridge multiple contexts.

11.1 Significance of the Research

A review of the mlearning literature found a lack of focus upon mlearning designed to facilitate explicit social constructivist pedagogies that enable student-generated content and student-generated contexts. The literature also reveals a lack of longitudinal mlearning case studies. This research not only addresses these gaps but has also led to the development of a unique mobile learning design framework based upon explicit social constructivist pedagogies and has developed a transferable model for designing and supporting mobile web 2.0 learning environments. Five critical success factors for mlearning were identified from the literature and extended. A sixth previously unidentified critical success factor was identified and its impact explored. These factors were then used as a critical framework informing the design and analysis of the mlearning projects. The research demonstrates that addressing these six critical success factors can create a foundation for the ontological shifts required for supporting pedagogical transformation from instructivism to social constructivism.

Thus the research has demonstrated that mlearning can be used as a catalyst for pedagogical change.

The resulting mobile web 2.0 support and implementation models developed from the research have been influential in informing the development of the institution's new elearning strategy, with many of the pedagogical and support strategies becoming integrated into this new elearning strategy. Thus the outcome of using an action research methodology has met the researcher's goal of having significant positive impact on the institution and the associated learning community.

11.1.1 Development of an Intentional Community of Practice Model for Lecturer Professional Development and Scaffolding Student Learning

The research extends Wenger et al.'s (2005) concept of intentionality within communities of practice and Langelier's (2005) notion of intentional communities of practice and appropriated the concepts to develop a model for lecturer professional development and for scaffolding the subsequent mlearning projects with students. Section 4.7 introduces the initial development of the intentional community of practice model, and each of the case studies represent the refinement and flexibility of the model. Section 10.2.3 discusses the further development of the model within the research. An intentional community of practice was used as a hub for lecturer professional development in preparation for each mlearning project rollout with their students. A critical role in these intentional communities of practice was identified by Wenger et al. (2005) as the Technology steward. This role was appropriated and extended by the researcher within the supporting communities of practice for each mlearning project. Just as the influence of web 2.0 social software and mlearning has exponentially grown since 2005, so has the importance of the role of the technology steward in guiding communities of practice in the use of these rapidly changing enabling technologies and in response to these changes facilitating communities of practice in new and unique ways unforeseen in 2005. Two examples are: the use of Twitter to support collaboration and virtual communities internationally, and the use of mobile live video streaming via Qik and UStream.

Using this intentional community of practice model, the research project has impacted and transformed the pedagogical approaches of the lecturers involved in this journey alongside the researcher, and their students have demonstrated increased engagement and a reconceptualisation of their role within a social constructivist learning environment.

11.1.2 Pedagogical Design Framework

The iterative development of mlearning project plans for the 2007 to 2009 action research cycles, integrated into courses situated in the five case studies, resulted in the development of a pedagogical design framework for the integration of mlearning into a course. The design framework grew out of the collaborative mlearning project plans developed by the researcher and course lecturers' modifying the course outlines and assessments for each mlearning project using shared and co-edited Google Docs. The development of these course plans began as brainstorming sessions within the lecturer communities of practice established by the researcher for lecturer professional development in mlearning, prior to instigation of the projects with the course students. These mlearning project plans were refined and reflected upon as collaborative peer-reviewed conference papers with the researcher and course lecturers becoming co-authors of these papers. The course mlearning project plans and subsequent research outputs became a shared repertoire of resources developed by the lecturer mlearning communities of practice, reifying the practice of the lecturer COPs and becoming boundary objects that were shared between the lecturer communities of practice within the five case studies as pedagogical mlearning integration examples. An example of the generation of this shared repertoire between three of the case studies is the collaborative 2009 EDULearn09 conference paper (Cochrane, Bateman, Cliffin, et al., 2009) that reflected upon three 2009 mlearning project plans: the 2009 second year Diploma of Contemporary Music project, the 2009 second year Diploma of Landscape Design project, and the 2009 third year Bachelor of Product Design projects.

The resultant design framework maps the unique affordances of mobile web 2.0 with social constructivist frameworks to create a shift along the Pedagogy-Andragogy-Heutagogy (PAH) continuum. The design framework extends Luckin et al.'s (2008; 2010) framework of learner generated contexts and bridging the PAH continuum, and develops a practical design framework for implementation from these concepts. The design framework focuses upon desired pedagogical outcomes first, and then maps the affordances of WMDs to these outcomes ensuring that the mlearning projects were driven by pedagogy rather than merely the latest technology. Section 4.8.5 and 10.3.1 discuss the developed mlearning framework further. Table 44 outlines the mlearning design framework and Table 46 outlines the social constructivist affordances of mobile web 2.0.

11.1.3 Critical Success Factors

Reflections and analysis of the 2007 and 2008 action research cycles led to the identification of six critical success factors for the integration of mlearning within a tertiary course:

1. The pedagogical integration of the technology into the course and assessment.
2. Lecturer modeling of the pedagogical use of the tools.
3. Creating a supportive learning community.
4. Appropriate choice of mobile devices and web 2.0 social software.
5. Technological and pedagogical support.
6. Creating sustained engagement that facilitates the development of ontological shifts, both for the lecturers and the students.

These were tested and refined during the following 2009 action research cycles. A comparison of these critical success factors with those identified in other mlearning research confirmed the focus upon pedagogical integration, with supporting identification of lecturer modeling, creating supportive learning communities, and the appropriate choice of supporting technologies also featuring in other mlearning research. However the research was found to be unique by the identification of the following two critical success factors: technological and pedagogical support, and creating sustained engagement facilitating ontological shifts for the participants. These two critical success factors are drawn from the researcher's experience of supporting the mlearning projects as the technology steward within intentional communities of practice throughout the length of the projects. As an integral member of these COPs the researcher was able to provide targeted pedagogical and technical support for the participants, and observe and identify critical incidents in the understanding of the participants. The researcher encouraged the participants to record any significant reflections as blog posts or VODCasts and share these with the other participants of the mlearning COPs. An example of collated lecturer VODCast reflections is available at: http://www.youtube.com/watch?v=EOt3lbfCuuo. An example of collated student VODCast reflections is available at: http://www.youtube.com/watch?v=pmydqBO6ltI.

When combined (See Figure 33 in section 10.2.6) the six critical success factors provide a foundation for facilitating ontological shifts within the participants. The six identified critical success factors will be used to guide future mlearning project design and implementation.

11.1.4 Transferable Implementation Strategy

One of the goals of the research was to facilitate pedagogical change within the researcher's institution by developing an mlearning implementation model that could be used in a wide variety of learning contexts. The literature review revealed that there were few mlearning implementation strategies with a focus upon facilitating student-generated content and student-generated contexts for mainstream tertiary education adoption. The research resulted in the development of a transferable design framework (Outlined in Table 44), and implementation strategy (Outlined in Table 50, and Table 51) for mobile web 2.0 in tertiary education that is flexible enough to allow for new and unique contexts. The implementation strategy matches the unique affordances of mobile web 2.0 with social constructivist pedagogies (Table 46, Table

51), minimizing the technical support needed for the participants, and maximizing transferability. The implementation strategy places the emphasis upon lecturer professional development and student scaffolding with the goal of transforming pedagogy rather than the development and programming of technically complex mobile software applications. The research developed explicit staging of the integration of mobile web 2.0 within courses and scaffolding and nurturing of the required ontological shifts in pedagogical transformation via a structured and sustained intentional community of practice model over the length of the course, resulting in positive pedagogical change for both the lecturers and the students. Coupled with an action research methodology this ensured that each new mlearning project did not have to reinvent the wheel, but built upon the lessons learnt from previous projects. The range of learning contexts covered by the thirteen mlearning projects demonstrated the transferability of the implementation strategy for mainstream adoption.

11.2 Answering the Research Questions

This section draws together the conclusions of the research in relation to the original research questions.

11.2.1 What are the key factors in integrating Wireless Mobile Devices (WMDs) within tertiary education courses?

While every implementation of mlearning and each learning context will be unique, six critical success factors have been identified by the research that have proven to be important across multiple mlearning implementations and contexts. These were identified throughout the five mlearning case studies and are expanded on in section 10.2 “Critical Success Factors”. The pedagogical integration of the technology into the course delivery and assessment is critical. Lecturer engagement and modeling of the pedagogical use of the WMDs is essential. These changes in curriculum design and practice (and student acceptance) require scaffolding and sustained engagement that facilitates ontological shifts leading to lecturers’ reconceptualising teaching, and students’ reconceptualising learning. The development of an intentional community of practice model to support these participant ontological shifts over the length of a course has been pivotal. In the five case studies the time frame for these shifts for participating lecturers has varied and in some cases spanned several years of sustained engagement and modeling by the researcher and other participating lecturers. Innovative practice must take a scaffolded and staged approach to implementation, and lecturers (and students) require sustained pedagogical and technical support to achieve this. This will allow the development of students’ web 2.0 eportfolios in the early stages of their courses while leveraging the unique affordances of mobile web 2.0 in the later stages of students’ courses, coinciding with the facilitation of staged movement along the pedagogy to heutagogy continuum. The role of an appropriate technology steward for pedagogical and technical support has been found to be critical.

11.2.2 What challenges/advantages to established pedagogies do these disruptive technologies present?

Mobile web 2.0 tools are disruptive technologies that democratize the learning environment, empowering students, and providing opportunities for social constructivist pedagogies. As theorized by Bruns (2007) and Laurillard (2007) and demonstrated by the research projects (for example within the Bachelor of Product Design mlearning projects critiqued in chapter 6) the ubiquitous connectivity of WMDs combined with the student content creation and sharing capabilities of web 2.0 shift the learning focus from teacher-directed to student-centred learning challenging instructivist pedagogies and providing a rich basis for flexible social constructivist pedagogies. Learning can then occur across multiple contexts, bridged by the ability of the WMDs to augment, capture, share and communicate learning experiences, as demonstrated by the SHaC09 mlearning project (Cochrane, Bateman, Cliffin, et al., 2009). This changes the role of the educator and the nature of learning for the students. These disruptions to the educators' and learners' conceptualizations of teaching and learning that are based on previous experiences require sustained engagement and expert modeling to reconceptualise, as the ontological shifts are come to terms with and the benefits realized. Technological and pedagogical support for these paradigm shifts is critical. The research extends the concepts of the Learner Generated Concepts group (Luckin, et al., 2008; Luckin, et al., 2010) providing practical examples of how these disruptions facilitate appropriate shifts along the pedagogy (teacher-directed) to heutagogy (learner-directed) continuum. Good pedagogical design of contextual learning environments is essential and should include assessment integration and curriculum alignment for students to value the integration of mlearning activities.

11.2.3 To what extent can these WMDs be utilized to support learner interactivity, collaboration, communication, reflection and interest, and thus provide pedagogically rich learning environments that engage and motivate the learner?

The research projects have explored a variety of applications of wireless mobile devices combined with web 2.0 services to a range of tertiary education settings. Focusing upon appropriating evolving mobile web 2.0 services has provided the development of a transferable methodology for mlearning implementation and integration with minimal specialist technical knowledge required of either lecturers or students. The limitations of small screen size and slow text entry of WMDs force a rethink of simply reproducing activities designed for laptop or desktop computers. Conversely the small size and portability of WMDs enable them to be carried almost anywhere, and bridge learning contexts and communication beyond the classroom. WMDs are a rapidly evolving technology with unique affordances that can be utilized within social constructivist learning environments to facilitate rich learning experiences guided by educators who model and integrate the use of these affordances into their daily work-flows and course curricula. The research projects have provided examples where these criteria have been met creating a transforming experience for students (for example the third year Bachelor of Product Design 2009), and examples where these criteria have not been met leading to a mediocre experience by students (for example the second year Bachelor of Architecture 2009).

The research has developed strategies for mlearning integration and implementation. The extent of the impact of WMDs on education has been demonstrated to be limited by the extent to which the identified six critical success factors are designed for in mlearning. Mobile web 2.0 can be used to facilitate the design of learning environments that focus upon interactivity (student-generated content and student-generated contexts), collaboration, and communication within authentic contexts, as demonstrated by the SHaC09 collaborative mlearning project (Cochrane, Bateman, Cliffin, et al., 2009). The aggregation of a variety of mobile web 2.0 tools facilitates media-rich student eportfolios, metacognition and reflection. Students' demonstrate increased motivation and engagement when using these personal devices and personalized media-rich learning spaces. The research has also extended Wenger et al.'s (2005) identification of the supporting role of a technology steward in communities of practice, to enable students initially interested and engaged by the use of personal and innovative technologies to appropriate the pedagogical use of these tools when scaffolded by the sustained engagement of supporting intentional communities of practice guided by an appropriate technology steward.

11.2.4 To what extent can WMDs be used to harness the potential of current and emerging social constructivist e-learning tools?

Emergent social constructivist e-learning tools are referred to as 'web 2.0' in this thesis, and mobile-formatted web 2.0 tools are termed 'mobile web 2.0'. The research identifies that the extent of appropriating mobile web 2.0 within education is maximised by the staging and scaffolding of the integration of these tools across the length of a course. Staging the integration of these tools across a course facilitates the bridging of the PAH continuum beyond that achieved by short-term stand-alone projects. Scaffolding the sustained engagement of staged implementation provides the pedagogical and technical support needed by the participants to effectively use these new tools within pedagogically designed environments.

The research demonstrates that mobile web 2.0 tools facilitate the use of authentic learning within authentic contexts, supporting the findings and premise of the mlearning research of Herrington, Mantei, Herrington, Olney, and Ferry (2008). The research has demonstrated and extended Cook (2007b) and Vavoula's (2007b) concept that mlearning bridges learning contexts (Cochrane, 2009c). Mobile web 2.0 has developed into a range of viable, user-friendly, rich-media, flexible and context aware tools that can be used to bridge both formal and informal learning environments, spanning both distance and time. A context bridging social-constructivist learning environment can be facilitated, as demonstrated by the 2009 third year Bachelor of Product Design Nomadic Studio. As these tools develop further, so will their educational potential and richness.

However the surveys of the previous technology usage of the student participants (2007 to 2009) show that Oblinger and Oblinger (2005) and Prensky's (2001) assertion of the prevalence of 'Net Generation' skills of students cannot be assumed and appropriate support structures must be established for the introduction of mobile web 2.0. The research confirms Laurillard's (2007) defense of the need for the pedagogical design input of lecturers in mlearning. The research demonstrates that the lecturers' role in modeling and integrating the use of mobile web 2.0 within authentic pedagogical environments is critical.

11.3 Limitations

While the research has sought to produce transferable principles and strategies to enhance tertiary education using mobile web 2.0, it is ultimately bound by the limits of the contexts of the learning communities that it is embedded in (the five case studies are based in the 'creative arts and industries' fields), and the current affordances of the available mobile web 2.0 technologies.

As the research is qualitative there is the danger that the data collection and analysis may be coloured by the researcher's opinions and bias, but by using a participatory action research methodology, the research focused upon a variety of communities of practice of which the researcher was a contributing member and also gained the input and reflections from the participating lecturers and students, ensuring that reflections and analysis accurately reflected participant views. This is particularly demonstrated in the multiple collaborative research outputs that the research has generated involving the researcher and several of the participating lecturers (Cochrane & Bateman, 2008a, 2008b, 2008c, 2008d, 2009a, 2009b, 2009c, 2009d, 2010a, 2010b, 2010c, 2010d, 2010e; Cochrane, Bateman, Cliffin, et al., 2009; Cochrane, Bateman, & Flitta, 2009a, 2009b; Cochrane & Flitta, 2009; Cochrane, Flitta, et al., 2009a, 2009b).

A limitation of the participatory action research methodology of the research is the significance of the input of the researcher as the technology steward for the projects. The collaboration between the researcher and the participating lecturers has been critical in supporting and providing direction for the projects. The researcher's appropriation of the role of the technology steward for the supporting intentional communities of practice has also been critical to the projects' success. It is yet to be seen whether the approach can be transferred to other mlearning contexts involving different technology stewards.

The data collection involved triangulation of participant reflections, activity, focus groups, surveys, and researcher observations captured in a variety of rich media sources including: participant blogs, VODCasts, YouTube videos, online photo albums, wiki pages, audio PODCasts, and social networking. This produced a vast amount of data that is difficult to reduce down to its essence in a written report. The accompanying DVD provides archived examples of this rich media.

The research has limited its pedagogical focus to facilitating social constructivist learning environments. This is a strength as an explicit foundation and direction, but also a limitation in regards to purposely not engaging with lecturer-directed pedagogies that focus upon lecturer-generated content delivered to small screen mobile devices, txt messaging or in-class polling using mobile devices. These aspects of mobile device usage in education are covered in many mlearning case studies as outlined in the literature review.

Issues not addressed in the research due to scope limitations include: gender, cultural and ethnic differences among the participants and the impact of these upon their engagement with WMDs and web 2.0.

11.4 Recommendations

The research has established the critical role of a technology steward for supporting the integration and implementation of mlearning within the five case studies. Future research is required to establish the validity of this model as a transferable model of technology stewardship beyond the direct input of the researcher.

Future research is required to reflect on and critique the outcomes of the institutions' new elearning strategy as it embeds the strategies developed from this research project with a focus upon student-owned WMDs and web 2.0 integration into teaching and learning in a wide variety of contexts.

Future research is also required to broaden the context of the design framework, implementation strategy, and supporting intentional community of practice model beyond a single institution. There is potential for creating national and international inter-institution collaborative mlearning projects supported by virtual COPs using the collaboration and communication affordances of mobile web 2.0, for example the use of Twitter for facilitating asynchronous international student collaboration.

The ubiquity of cellphone ownership by students was clear from the previous technology surveys of the students, it was also clear that the percentage of students owning cameraphones increased throughout the research period. This indicates that the capability of the WMDs owned by students is reaching the point where a focus on student-owned WMDs for sustainable mlearning integration in education is possible. Future mobile web 2.0 research should focus on student-owned WMDs rather than institutionally-loaned devices for the widest mainstream adoption. However, there will be value in mlearning research that explores new mobile technologies beyond what students currently own, based upon sound design frameworks and implementation strategies such as those established by this research.

11.5 Conclusions

Mobile web 2.0 is a continually evolving environment with new technologies and affordances developing at an astonishing rate. However this research has illustrated that it is possible for typical techno-wary tertiary lecturers to appropriate these tools and become comfortable within this innovation wave, even to the point of becoming mlearning evangelists themselves. Purposely capturing the critical incidents in the lecturers' journeys via rich multimedia has created authentic pedagogical transformation stories. The sharing of these participants' stories as boundary objects of the supporting mlearning COPs reified as YouTube videos, conference presentations, and peer-reviewed papers has been demonstrated to draw other tertiary educators in from the periphery of the mlearning COPs to investigate integrating the use of mobile web 2.0 tools into their own pedagogical toolkits. This has been demonstrated by the growth of the mlearning projects from one in 2007 to seven projects in 2009, and a following twelve concurrent mlearning projects in 2010.

An intentional community of practice model provides a sustainable framework for pedagogical and technical support of mlearning projects. While it is time-consuming, as Langelier (2005) emphasizes in his report on intentional communities of practice: "The community of practice is one way to manage knowledge. It is a powerful, but demanding tool" (p. 8). However the results are rich. The intentional COP model for supporting the mlearning projects has led to the development of mutually collaborative partnerships that have seen rewards in increased student engagement, deeper pedagogical reflection, and practice-based research outputs. The symbiotic relationship developed between the researcher (as the technology steward) and the lecturers involved in each of the mobile learning projects has proven to be a vital partnership for harnessing mobile web 2.0 technologies to design social constructivist learning environments for different groups of tertiary students. The disruptive nature of mobile web 2.0 technologies has been presented as a catalyst to move instructivist pedagogies towards social constructivist pedagogies that bridge both on and off campus learning contexts. The insights gained and in particular the identification of critical success factors and an mlearning implementation strategy will continue to be useful in informing the maturing of the institutions' newly developed elearning strategy, and wider mlearning research.

12 REFERENCES

Alexander, B. (2004, September/October). Going nomadic: Mobile learning in higher education. *Educause Review, 39,* 28-35.

Alexander, B. (2006, March/April). Web 2.0: A new wave of innovation for teaching and learning? *Educause Review, 41,* 33-44.

Alexander, B., Brown, M., Doogan, V., Johnson, L., Levine, A., Sabean, R., et al. (2006). *The Horizon Report 2006 Edition*. Austin, Texas: The New Media Consortium.

Allen Consulting Group. (2004). *Development of a strategy to support the universal recognition and recording of employability skills: a skills portfolio approach - final report*. Canberra: Department of Education, Science and Training (DEST).

Ally, M. (2008). Foundations of educational theory for online learning. In T. Anderson (Ed.), *Theory and practice of online learning* (Second Edition ed., pp. 15-44). Edmonton: AU Press, Athabasca University.

Ally, M. (Ed.). (2009). *Mobile learning: Transforming the delivery of education and training*. Edmonton: AU Press, Athabasca University.

Anderson, P. (2007). What is Web 2.0? Ideas, technologies and implications for education. *TechWatch: Horizon Scanning Reports,* (February), 63. Retrieved from http://www.jisc.ac.uk/whatwedo/services/techwatch/reports/horizonscanning/hs0701.aspx

Andrew, M., Hall, R., & Taylor, P. (2009). Mobilising remote student engagement (MORSE) using mobile and web2.0 technologies: Initial perspectives. In I. A. Sanchez & P. Isaias (Eds.), *Proceedings of IADIS International Conference on Mobile Learning 2009* (pp. 199-202). Barcelona, Spain: iadis: international association for development of the information society.

Armstrong, J., Franklin, T., McLoughlin, C., Westera, W., Schmidt, P., Kelly, B., et al. (2008). *A review of current and developing international practice in the use of social networking (Web 2.0) in higher education*. York, UK: Franklin Consulting.

Attewell, J. (2004). *Mobile technologies and learning: A technology update and m-learning project summary*. London: the Learning and Skills Development Agency.

Attewell, J. (2005). From research and development to mobile learning: Tools for education and training providers and their learners. In H. v. d. Merwe & T. Brown (Eds.), *Proceedings of mLearn 2005: 4th World Conference on Mobile Learning*. Cape Town: mLearn 2005.

Attewell, J. (2008). Towards sustainable large scale implementation of mobile learning: The mobile learning network (MoLeNET). In J. Traxler, B. Riordan & C. Dennett (Eds.), *MLearn08: The bridge from text to context* (pp. 28-35). Ironbridge Gorge, Shropshire, UK: University of Wolverhampton, School of Computing and IT.

Attewell, J., Savill-Smith, C., & Douch, R. (2009). *The impact of mobile learning: Examining what it means for teaching and learning*. London: Learning and Skills Network.

Attwell, G. (2006, 1 July 2006). Personal learning environments. *The Wales-wide web* Retrieved 1 June, 2006, from http://www.knownet.com/writing/weblogs/Graham_Attwell/entries/6521819364

Attwell, G. (2007). The personal learning environments - the future of elearning? *eLearning Papers, 2*(1), 1-8.
Bain, J. D., Ballantyne, R., Packer, J., & Mills, C. (1999). Using journal writing to enhance student teacher's reflectivity during field experience placements. *Teachers and Teaching, 5*(1), 51-73.
Bandura, A. (1986). *Social foundations of thought and action*. Englewood Cliffs, NJ: Prentice-Hall.
Barbaux, M.-T. (2006). From lifelong learning to m-learning. In D. Whitelock & S. Wheeler (Eds.), *Proceedings of 13th Association for Learning Technology Conference (ALT-C 2006)* (pp. 132-141). Heriot-Watt University, Edinburgh, Scotland, UK: Association for Learning Technology.
Barker, A., Krull, G., & Mallinson, B. (2005). A proposed theoretical model for m-learning adoption in developing countries. In H. van der Merwe & T. Brown (Eds.), *Proceedings of mLearn 2005: 4th World conference on mlearning*. Cape Town, South Africa: mLearn 2005.
Bateman, R., & Cochrane, T. (2008). Design project outline. Retrieved 16 October, 2008, from http://docs.google.com/Doc?id=dchr4rgg_71dgp6ntf6
Becta. (2007). Emerging technologies for learning: Volume 2 (2007). Retrieved March, 2007, from http://partners.becta.org.uk/index.php?section=rh&catcode=_re_rp_ap_03&rid=11380
Bell, J. (1999). *Doing your research project* (Third ed.). Buckingham: Open University Press.
Bell, T., Cockburn, A., Wingkvist, A., & Green, R. (2007). Podcasts as a supplement in tertiary education: An experiment with two computer science courses. In D. Parsons & H. Ryu (Eds.), *Proceedings of Conference on Mobile Learning Technologies and Applications (MOLTA)* (pp. 70-77). Massey University, Auckland, New Zealand.
Belshaw, D. (2010). *Mobile and wireless technologies review*. Newcastle upon Tyne, UK: JISC infoNet.
Biggs, J. (2003). *Teaching for quality learning at university* (Second ed.). Buckingham: The Society for Research into Higher Education.
Bijker, W. (1995). *Of bicycles, bakelites, and bulbs. Toward a theory of sociotechnical change*. Cambridge: MIT Press.
Bijker, W., Hughes, T., & Pinch, T. (Eds.). (1987). *Social construction of technological systems: New directions in the sociology and history of technology*. Cambridge: MIT Press.
Bower, M., Hedberg, J., & Kuswara, A. (2009). Conceptualising Web 2.0 enabled learning designs. In R. Atkinson & C. McBeath (Eds.), *Proceedings of 26th ascilite conference 2009: Same places, different spaces* (pp. 1153 - 1162). University of Auckland, New Zealand: ascilite.
Boyd, D. M., & Ellison, N. B. (2007). Social network sites: Definition, history, and scholarship. [Internet]. *Journal of Computer-Mediated Communication, 13*(1), article 11.
Brookfield, S. (1995). *Becoming a critically reflective teacher*. San Francisco: Jossey-Bass Inc.
Brown, J. S. (2006). New learning environments for the 21st century: Exploring the edge. *Change, September/October,* 18-24.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-41.
Brown, T. (2005). Beyond constructivism: Exploring future learning paradigms. *Education Today,* (2), 11. Retrieved from http://www.bucks.edu/IDlab/Beyond_constructivism.pdf
Brown, T. (2006). Beyond constructivism: Navigationism in the knowledge era. *On the Horizon, 14*(3), 108-120.
Bruner, J. (1966). *Toward a theory of instruction*. Cambridge: Belknap Press of Harvard University.
Bruner, J. (1973). *Going beyond the information given*. New York: Norton.
Bruns, A. (2007, March 21-23). *Beyond difference: reconfiguring education for the user-led age.* Paper presented at the ICE3: Ideas in cyberspace education: digital difference, Ross Priory, Loch Lomond, Scotland.
Bruns, A. (2008). *Blogs, Wikipedia, Second Life, and beyond: From production to produsage*. New York: Peter Lang Publishing.
Bryan, J. (2007). The economics of laptop universities. *Educause Quarterly, 2*, 64-68.
Bryant, T. (2006). Social software in academia. *Educause Quarterly, 2*, 61-64.
Cameron, D. (2006, 4-7 December). *The rocket in your pocket: How mobile phones became the Media by stealth.* Paper presented at the 2nd joint JEANZ/JEA conference, Rendevous Hotel, Auckland, New Zealand.
Carroll, J., Howard, S., Peck, J., & Murphy, J. (2003). From adoption to use: The process of appropriating a mobile Phone. *Australasian Journal of Information Systems, 10*(2), 38 - 48.
Caruso, J. B., & Salaway, G. (2007). Highlights of the 2007 ECAR study of students and information technology. *ECAR Symposium 2007* Retrieved 21 January, 2008, from http://connect.educause.edu/Library/ECAR/Highlightsofthe2007ECARSt/45912
CeLeKT. (2009). AMULETS. Advanced mobile and ubiquitous learning environments for teachers and students. Retrieved from http://www.celekt.info/projects/show/11
Chan, S. (2006, 22 - 25 October). *mLearning for workbased apprentices: A report on trials undertaken to set up mobile portfolios.* Paper presented at the MLearn2006 - the 5th World Conference on Mobile Learning, Banff, Canada.
Chan, S. (2007). mLearning and the workplace learner: Integrating mlearning ePortfolios with Moodle. In D. Parsons & H. Ryu (Eds.), *Proceedings of Conference on Mobile Learning Technologies and Applications (MOLTA)* (pp. 55-62). Massey University, Auckland, New Zealand.
Chen, W. P., Millard, D. E., & Wills, G. B. (2008). Mobile VLE vs. mobile PLE: How informal is mobile learning? In J. Traxler, B. Riordan & C. Dennett (Eds.), *Proceedings of MLearn08: The bridge from text to context* (pp. 82 - 88). Ironbridge Gorge, Shropshire, UK: University of Wolverhampton, School of Computing and IT.
Cheney, S. (2010). Why mobile innovation is blowing away PCs. *TechCrunch,* (20th June). Retrieved from http://techcrunch.com/2010/06/20/why-mobile-innovation-is-blowing-away-pcs/
Chi, M., & Hausmann, R. (2003). Do radical discoveries require ontological shifts? In L. Shavinina & R. Sternberg (Eds.), *International Handbook on Innovation* (Vol. 3, pp. 430 - 444). New York: Elsevier Science Ltd.

Clark, S., Sutton-Brady, C., Scott, K., & Taylor, L. (2007). Short Podcasts: The impact on learning and teaching. In C. Oliver (Ed.), *Proceedings of MLearn 2007 - Making the Connections 6th International Conference on Mobile Learning* (pp. 270-274). Melbourne: MLearn 2007.

Cobcroft, R. S. (2006). Literature review into mobile learning in the university context. 138. Retrieved from http://eprints.qut.edu.au/4805/

Cochrane, T. (2003). *Creating an e-learning environment for a polytechnic course.* Paper presented at the eFest 2003, CPIT Christchurch.

Cochrane, T. (2005a). Interactive QuickTime: Developing and evaluating multimedia Learning Objects to enhance both face to face and distance e-learning environments. *Inter Disciplinary Journal of Knowledge and Learning Objects, 1*(1), 32-54.

Cochrane, T. (2005b). Mobilising learning: A primer for utilising wireless palm devices to facilitate a collaborative learning environment. In H. Goss (Ed.), *Proceedings of 22nd ASCILITE Conference: Maintaining the Momentum?* (Vol. 1, pp. 147-157). Brisbane: Queensland University of Technology.

Cochrane, T. (2005c, 19-21 September). *Mobilzing learning: A primer for utilizing wireless palm devices to facilitate a collaborative learning environment.* Paper presented at the eFest 2005, Wellington Convention Centre.

Cochrane, T. (2006a). Dummies2Delight intro video. from http://www.youtube.com/watch?v=-jn0HBIkF_U

Cochrane, T. (2006b). Dummies2Delight symposium presentation video. from http://www.youtube.com/watch?v=kUuJ-gW_vuc

Cochrane, T. (2006c). Learning with wireless mobile devices and social software. In L. Markauskaite, P. Goodyear & P. Reimann (Eds.), *Proceedings of 23rd ASCILITE Conference: Who's Learning? Whose technology?* (Vol. 1, pp. 143-148). Sydney: The University of Sydney.

Cochrane, T. (2006d). MLearning overview. from http://ltxserver.unitec.ac.nz/mediawiki/index.php/MlearningOverview

Cochrane, T. (2006e, 27-29 September). *Moving beyond the LMS - Getting Flock'd: A hub for social software tools.* Paper presented at the eFest, Wellington Convention Centre.

Cochrane, T. (2007a). Developing interactive multimedia Learning Objects using QuickTime. [Journal]. *Computers in Human Behavior, 23*, 2596-2640.

Cochrane, T. (2007b, 26-28 September). *Integrating multimedia In Moodle courses.* Paper presented at the Moodle Moot 2007, Wintec, Hamilton.

Cochrane, T. (2007c). *Mobile blogging.* Paper presented at the CALL Symposium, Unitec, New Zealand.

Cochrane, T. (2007d). Mobile blogging: A guide for educators. In L. Bevin (Ed.), *Proceedings of EIT Teaching & Learning Symposium*. Napier, New Zealand: Eastern Institute of Technology.

Cochrane, T. (2007e). Mobile blogging. from http://ltxserver.unitec.ac.nz/mediawiki/index.php/MobileBlogging

Cochrane, T. (2007f). Mobile Blogging: A Guide for Educators In C. Oliver (Ed.), *Proceedings of MLearn 2007 - Making the Connections 6th International Conference on Mobile Learning* (pp. 26-34). Melbourne Exhibition Centre, Melbourne: MLearn 2007.

Cochrane, T. (2007g). Mobile Web2 pedagogies. In D. Parsons & H. Ryu (Eds.), *Proceedings of Conference on Mobile Learning Technologies and Applications*

(MOLTA) (pp. 31-38). Massey University, Auckland, New Zealand.
Cochrane, T. (2007h). Moving mobile mainstream: Using communities of practice to develop educational technology literacy in tertiary academics. In C. Oliver (Ed.), *Proceedings of MLearn 2007 - Making the Connections 6th International Conference on Mobile Learning* (pp. 35-42). Melbourne Exhibition Centre, Melbourne: MLearn 2007.
Cochrane, T. (2008a). Contemporary Music Students and Technology. from http://docs.google.com/Doc?docid=dchr4rgg_66dsnt9xgp&hl=en_GB
Cochrane, T. (2008b). Designing mobile learning environments: Mobile trials at Unitec 2008. In J. Traxler, B. Riordan & C. Dennett (Eds.), *Proceedings of MLearn08: The bridge from text to context* (pp. 89-96). Ironbridge Gorge, Shropshire, UK: University of Wolverhampton, School of Computing and IT.
Cochrane, T. (2008c). The educational potential of Wireless Mobile Devices and Web2. from http://elg.massey.ac.nz/index.php?title=The_educational_potential_of_Wireless_Mobile_Devices_and_Web2
Cochrane, T. (2008d). Going for gold: a moblogging case study. In M. Barrow & K. Sutherland (Eds.), *Proceedings of HERDSA 2008: Engaging Communities*. Millenium Hotel, Rotorua, New Zealand: HERDSA.
Cochrane, T. (2008e, 25 September). Mobile learning case studies overview2. from http://www.youtube.com/watch?v=8Eh5ktXMji8
Cochrane, T. (2008f). Mobile Web2.0 the new frontier. In A. Farley & D. Holt (Eds.), *Proceedings of ASCILITE 2008* (pp. 177-186). Deakin University, Melbourne, Australia: ascilite.
Cochrane, T. (2008g). Mobilizing learning: Intentional disruption. Harnessing the potential of social software tools in higher education using wireless mobile devices. *International Journal of Mobile Learning and Organisation*(Special edition: Developing Themes in Mobile Learning - in pre-press).
Cochrane, T. (2009a). Contemporary music students and mobile technology. In J. Odonoghue (Ed.), *Technology Supported Environment for Personalised Learning: Methods and Case Studies* (pp. 429 - 454). Hershey, PA 17033, USA: IGI Global.
Cochrane, T. (2009b). Exploring mobile learning success factors. *ALT-J, Research in Learning Technologies, 17*(A special issue of ALT Journal, Mobile and Contextual Learning).
Cochrane, T. (2009c). Mobile Web2.0: Bridging learning contexts. In S. Caballe, F. Xhafa, T. Daradoumis & A. A. Juan (Eds.), *Architectures for Distributed and Complex M-Learning Systems: Applying Intelligent Technologies* (pp. 123 - 151). Hershey, PA 17033, USA: IGI Global.
Cochrane, T. (2009d). Mobile Web 2.0: From pilots to the mainstream. In D. Metcalf, A. Hamilton & C. Graffeo (Eds.), *Proceedings of MLearn 2009: The 8th World Conference on Mobile and Contextual Learning* (pp. 18 - 25). Orlando, Florida: University of Central Florida, Institute for Simulation and Training.
Cochrane, T. (2009e). Mobilizing learning: Intentional disruption. Harnessing the potential of social software tools in higher education using wireless mobile devices. *International Journal of Mobile Learning and Organisation, 3*(4. Special edition: Developing Themes in Mobile Learning), 399 - 419.
Cochrane, T. (2010a). Beyond the yellow brick road: Mobile web 2.0 informing a new institutional elearning strategy. *Special Issue 'The Transformational*

Impact of Learning technology' of ALT-J, Research in Learning Technology, 18(3), 221–231.
Cochrane, T. (2010b). Exploring mobile learning success factors. *ALT-J, Research in Learning Technology, 18*(2), 133-148.
Cochrane, T. (2010c). Exploring the pedagogical affordances of mobile Web 2.0. In L. Chao (Ed.), *Open Source Mobile Learning: Mobile Linux Applications* (Vol. In Pre-Press). Hershey, PA 17033, USA: IGI Global.
Cochrane, T. (2010d). An mlearning journey: Mobile Web 2.0 critical success factors. In M. Montebello, V. Camilleri & A. Dingli (Eds.), *Proceedings of MLearn 2010: The 9th International Conference on Mobile Learning* (pp. 167-174). Valletta, Malta: University of Malta.
Cochrane, T. (2010e). Twitter tales:Facilitating international collaboration with mobile web 2.0. In C. H. Steel, M. J. Keppell, P. Gerbic & S. Housego (Eds.), *Proceedings of 27th ASCILITE Conference* (pp. 195-205). Sydney, Australia: ASCILITE 2010.
Cochrane, T., & Bateman, R. (2008a, 20 June). Bachelor of Product Design blogging reflections Video. from http://www.youtube.com/watch?v=d44q77cz7H4
Cochrane, T., & Bateman, R. (2008b, 20 June). Bachelor of Product Design moblogging reflections Video. from http://www.youtube.com/watch?v=V5co1cdzfik
Cochrane, T., & Bateman, R. (2008c, 8-10 September). *Engaging students with mobile Web2.0.* Paper presented at the eFest, Sky City Convention Centre.
Cochrane, T., & Bateman, R. (2008d). Engaging students with mobile Web2.0. In L. Bevin (Ed.), *Proceedings of EIT Teaching & Learning Conference*. Napier, New Zealand: Eastern Institute of Technology.
Cochrane, T., & Bateman, R. (2009a). mLearning journeys: Redesigning teaching for mlearning. In D. Sturrock & A. Aubrey (Eds.), *Proceedings of Teaching and Learning Conference*. Palmerston North: Universal College Of Learning (UCOL).
Cochrane, T., & Bateman, R. (2009b). Smartphones give you wings: Pedagogical affordances of mobile Web 2.0. In R. Atkinson & C. McBeath (Eds.), *26th ascilite conference 2009: Same places, different spaces* (pp. 142-152). University of Auckland, New Zealand: ascilite.
Cochrane, T., & Bateman, R. (2009c). Transforming pedagogy using mobile Web 2.0. In I. A. Sanchez & P. Isaias (Eds.), *Proceedings of IADIS International Conference on Mobile Learning 2009* (pp. 121-128). Barcelona, Spain: iadis: international association for development of the information society.
Cochrane, T., & Bateman, R. (2009d). Transforming pedagogy using mobile Web 2.0. *International Journal of Mobile and Blended Learning, 1*(4), 56-83.
Cochrane, T., & Bateman, R. (2010a). *A mobile learning journey: Or "a tale of two academics pedagogical partnership"*. Paper presented at the The 6th International Conference on Technology, Knowledge and Society 2010. Retrieved from http://t10.cgpublisher.com/proposals/89/index_html
Cochrane, T., & Bateman, R. (2010b). Pedagogy 2.0: Invigorating A Paper Based Design History Course. In L. G. Chova (Ed.), *Proceedings of EDULEARN10 the International Conference on Education and New Learning Technologies* (pp. 5313-5322). Barcelona, Spain: International Association of Technology, Education and Development.
Cochrane, T., & Bateman, R. (2010c). Reflections on 3 years of mlearning implementation

(2007-2009). In I. A. Sánchez & P. Isaias (Eds.), *Proceedings of IADIS International Conference Mobile Learning 2010* (pp. 181-188). Porto, Portugal: iadis: international association for development of the information society.

Cochrane, T., & Bateman, R. (2010d). Smartphones give you wings: Pedagogical affordances of mobile web 2.0. *Australasian Journal of Educational Technology, 26*(1), 1-14.

Cochrane, T., & Bateman, R. (2010e). Strategies for mlearning integration: Evaluating a case study of staging and scaffolding mlearning integration across a three-year bachelor's degree. In L. Creanor, D. Hawkridge, K. Ng & F. Rennie (Eds.), *Proceedings of "into something rich and strange" - making sense of the sea-change. The 17th Association for Learning Technology Conference (ALT-C 2010)* (pp. 11-20). University of Nottingham, England, UK: Association for Learning Technology.

Cochrane, T., Bateman, R., Cliffin, P., Gardner, J., Henderson, I., & Holloway, S. (2009). Mobilizing learning: Mobile Web 2.0 scenarios in tertiary education. In L. G. Chova, D. M. Beleguer & I. C. Torres (Eds.), *Proceedings of EDULEARN09 the International Conference on Education and New Learning Technologies* (pp. 4614-4625). Barcelona, Spain: International Association of Technology, Education and Development (IATED).

Cochrane, T., Bateman, R., & Flitta, I. (2009a, 15 - 17 February). *Facilitating social constructivist learning environments for product design students using social software (Web2) and wireless mobile devices.* Paper presented at the Design/09 the Third International Conference on Design Principles and Practices, Technical University Berlin, Germany.

Cochrane, T., Bateman, R., & Flitta, I. (2009b). Integrating mobile Web 2.0 within tertiary education. In A. Méndez-Vilas (Ed.), *Proceedings of m-ICTE2009* (Vol. 3, pp. 1348-1352). Lisbon, Portugal: Formatex Research Center.

Cochrane, T., & Flitta, I. (2009). An mlearning journey: Critical incidents in transforming pedagogy *Proceedings of International Conference of Education, Research and Innovation (ICERI2009)* (pp. 3456-3467). Madrid, Spain: International Association of Technology, Education and Development (IATED).

Cochrane, T., Flitta, I., & Bateman, R. (2009a). Facilitating social constructivist learning environments for product design students using social software (Web2) and wireless mobile devices. [Journal]. *DESIGN Principles and Practices: An International Journal, 3*(1), 67-88.

Cochrane, T., Flitta, I., & Bateman, R. (2009b, 20-24 April). *Using smartphones and mobile Web 2.0 to create a mobile computing platform for tertiary education.* Paper presented at the ANZAAE Conference 2009, Dunedin.

Cochrane, T., & Kligyte, G. (2007a, 23-25 June). *Dummies2Delight: Using communities of practice to develop educational technology literacy in tertiary academics.* Paper presented at the eFest, Wellington Convention Centre.

Cochrane, T., & Kligyte, G. (2007b). Dummies2Delight: Using communities of practice to develop educational technology literacy in tertiary academics. In G. Minshull & J. Mole (Eds.), *Proceedings of JISC Innovating e-Learning 2007 online conference* (pp. 36-38). JISC online conference: Direct Learn Services Ltd, The Limes, Norbury, Bishop's Castle, Shropshire, SY9 5EA.

Cochrane, T., & Kligyte, G. (2007c, 11-14 June). *Dummies2Delight: Using communities of practice to develop educational technology literacy in tertiary academics.* Paper presented at the JISC Innovating e-Learning 2007 online conference, JISC online conference.

Cole, M. (1996). *Cultural psychology: A once and future discipline*. Cambridge, MA: Harvard University Press.

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the craft of reading, writing, and mathematics. In L. B. Resnick (Ed.), *Knowing, learning, and instruction: Essays in honor of Robert Glaser*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Cook, J. (2007a). *Generating new learning contexts: Novel forms of reuse and learning on the move*. Paper presented at the ED-MEDIA 2007 - World Conference on Educational Multimedia, Hypermedia & Telecommunications. Retrieved from http://www.rlo-cetl.ac.uk/joomla/press/publications/EdMedia2007%20Cook_invited_paper_final.doc

Cook, J. (2007b, 21-23 March). *Smells like teen spirit: Generation CX.* Paper presented at the Ideas in Cyberspace Education (ICE3), Loch Lomond, Scotland.

Cook, J. (2009a). Phases of mobile learning. *Joint European Summer School on Technology Enhanced Learning,* (May 30 - June 6). Retrieved from http://www.slideshare.net/johnnigelcook/cook-phases-of-mobile-learning

Cook, J. (2009b). Scaffolding the mobile wave. *JISC Institutional Impact Programme online meeting,* (July 9). Retrieved from http://www.slideshare.net/johnnigelcook/cook-1697245

Cook, J. (2010). Mobile phones as mediating tools within augmented contexts for development. *International Journal of Mobile and Blended Learning, 2*(3), 1-12.

Cook, J., Bradley, C., Lance, J., Smith, C., & Haynes, R. (2007). Generating learner contexts with mobile devices. In N. Pachler (Ed.), *Mobile learning: towards a research agenda* (pp. 55-73). London: WLE Centre, Institute of Education.

Cook, J., Pachler, N., & Bradley, C. (2008). Bridging the gap? Mobile phones at the interface between informal and formal learning. *Journal of the Research Center for Educational Technology (RCET), 4*(1), 3 - 18.

Corlett, D., Sharples, M., Bull, S., & Chan, T. (2005). Evaluation of a mobile learning organiser for university students. *Journal of Computer Assisted Learning, 21*(3), 162-170.

Cox, A. (2005). What are communities of practice? A comparative review of four seminal works. *Journal of Information Science, 31*(6), 527-540.

Cych, L. (2006). Social networks. *Emerging technologies for learning* Retrieved 6 April, 2006, from http://www.becta.org.uk/corporate/publications/

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information. *MIS Quarterly, 13*(3), 319-340.

Delaney, P., Timbrell, G., & Chan, T. (2008). A Marxian model of technology appropriation. In M. Avital & K. Crowston (Eds.), *JAIS Theory Development Workshop* (Vol. 8). University of Amsterdam, Netherlands: Sprouts: Working Papers on Information Systems.

Denzin, N. K., & Lincoln, Y. S. (Eds.). (2005). *The SAGE handbook of qualitative research* (3rd ed.). Thousand Oaks: Sage Publications.

Dewald, N. (1999). Web-Based library instruction: What is good pedagogy? (using the World Wide Web for education). *Information Technology and Libraries, 18*(1), 26-31.
Dewey, J. (1916). *Democarcy and education*: The Macmillan Company.
Dougiamas, M. (1998, 9 November 2007). A journey into constructivism. Retrieved 25 August, 2010, from http://dougiamas.com/writing/constructivism.html
Dougiamis, M. (2005). Moodle docs: Philosophy. Retrieved 6 April, 2006, from http://docs.moodle.org/en/Philosophy
Dourish, P. (2004). What we talk about when we talk about context. *Personal and Ubiquitous Computing, 8*(1), 19-30.
Downes, S. (2005, October). E-learning 2.0. *eLearn Magazine, 2005*.
Draper, S. (1997). Adding (negotiated) learning management to models of teaching and learning. *ITFORUM,* (11 April). Retrieved from http://www.psy.gla.ac.uk/~steve/TLP.management.html
Drinnan, J., & Twose, H. (2009, Saturday May 02). Survival of the fittest in mobile phone war. *NZ Herald,* p. 2. Retrieved from http://www.nzherald.co.nz/technology/news/article.cfm?c_id=5&objectid=10569922
Duncan-Howell, J., & Lee, K.-T. (2007). M-learning - innovations and initiatives: Finding a place for mobile technologies within tertiary educational settings. In R. J. Atkinson, C. McBeath, S. K. A. Song & C. Cheers (Eds.), *Proceedings of Ascilite 2007, ICT: Providing choices for learners and learning* (pp. 223-232). Singapore: Centre for Educational Development, Nanyang Technological University.
Dyson, L. E., Litchfield, A., Lawrence, E., Raban, R., & Leijdekkers, P. (2009). Advancing the m-learning research agenda for active learning: Four case studies. *Australasian Journal of Educational Technology, 25*(2), 250-267.
Dyson, L. E., Raban, R., Litchfield, A., & Zmijewska, A. (2008). Embedding m-learning into mainstream educational practice: Overcoming the cost barrier. In M. E. Auer & A. Y. Al-Zoubi (Eds.), *Proceedings of 4th International Conference on Interactive Mobile and Computer Aided Learning (IMCL2008)* (pp. 1-9). Amman, Jordan.
Educause. (2005a). Collaborative editing. *7 things you should know about...* 2005, from http://www.educause.edu/LibraryDetailPage/666?ID=ELI7009
Educause. (2005b). Instant messaging. *7 things you should know about...* 2005, from http://www.educause.edu/LibraryDetailPage/666?ID=ELI7008
Educause. (2005c). PodCasting. *7 things you should know about...* 2005, from http://www.educause.edu/LibraryDetailPage/666?ID=ELI7003
Educause. (2005d). Social bookmarking. *7 things you should know about...* 2005, from http://www.educause.edu/LibraryDetailPage/666?ID=ELI7001
Educause. (2005e). Videoblogging. *7 things you should know about...* 2005, from http://www.educause.edu/LibraryDetailPage/666?ID=ELI7005
Educause. (2005f). Wikis. *7 things you should know about...* 2005, from http://www.educause.edu/LibraryDetailPage/666?ID=ELI7004
Educause Connect. (2008a, 15 February). 7 things you should know about. *7 things you should know about...* Retrieved 20 August, 2008, from http://connect.educause.edu/Library/ELI/7ThingsYouShouldKnowAbout/46186

Educause Connect. (2008b, 19 March). 7 things you should know about Google Apps. *7 things you should know about...* Retrieved 20 August, 2008, from http://connect.educause.edu/Library/ELI/7ThingsYouShouldKnowAbout/46436

Educause Connect. (2008c, 23 April). 7 things you should know about Ning. *7 things you should know about...* Retrieved 20 August, 2008, from http://connect.educause.edu/Library/ELI/7ThingsYouShouldKnowAbout/46666

Educause Learning Initiative. (2005). Blogs. *7 things you should know about... 2005*. Retrieved from http://www.educause.edu/LibraryDetailPage/666?ID=ELI7006

Educause Learning Initiative. (2007). RSS. *7 things you should know about...* 2007, from http://www.educause.edu/LibraryDetailPage/666?ID=ELI7024

Educause Learning Initiative. (2008). 7 things you should know about Geolocation. *7 things you should know about... 2008*(27 August). Retrieved from http://www.educause.edu/ELI/7ThingsYouShouldKnowAboutGeolo/163157

Educause Learning Initiative. (2009a). 7 things you should know about Location-Aware Applications. *7 things you should know about... 2009*(16 March). Retrieved from http://www.educause.edu/ELI/7ThingsYouShouldKnowAboutLocat/163839

Educause Learning Initiative. (2009b). 7 things you should know about Microblogging. *7 things you should know about... 2010*(7 July). Retrieved from http://www.educause.edu/Resources/7ThingsYouShouldKnowAboutMicro/174629

Educause Learning Initiative. (2009c). 7 things you should know about QR Codes. *7 things you should know about... 2009*(13 February). Retrieved from http://www.educause.edu/ELI/7ThingsYouShouldKnowAboutQRCod/163728

Educause Learning Initiative. (2010). 7 things you should know about Mobile Apps for Learning. *7 things you should know about... 2010*(5 April). Retrieved from http://www.educause.edu/Resources/7ThingsYouShouldKnowAboutMobil/204763

Elias, L. (2009). QR codes, cell phones and a graphic design scavengar hunt. In D. Metcalf, A. Hamilton & C. Graffeo (Eds.), *Proceedings of MLearn 2009: The 8th World Conference on Mobile and Contextual Learning* (pp. 121-122). University of Central Florida, Institute for Simulation and Training, Orlando, Florida: University of Central Florida.

Ellis, J. H. M., & Kiely, J. A. (2000). The promise of action enquiry in tackling organisational problems in real time. *Action Research International, 2002*(May 3), Paper 5. Retrieved from http://www.scu.edu.au/schools/gcm/ar/ari/p-jellis00.html

Elmendorp, R. (2007). Videoreporter.nl. Retrieved 21 October, 2007, from http://www.videoreporter.nl/videos.htm

Engestrom, Y. (1987). *Learning by expanding: An activity-theoretical approach to developmental research*. Helsinki: Orienta-Konsultit.

Evans, D. (2005). *Potential uses of wireless and mobile learning* (http://www.jisc.ac.uk/uploaded_documents/Potential%20Uses%20FINAL%202005.doc). Bristol: JISC.

Fabris, N. (2007, March 20). Nokia leading smartphone market with 56%, while symbian's share of OS markett is set to fall. Retrieved 11 August, 2008, from http://www.abiresearch.com/abiprdisplay.jsp?pressid=826

Farmer, J. (2004). Communication dynamics: Discussion boards, weblogs and the development of communities of inquiry in online learning environments. In R. Atkinson, C. McBeath, D. Jonas-Dwyer & R. Phillips (Eds.), *Proceedings of 21st ASCILITE Conference: Beyond the comfort zone* (pp. 274-283). Perth: ascilite.

Farmer, J., & Bartlett-Bragg, A. (2005). Blogs @ anywhere: High fidelity online communication. In H. Goss (Ed.), *Proceedings of 22nd ASCILITE Conference: Balance, Fidelity, Mobility. Maintaining the Momentum?* (pp. 197 - 203). Brisbane: Queensland University of Technology.

Fielden, K., & Malcolm, P. (2007). Cell phones In New Zealand secondary schools: boon, banned or biased. In D. Parsons & H. Ryu (Eds.), *Proceedings of Conference on Mobile Learning technologies and Applications (MOLTA)*. Massey University, Auckland, New Zealand.

Fielder, S., Reinmann, G., Mittendorfer, H., Sharma, P., Paquet, S., & Efimova, L. (2004). Introducing disruptive technologies for learning: Personal webpublishing and weblogs. In L. Cantoni & C. McLoughlin (Eds.), *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2004* (pp. 2584-2591). Norfolk, VA: Association for the Advancement of Computing in Education (AACE).

Fisher, M., & Baird, D. E. (2006). Making mLearning work: Utilizing mobile technologies for active exploration, collaboration, assessment, and reflection in higher education. *Journal of Educational Technology Systems, 35*(1), 3-30.

Flitta, I., Cochrane, T., & Bateman, R. (2009). Using smartphones and mobile Web 2.0 to create a mobile computing platform for tertiary education. *Scope: Contemporary Research Topics (Learning and Teaching), November 2009*, 18-27.

Floyd, W. (2008, 22 September). Vital congregations as intentional communities of practice. *Alban Weekly, 217*.

Frohberg, D., Goth, C., & Schwabe, G. (2009). Mobile learning projects - a critical analysis of the state of the art. [Research article]. *Journal of Computer Assisted Learning, 25*(4), 307-331.

Fulton, N. (2007, 22 October). The mobile journalism toolkit contents. *Reuters Mobile Journalism* Retrieved 24 October, from http://reutersmojo.com/2007/10/22/the-mobile-journalism-toolkit-contents/

Glogoff, S. (2005). Instructional blogging: Promoting interactivity, student-centered learning, and peer input. *Innovate, 1*(5), http://www.innovateonline.info/index.php?view=article&id=126.

Gohring, N. (2006, February 28). Sony Ericsson unwraps 3.2-megapixel blogging phone. Retrieved March 1, 2006, from http://www.macworld.com/news/2006/02/28/sonyericcson/index.php?lsrc=mwrss

Green, H., & Hannon, C. (2007). Their space: education for a digital generation. Retrieved 1 February, 2007, from http://elearning.hecacademy.ac.uk/weblogs/pathfinder/?p=46

Greenwood, & Levin. (2005). Reform through action research. In N. K. Denzin & Y. S. Lincoln (Eds.), *The SAGE handbook of qualitative research* (3rd ed., pp. 43-64). Thousand Oaks: Sage Publications.

Hager, P., & Holland, S. (Eds.). (2006). *Graduate attributes, learning and employability*. Dordrecht, The Netherlands: Springer.
Hameed, K., & Shah, H. (2009). Mobile learning in higher education: Adoption and discussion criteria. In I. Arnedillo-Sanchez & P. Isalias (Eds.), *Proceedings of IADIS International Conference on Mobile Learning 2009* (pp. 339 - 342). Barcelona, Spain: International Association for Development of the Information Society.
Head, G., & Dakers, J. (2005). Verillon's trio and Wenger's community: Learning in technology education. *International Journal of Technology and Design Education, 15*, 33-46.
Hendery, S. (2009, 9 July). Great gadget, stratospheric price. *New Zealand Herald,* p. B4. Retrieved from http://www.nzherald.co.nz/technology/news/article.cfm?c_id=5&objectid=10583290&pnum=0
Hercules, F. (2001, 18-21 April). *Dyslexia in art and design higher education: Hidden strengths, hidden weaknesses.* Paper presented at the 5th British Dyslexia Association International Conference, DYSLEXIA: At the Dawn of the New Century, University of York, UK.
Herrington, A. (2008). Adult educators' authentic use of smartphones to create digital teaching resources. In A. Farley & D. Holt (Eds.), *Proceedings of ASCILITE 2008* (pp. 414 - 418). Deakin University, Melbourne, Australia: ascilite.
Herrington, A., & Herrington, J. (2006a). What is an authentic learning environment? In A. Herrington & J. Herrington (Eds.), *Authentic learning environments in higher education* (pp. 1-13). Hershy: Information Science Publishing.
Herrington, A., & Herrington, J. (2007). Authentic mobile learning in higher education. In P. L. Jeffery (Ed.), *Proceedings of AARE 2007 International Educational Research Conference*. Fremantle, Australia: AARE.
Herrington, A., & Herrington, J. (Eds.). (2006b). *Authentic learning environments in higher education*. Hershy: Information Science Publishing.
Herrington, A., Herrington, J., Kervin, L., & Ferry, B. (2006). The design of an online community of practice for beginning teachers. *Contemporary Issues in Technology and Teacher Education, 6*(1). Retrieved from http://www.citejournal.org/vol6/iss1/general/article1.cfm
Herrington, A., Herrington, J., & Mantei, J. (2009). Design principles for mobile learning. In J. Herrington, A. Herrington, J. Mantei, I. Olney & B. Ferry (Eds.), *New Technologies, new pedagogies: Mobile learning in higher education* (pp. 129-138). Wollongong: Faculty of Education, University of Wollongong.
Herrington, J. (2006). Authentic e-learning in higher education: Design principles for authentic learning environments and tasks. In T. C. Reeves & S. Yamashita (Eds.), *Proceedings of World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education 2006* (pp. 3164-3173). Chesapeake, VA: AACE.
Herrington, J., Herrington, A., Mantei, J., Olney, I., & Ferry, B. (2009a). *New technologies, new pedagogies: Using mobile technologies to create new ways of teaching and learning - Final report to ALTC*: The University of Wollongong.
Herrington, J., Herrington, A., Mantei, J., Olney, I., & Ferry, B. (Eds.). (2009b). *New Technologies, new pedagogies: Mobile learning in higher education*. Wollongong: Faculty of Education, University of Wollongong.

Herrington, J., & Kervin, L. (2007). Authentic learning supported by technology: 10 suggestions and cases of integration in classrooms. *Educational Media Internatioanl, 44*(3), 219-236.
Herrington, J., Mantei, J., Herrington, A., Olney, I., & Ferry, B. (2008). New technologies, new pedagogies: Mobile technologies and new ways of teaching and learning. In A. Farley & D. Holt (Eds.), *Proceedings of ASCILITE 2008* (pp. 419 - 427). Deakin University, Melbourne, Australia: ascilite.
Herrington, J., & Oliver, R. (1995). Critical characteristics of situated learning: Implications for the instructional design of multimedia. In C. McNaught, A. Ellis & G. Hart (Eds.), *Proceedings of Ascilite95: Learning with technology*. Melbourne, Australia: ascilite.
Herrington, J., & Oliver, R. (2000). An instructional design framework for authentic learning environments. *Educational Technology Research and Development, 48*(3), 23-48.
Herrington, J., Oliver, R., & Reeves, T. (2003). Patterns of engagement in authentic online learning environments. *Australian Journal of Educational Technology, 19*(1), 59-71.
Herrington, J., Reeves, T., & Oliver, R. (2005). Online learning as information delivery: Digital myopia. *Journal of Interactive Learning Research, 16*(4), 353-367.
Herrington, J., Reeves, T., & Oliver, R. (2006). Authentic tasks online: A synergy among learner, task and technology. *Distance Education, 27*(2), 233-248.
Herrington, J., Reeves, T., & Oliver, R. (2007). Immersive learning technologies: Realism and online authentic learning. *Journal of Computing in Higher Education, 19*(1), 65-84.
Herrington, J., Reeves, T., & Oliver, R. (2009). *A guide to authentic e-learning*. London and New York: Routledge.
Hodkinson, P., & Hodkinson, H. (2004). *A constructive critique of communities of practice: moving beyond Lave and Wenger*. Paper presented at the OVAL Research Seminar. Retrieved from http://www.voced.edu.au/td/tnc_81.427
Hoepfl, M. (1997). Choosing qualitative research: A Primer For Technology Education Researchers. Retrieved 19 April, 2002, from http://www.scholar.lib.vt.edu/ejournals/JTE/v9n1/hoepfl.html
Holian, R. (1999). Doing action research in my own organisation: ethical dilemmas, hopes and triumphs. *Action Research International, 2002*(May 3), Paper 3. Retrieved from http://www.scu.edu.au/schools/gcm/ar/ari/p-rholian99.html
Hoppe, H. U., Joiner, R., Milrad, M., & Sharples, M. (2003). Guest editorial: Wireless and mobile technologies in education. *Journal of Computer Assisted Learning, 19*(3), 255-259.
Hsi, S. (2007). Conceptualizing learning from the everyday activities of digital kids. *International Journal of Science Education, 29*(12), 1509-1529.
IEEE Standards Association. (2009). Get IEEE 802. Retrieved from http://standards.ieee.org/getieee802/index.html
International Association for Mobile Learning. (2008). Mobile learning projects. Retrieved December, 2008, from http://mlearning.noe-kaleidoscope.org/projects/
ITU. (2009). *The world in 2009: ICT facts and figures*. Geneva: International Telecommunications Union.

Jafari, A., McGee, P., & Carmean, C. (2006). Managing courses, defining learning: What faculty, students, and administrtaors want. *Educause review, July/August,* 50-70.
Jamieson, J. (2004). Projects: New practices in flexible learning 2004: Txt Me: Supporting disengaged youth using mobile technologies. Retrieved from http://pre2005.flexiblelearning.net.au/projects/txtme.htm
Jenkins, H. (2006). *Convergence culture: Where old and new media collide*. New York: New York University Press.
JISC. (2004). The e-learning advantage. *Effective practive with e-learning*, 2006, from http://www.elearning.ac.uk/effprac/html/e_intro.htm
JISC. (2005a). An e-learning manager's planning tool for use of mobile and wireless technologies. *Innovative Practice with e-Learning: A good practice guide to embedding mobile and wireless technologies into everyday practice* Retrieved 16 September, 2005, from http://www.jisc.ac.uk/uploaded_documents/elearn_manager_plan.doc
JISC. (2005b). Effective practice planner. *Effective Practice with e-Learning, 2006*(11 April). Retrieved from http://www.jisc.ac.uk/index.cfm?name=elp_practice
JISC. (2005c). Innovative practice with e-learning: A good practice guide to embedding mobile and wireless technologies into everyday practice. Retrieved 16 September, 2005, from http://www.jisc.ac.uk/eli_practice.html
JISC. (2005d). A manager's planning tool for the use of mobile and wireless technologies. *Innovative Practice with e-Learning: A good practice guide to embedding mobile and wireless technologies into everyday practice* Retrieved 16 September, 2005, from http://www.jisc.ac.uk/uploaded_documents/manager_plan.doc
JISC. (2005e). A practitioner's planning tool for the use of mobile and wireless technologies. *Innovative Practice with e-Learning: A good practice guide to embedding mobile and wireless technologies into everyday practice* Retrieved 16 September, 2005, from http://www.jisc.ac.uk/uploaded_documents/practitioner_plan.doc
JISC. (2007). *In their own words: Exploring the learner's perspective on e-learning* (Internet). Bristol: Higher Education Funding Council for England.
JISC. (2009a). Effective practice in a digital age. In JISC (Eds.) Available from http://www.jisc.ac.uk/publications/documents/effectivepracticedigitalage.aspx
JISC. (2009b). *Higher education in a Web 2.0 world* (http://www.jisc.ac.uk/publications/documents/heweb2.aspx): JISC.
John, M. (2010). World leading mobile project report due - MoLeNET. *MJO merlinjohnonline, May 24th*. Retrieved from http://www.agent4change.net/resources/research/619-world-leading-handheld-project-ready-for-feedback.html
Johnson, L., Levine, A., & Smith, R. (2007). The Horizon report: 2007 edition. *The Horizon Report*, 2007, from http://www.nmc.org/horizon/2007/report
Johnson, L., Levine, A., & Smith, R. (2008). The Horizon report: 2008 edition. *The Horizon Report* Retrieved 29 January, 2008, from http://horizon.nmc.org/wiki/Main_Page
Johnson, L., Levine, A., & Smith, R. (2009). *The Horizon report: 2009 edition* (Internet). Austin, TX: New Media Consortium.
Kaplan-Leiserson, E. (2004). RSS: A learning trend. Retrieved 4 April, 2005, from http://www.learningcircuits.org/2004/may2004/0405_Trends.htm

Kaywa. (2005). The Kaywa reader. 2006, from http://reader.kaywa.com/
Keegan, D. (2005a). The incorporation of mobile learning into mainstream education and training. In H. Van der Merwe & T. Brown (Eds.), *Proceedings of mLearn 2005 4th World conference on mLearning*. Cape Town: mlearn.
Keegan, D. (2005b). Mobile learning: The next generation of learning Available from http://learning.ericsson.net/mlearning2/files/workpackage5/book.doc
Keen, A. (2007). *The cult of the amateur: how today's internet is killing our culture* (1st ed.). New York: Doubleday/Currency.
Kennedy, D., & McNaught, C. (1997). Interactive multimedia and good teaching. *ultiBASE Articles*. Retrieved from http://ultibase.rmit.edu.au/Articles/dec97/kenne1.htm
Kennedy, G., Dalgarno, B., Gray, K., Judd, T., Waycott, J., Bennett, S., et al. (2007). The net generation are not big users of Web 2.0 technologies: Preliminary findings. In R. J. Atkinson, C. McBeath, S. K. A. Song & C. Cheers (Eds.), *Proceedings of Ascilite 2007, ICT: Providing choices for learners and learning* (pp. 517-525). Singapore: Centre for Educational Development, Nanyang Technological University.
Kim, B. (2001). Social constructivism. In M. Orey (Ed.), *Learning, Teaching, & Technology*. http://www.coe.uga.edu/epltt/SocialConstructivism.htm: The University of Georgia College of Education.
Kirschner, P. (2002). Cognitive load theory: implications of cognitive load theory on the design of learning. *Learning and Instruction, 12*(1), 1-10.
Kirschner, P., Sweller, J., & Clark, R. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 4*(2), 75-86.
Knight, S. (2009). *Effective practice in a digital age* (PDF). Bristol BS8 1QU: JISC Innovation Group, University of Bristol.
Knight, S. (Ed.). (2005). *Innovative practice with e-learning: A manager's planning tool for use of mobile and wireless technologies* (Vol. 2005). Bristol: JISC.
Koohang, A., Riley, L., Smith, T., & Schreurs, J. (2009). E-Learning and constructivism: From theory to application. *Interdisciplinary Journal of E-Learning and Learning Objects, 5*, 91-109.
Kop, R. (2008). Web 2.0 technologies: disruptive or liberating for adult education? *Proceedings of Adult Education Research Conference*. St Louis, Missouri: AERC, http://www.adulterc.org/Proceedings/2008/Proceedings/Kop.pdf.
Koszalka, T. A., & Ntloedibe-Kuswani, G. S. (2010). Literature on the safe and disruptive learning potential of mobile technologies. *Distance Education, 31*(2), 139-157.
Koubaridis, A. (2007, 14 November). Sustainability turns out a winner. *New Zealand Herald*. Retrieved from http://www.nzherald.co.nz/index.cfm?objectid=10475896
Kress, G., & Pachler, N. (2007). Thinking about the 'm' in m-learning. In N. Pachler (Ed.), *Mobile Learning: towards a research agenda* (Vol. 1, pp. 6-32). London: WLE Centre, Institute of Education.
Kukulsa-Hulme, A., & Traxler, J. (2005a). Mobile teaching and learning. In A. Kukulsa-Hulme & J. Traxler (Eds.), *mobile Learning* (pp. 25 - 44). Oxon: Routledge.

Kukulsa-Hulme, A., & Traxler, J. (2007). Design for mobile and wireless technologies. In H. Beetham & R. Sharpe (Eds.), *Rethinking Pedagogy for the Digital Age*. London: Routledge.
Kukulsa-Hulme, A., & Traxler, J. (Eds.). (2005b). *Mobile learning*. Oxon: Routledge.
Kukulska-Hulme, A., & Pettit, J. (2007). Self-service education: Smartphones as a catalyst for informal collective and individual learning. In C. Oliver (Ed.), *Proceedings of MLearn 2007 - Making the Connections 6th International Conference on Mobile Learning* (pp. 114-124). Melbourne: mlearn.
Kukulska-Hulme, A., & Pettit, J. (2008). Semi-formal learning communities for professional development in mobile learning. *Journal of Computing in Higher Education, 20*(2), 35-47.
Kukulska-Hulme, A., Sharples, M., Milrad, M., Arnedillo-Sanchez, I., & Vavoula, G. (2009). Innovation in mobile learning: A European perspective. [Journal]. *International Journal of Mobile and Blended Learning, 1*(1), 13-35.
Laine, T. H., & Suhonen, J. (2008). Establishing a mobile blog system in a distance education environment. *International Journal of Mobile Learning and Organisation, 2*(2), 149 - 165.
Land, R., Cousin, G., Meyer, J., & Davies, P. (2005). Threshold concepts and troublesome knowledge (3)*: implications for course design and evaluation. In C. Rust (Ed.), *Improving Student Learning Diversity and Inclusivity* (pp. 53 - 64). Oxford: Oxford Centre for Staff and Learning Development.
Lang, J., Vargas, J., & Conover, C. (2007). A net gen perspective: Technology in higher education. *Educating the Net Generation, 2007*(9 May). Retrieved from http://www.educause.edu/LibraryDetailPage/666?ID=ELIWEB075
Langelier, L. (2005). *Working, learning and collaborating in a network: Guide to the implementation and leadership of intentional communities of practice*. Quebec City: CEFIRO (Recherche et Études de cas collection).
Larkin, J., & Simon, H. (1987). Why a diagram is (sometimes) worth ten thousand words. *Cognitive Science, 11*, 69-100.
Larrivee, B. (2000). Transforming teaching practice: becoming the critically reflective teacher. *Reflective Practice, 1*(3), 293-307.
Laurillard, D. (1993). *Rethinking university teaching: a framework for the effective use of educational technology*. London: Routledge.
Laurillard, D. (2001). *Rethinking university teaching: a framework for the effective use of educational technology* (Second ed.). London: Routledge.
Laurillard, D. (2007). Pedagogcal forms of mobile learning: framing research questions. In N. Pachler (Ed.), *Mobile learning: towards a research agenda* (pp. 33-54). London: WLE Centre, Institute of Education.
Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.
Learning and Skills Network. (2009). MoleNET. *2009*(30 July), MoleNET web site. Retrieved from http://www.molenet.org.uk/about/
Lee, M., & McLoughlin, C. (Eds.). (2010). *Web 2.0-based e-learning: Applying social informatics for tertiary teaching*. Hershey, PA: IGI Global.
Leont'ev, A. N. (1978). *Activity, consciouness, and personality*. Englewood Cliffs: Prentice Hall.
Levene, M., & Peterson, D. (2002). *Trail record and ampliative learning* (Research report BBKCS-02-10): School of Computer Science and Information Systems, Birbeck College, University of London.

Li, L., Grimshaw, J., Nielsen, C., Judd, M., Coyte, P., & Graham, I. (2009). Evolution of Wenger's concept of community of practice. *Implementation Science, 4*(11), 8.

Litchfield, A., Dyson, L. E., Lawrence, E., & Zmijewska, A. (2007). Directions for m-learning research to enhance active learning. In R. J. Atkinson, C. McBeath, S. K. A. Song & C. Cheers (Eds.), *Proceedings of Ascilite 2007, ICT: Providing choices for learners and learning* (pp. 587-596). Singapore: Centre for Educational Development, Nanyang Technological University.

Litchfield, A., & Nettleton, S. (2008). Work-ready wiki: Supporting the learning and teaching of professional graduate attributes. In A. Farley & D. Holt (Eds.), *Proceedings of ASCILITE 2008: Hello! Where are you in the landscape of educational technology?* (pp. 552-561). Deakin University, Melbourne, Australia: ascilite.

Lockyer, L., Patterson, J., Rowland, G., & Hearne, D. (2002). Online mentoring and peer support: Using learning technologies to facilitate entry into a community of practice. *ALT-J, Research in Learning Technologies, 10*(1), 24-31.

Lomas, C., Burke, M., & Page, C. (2008). Collaboration tools. *ELI Paper* Retrieved 22 August, 2008, from http://connect.educause.edu/Library/ELI/CollaborationTools/47200

Lorenzo, G., & lttelson, J. (2005a). Demonstrating and assessing student learning with e-portfolios. *E-Portfolio Series*, 2006, from http://www.educause.edu/ELIResources/10220

Lorenzo, G., & lttelson, J. (2005b). An overview of e-portfolios. *E-Portfolio Series*, 2006, from http://www.educause.edu/ELIResources/10220

Lorenzo, G., & lttelson, J. (2005c). An overview of institutional e-portfolios. *E-Portfolio Series*, 2006, from http://www.educause.edu/ELIResources/10220

Luca, J., & McLoughlin, C. (2005). Can blogs promote fair and equitable teamwork? In H. Goss (Ed.), *Proceedings of 22nd ASCILITE Conference: Balance, Fidelity, Mobility. Maintaining the Momentum?* (pp. 379 - 386). Brisbane: Queensland University of Technology.

Luckin, R. (2008). The learner centric ecology of resources: A framework for using technology to scaffold learning. *Computers & Education, 50*(2), 449-462.

Luckin, R., Clark, W., Garnett, F., Whitworth, A., Akass, J., Cook, J., et al. (2008). Learner generated contexts: A framework to support the effective use of technology to support learning. Retrieved 5 November, 2008, from http://api.ning.com/files/Ij6j7ucsB9vgb11pKPHU6LKMGQQkR-YDVnxruI9tBGf1Q-eSYUDv-Mil6uWqX4F1jYA1PUkZRXvbxhnxuHusyL1lRXVrBKnO/LGCOpenContextModelning.doc

Luckin, R., Clark, W., Garnett, F., Whitworth, A., Akass, J., Cook, J., et al. (2010). Learner-generated contexts: A framework to support the effective use of technology for learning. In M. Lee & C. McLoughlin (Eds.), *Web 2.0-Based E-Learning: Applying Social Informatics for Tertiary Teaching* (pp. 70-84). Hershey, PA: IGI Global.

MacCallum, K., & Kinshuk. (2007). Practical issues when viewing discussions on a mobile device. In D. Parsons & H. Ryu (Eds.), *Proceedings of Conference on Mobile Learning technologies and Applications (MOLTA)* (pp. 9-15). Massey University, Auckland, New Zealand.

Mackay, B. (2007, 19 February). *M-support for nursing students in primary health care nursing.* Paper presented at the Proceedings of Conference on Mobile Learning technologies and Applications (MOLTA), Massey University, Auckland, New Zealand.

Mayer, R. (2004). Should there be a three-strikes rule against pure discovery learning? *American Psychologist, 59*(1), 14-19.

McFarlane, A., Roche, N., & Triggs, P. (2007). *Mobile learning: Research findings*: University of Bristol.

McKinney, D., Dyck, J. L., & Luber, E. S. (2009). iTunes University and the classroom: Can podcasts replace professors? *Computers & Education, 52*(3), 617-623.

McLoughlin, C., & Burgess, J. (2009). Texting, sexting and social networking among Australian youth and the need for cyber safety education. In P. L. Jeffery (Ed.), *Proceedings of AARE International Education Research Conference*. Canberra: Australian Association for Research in Education, Melbourne, Victoria, Australia.

McLoughlin, C., & Lee, M. (2007). Social software and participatory learning: Pedagogical choices with technology affordances in the Web 2.0 era. In R. J. Atkinson, C. McBeath, S. K. A. Soong & C. Cheers (Eds.), *Proceedings of Ascilite 2007, ICT: Providing Choices for Learners and Learning* (Vol. 2007, pp. 664-675). Centre for Educational Development, Nanyang Technological University, Singapore: ascilite.

McLoughlin, C., & Lee, M. (2008a). Future learning landscapes: Transforming pedagogy through social software. *Innovate: Journal of Online Education, 4*(5), 7.

McLoughlin, C., & Lee, M. (2008). Mapping the digital terrain: New media and social software as catalysts for pedagogical change. In A. Farley & D. Holt (Eds.), *Proceedings of ASCILITE 2008* (pp. 641-652). Deakin University, Melbourne, Australia: ascilite.

McLoughlin, C., & Lee, M. (2010). Pedagogy 2.0: critical challenges and responses to Web 2.0 and social software in tertiary teaching. In M. Lee & C. McLoughlin (Eds.), *Web 2.0-Based E-Learning: Applying Social Informatics for Tertiary Teaching* (pp. 46-69). Hershey, PA: IGI Global.

McMahon, M. (1997). Social constructivism and the world wide web - A paradigm for learning. In D. Cameron (Ed.), *Proceedings of ASCILITE'97*. Curtin University of Technology, Western Australia: ascilite.

Mejias, U. (2006). Teaching social software with social software. *Innovate, 2*(5), 1-6.

Mellow, P. (2005). The media generation: Maximise learning by getting mobile. In H. Goss (Ed.), *Proceedings of 22nd ASCILITE Conference: Balance, Fidelity, Mobility. Maintaining the Momentum?* (pp. 469 - 476). Brisbane: Queensland University of Technology.

Mioduser, D., Nachmias, R., Oren, A., & Lahav, O. (1999). Web-based learning environments: Current states and emerging trends. In B. Collis & R. Oliver (Eds.), *Proceedings of EdMedia 1999* (pp. 753-758). Seattle: AACE.

Mishra, P., Koehler, M. J., & Zhao, Y. (Eds.). (2007). *Faculty development by design: Integrating technology in higher education*. Charlotte: Information Age Publishing.

Monash University. (2003a). Consent form. Retrieved 12 April, 2006, from http://www.monash.edu.au/research/ethics/human/researchers/forms-list.html

Monash University. (2003b). Explanatory statement. Retrieved 12 April, 2006, from http://www.monash.edu.au/research/ethics/human/researchers/es.html
Monash University. (2003c). Permission letter template. Retrieved 12 April, 2006, from http://www.monash.edu.au/research/ethics/human/researchers/forms-list.html
Morgan, M., Butler, M., & Power, M. (2007). Evaluating ICT in education: A comparison of the affordances of the ipod, DS and Wii. In R. J. Atkinson, C. McBeath, S. K. A. Soong & C. Cheers (Eds.), *Proceedings of Ascilite 2007, ICT: Providing Choices for Learners and Learning* (pp. 717-726). Centre for Educational Development, Nanyang Technological University, Singapore: ascilite.
Moser, F. Z. (2007). Faculty adoption of educational technology. *Educause Quarterly, 1*, 66-69.
Mullen, C., Buttignol, M., & Diamond, P. (2005). Flyboy: Using the arts and theatre to assist suicidal adolescents. *International Journal of Education & the Arts, 6*(5), 16.
Mwanza-Simwami, D. (2009). Using activity-oriented design methods (AODM) to investigate mobile learning. In G. Vavoula, N. Pachler & A. Kukulska-Hulme (Eds.), *Researching Mobile Learning: Frameworks, tools and research designs* (pp. 97-121). Bern, Switzerland: Peter Lang.
Naismith, L., Lonsdale, P., Vavoula, G., & Sharples, M. (2004). *Literature review in mobile technologies and learning* (No. 11): University of Birmingham.
Nalder, G., Kendall, E., & Menzies, V. (2007). Self-organising m-learning communities: A case-study. In C. Oliver (Ed.), *Proceedings of MLearn 2007 - Making the Connections 6th International Conference on Mobile Learning* (pp. 171-178). Melbourne: mlearn.
New Media Consortium. (2007). The Horizon report: 2007 edition. *The Horizon Report*, 2007, from http://www.nmc.org/horizon/2007/report
New Media Consortium. (2008). The Horizon report: 2008 edition. *The Horizon Report* Retrieved 29 January, 2008, from http://horizon.nmc.org/wiki/Main_Page
New Zealand Herald. (2006). The most effective form of emerging media to reach New Zealanders aged 14 to 30. Auckland: New Zealand Herald.
Newman, E. (2009, 26 December). Latest OECD broadband statistics highlight NZ data caps. Weblog posted to http://www.tuanz.org.nz/blog/e379f711-b2b6-4423-9e32-4a8bf9f301db/cc7d9b67-8aa2-4674-a967-3bdd9fdaa241.html
Nokia. (2007). Nokia NSeries. Retrieved 26 April, 2007, from http://www.nseries.com/index.html
Nokia. (2010). Share online. Retrieved from http://europe.nokia.com/support/learn-how/sharing-and-blogging
O'Brien, K. (2008, January 25, 2008). Nokia increases profit and market share. Retrieved 11 August, 2008, from http://www.nytimes.com/2008/01/25/technology/25nokia.html
O'Malley, C., Vavoula, G., Glew, J., Taylor, J., Sharples, M., Lefrere, P., et al. (2005). MOBIlearn: D4.1 Guidelines for learning/teaching/tutoring in a mobile environment. Retrieved February, 2007, from http://kn.open.ac.uk/public/document.cfm?docid=7232
O'Reilly, T. (2005). What is Web 2.0: Design patterns and business models for the next generation of software. Retrieved March, 2006, from

http://www.oreillynet.com/pub/a/oreilly/tim/news/2005/09/30/what-is-web-20.html
Oblinger, D., & Oblinger, J. (2005). Is it age or IT?: First steps towards understanding the net generation. In D. Oblinger & J. Oblinger (Eds.), *Educating the Net Generation* (pp. 10-29): Educause.
Olney, I., & Lefoe, G. (2007). Introducing mobile technologies: Prepatory staff development issues. In R. J. Atkinson, C. McBeath, S. K. A. Soong & C. Cheers (Eds.), *Proceedings of Ascilite 2007, ICT: Providing Choices for Learners and Learning* (pp. 799-803). Centre for Educational Development, Nanyang Technological University, Singapore: ascilite.
Osborne, J. (1996). Beyond constructivism. *Science Education, 80*(1), 53-82.
Pachler, N., Bachmair, B., & Cook, J. (2010). *Mobile learning: Structures, agency, practices*. London: Springer.
Panday, P. P. (2007). Why blogs? Retrieved April, 2007, from http://www.educause.edu/LibraryDetailPage/666?ID=CSD4902
Papert, S. (1980). *Mindstorms: children, computers and powerful ideas*. New York: Basic Books.
Parsons, D., & Ryu, H. (2007). Software architectures for mobile learning. In D. Parsons & H. Ryu (Eds.), *Proceedings of Conference on Mobile Learning technologies and Applications (MOLTA)* (pp. 39-46). Massey University, Auckland, New Zealand.
Pattern, B., Arnedillo-Sanchez, I., & Tangney, B. (2006). Designing collaborative, constructionist and contextual applications for handheld devices: Virtual Learning? *Computers and Education, 46*(3), 294-308.
Pea, R. (1994). Seeing what we build together: distributed multimedia leaqrning environments for transformative communications. *Journal of the Learning Sciences, 3*(3), 285-299.
Perry, D. (2003). Handheld computers (PDAs) in schools. Retrieved from http://partners.becta.org.uk/index.php?section=rh&rid=13623
Piaget, J. (1973). *To understand is to invent*. New York: Viking Press.
Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon, 9*(5), 6.
Prensky, M. (2005a). Engage me or enrage me: What today's learners demand. *Educause Review, 40*(5), 60-65.
Prensky, M. (2005b). What can you learn from a cell phone? Almost anything! *Innovate, 1*(5), 8. Retrieved from http://www.innovateonline.info/index.php?view=article&id=83
Price, S. (2007). Ubiquitous computing: digital augmentation and learning. In N. Pachler (Ed.), *Mobile Learning: towards a research agenda* (Vol. 1, pp. 33-54). London: WLE Centre, Institute of Education.
Priestnall, G., Brown, E., Sharples, M., & Polmear, G. (2009). A student-led comparison of techniques for augmenting the field experience. In D. Metcalf, A. Hamilton & C. Graffeo (Eds.), *Proceedings of mLearn2009: 8th World Conference on Mobile and Contextual Learning* (pp. 195 - 198). Florida: University of Central Florida.
Putt, S. (2007a, 26 December). 21 in OECD ranking. Weblog posted to http://www.tuanz.org.nz/blog/e379f711-b2b6-4423-9e32-4a8bf9f301db/25d8eb68-9306-4e98-883c-6db22f6bf72b.html
Putt, S. (2007b, March/April). Get with the program. *TUANZ Topics, 17,* 35-38.

Ragus, M., Meredith, S., Dacey, D., Richter, C., Paterson, A., & Hayes, A. (2005). The Australian mobile learning network: Australian innovations. In H. Van der Merwe & T. Brown (Eds.), *Proceedings of mLearn 2005: 4th World conference on mlearning*. Cape Town, South Africa: mLearn 2005.

Rawlinson, D., & Bartel, K. (2006). Implementing wireless PDA technology in the IT curriculum. *Educause Quarterly, Number 1*(2006), 41 - 47.

Rogers, Y., & Price, S. (2006). Using ubiquitous computing to extend and enhance learning experiences. In Mark van't Hooft & K. Swan (Eds.), *Ubiquitous computing in education: invisible technology, visible impact*. Mahwah, NJ: Lawrence Erlbaum Associates.

Ryu, H., Brown, R., Wong, A., & Parsons, D. (2007). Personal learning organiser: Designing a mobile learning experience for university students. In D. Parsons & H. Ryu (Eds.), *Proceedings of Conference on Mobile Learning technologies and Applications (MOLTA)* (pp. 23-30). Massey University, Auckland, New Zealand.

Samarawickrema, G. (2007). Piloting social networking and Web 2.0 software at Deakin University. In R. J. Atkinson, C. McBeath, S. K. A. Soong & C. Cheers (Eds.), *Proceedings of Ascilite 2007, ICT: Providing Choices for Learners and Learning* (pp. 904-908). Centre for Educational Development, Nanyang Technological University, Singapore: ascilite.

Schomberg, S. (1986). *Strategies for active teaching and learning in university classrooms*. Minneapolis: University of Minnesota.

Scornavacca, E., Huff, S., & Marshall, S. (2007). Practical issues when viewing discussions on a mobile device. In D. Parsons & H. Ryu (Eds.), *Proceedings of Conference on Mobile Learning technologies and Applications (MOLTA)* (pp. 47-54). Massey University, Auckland, New Zealand.

Sharples, M. (2000). Disruptive devices: Personal technologies and education. Retrieved 27 June, 2006, from http://www.eee.bham.ac.uk/handler/ePapers/disruptive.pdf

Sharples, M. (2001). Disruptive devices: mobile technology for conversational learning. *International Journal of Continuing Education and Lifelong Learning, 12*(5/6), 504-520.

Sharples, M. (2005). Learning as conversation: Transforming education in the mobile age. In M. Osszefoglalok (Ed.), *Proceedings of Conference on Seeing, Understanding, Learning in the Mobile Age* (pp. 147-152). Budapest, Hungary: Hungarian Academy of Sciences.

Sharples, M. (2009a). Learning at large. In D. Metcalf, A. Hamilton & C. Graffeo (Eds.), *Keynote at mLearn 2009: The 8th World Conference on Mobile and Contextual Learning*. Orlando, Florida: University of Central Florida, Institute for Simulation and Training.

Sharples, M. (2009b). Methods for evaluating mobile learning. In G. Vavoula, N. Pachler & A. Kukulska-Hulme (Eds.), *Researching Mobile Learning* (pp. 17 - 39). Bern: Peter Lang.

Sharples, M. (2010). *Innovation in mlearning: An international perspective*. Paper presented at the mLearnCon: Context is king. Content is core. Learning is everywhere. Retrieved from http://www.elearningguild.com/mLearnCon/concurrent-sessions/session-details.cfm?event=62&date=06/15/2010&time=10:45:00#2425

Sharples, M., & Brown, E. (2009, 26-30 October). *mLearn2009 workshop: Location-based, contextual and augmented reality (AR) mobile learning.* Workshop

presented at the MLearn 2009: The 8th World Conference on Mobile and Contextual Learning, University of Central Florida, Institute for Simulation and Training, Orlando, Florida.
Sharples, M., Corlett, D., Bull, S., Chan, T., & Rudman, P. (2005). The student learning organiser. In A. Kukulska-Hulme & J. Traxler (Eds.), *Mobile Learning* (pp. 139-149). Oxon: Routledge.
Sharples, M., Crook, C., Jones, I., Kay, D., Chowcat, I., Balmer, K., et al. (2009). *CAPITAL year one final report* (Draft): University of Nottingham.
Sharples, M., Lonsdale, P., Meek, J., Rudman, P., & Vavoula, G. (2007, 16-19 October). *An evaluation of MyArtSpace: A mobile learning service for school museum trips.* Paper presented at the Proceedings of MLearn 2007 - Making the Connections 6th International Conference on Mobile Learning, Melbourne Exhibition Centre, Melbourne.
Sharples, M., Milrad, M., Arnedillo-Sanchez, I., & Vavoula, G. (2009). Mobile learning: Small devices, big issues. In N. Balacheff, S. Ludvigsen, T. de Jong, A. Lazonder, S. Barnes & L. Montandon (Eds.), *Technology Enhanced Learning: Principles and Products* (pp. 233-249). Berlin: Springer-Verlag.
Sharples, M., Taylor, J., & Vavoula, G. (2005). Towards a theory of mobile learning. In H. Van der Merwe & T. Brown (Eds.), *Proceedings of mLearn 2005 4th World conference on mLearning*. Cape Town: mlearn.
Sharples, M., Taylor, J., & Vavoula, G. (2006). A Theory of learning for the mobile age (pre-print). Retrieved February, 2007, from http://kn.open.ac.uk/public/document.cfm?docid=8558
Sharples, M., Taylor, J., & Vavoula, G. (2007). A theory of learning for the mobile age. In K. Littleton & P. Light (Eds.), *The Sage Handbook of E-learning Research* (pp. 221-247). London: Sage.
Sharples, M., Vavoula, G., Meek, J., Lonsdale, P., & Rudman, P. (2007). OOKL evaluation. 3. Retrieved from http://ookl.files.wordpress.com/2008/10/u-of-birmingham-final-report-headlines.pdf
Sheely, S. (2008). Latour meets the digital natives: What do we really know. In A. Farley & D. Holt (Eds.), *Proceedings of ASCILITE 2008: Hello! Where are you in the landscape of educational technology?* (pp. 908-916). Deakin University, Melbourne, Australia: ascilite.
Siemens, G. (2004). Connectivism: A learning theory for the digital age. *eLearnspace,* (12 December). Retrieved from http://www.elearnspace.org/Articles/connectivism.htm
Six Apart Ltd. (2007a). TypePad mobile. 2007, from http://get.typepad.com/
Six Apart Ltd. (2007b). Vox. 2007, from http://www.vox.com
Skoeps. (2007). Skoeps - everyone's a reporter. Retrieved 24 October, 2007, from http://www.skoeps.com/landing.html
Sony Ericsson. (2006, 28 February). Sony Ericsson and Google collaborate on integration of Blogger and Google Search into handsets. Retrieved March, 2006, from http://www.sonyericsson.com/spg.jsp?cc=global&lc=en&ver=4001&template=pc3_1_1&zone=pc&lm=pc3_1&prid=4832
Sotillo, S. M. (2003). Pedagogical advantages of ubiquitous computing in a wireless environment. May/June. Retrieved 10 June, 2005, from http://ts.mivu.org/default.asp?show=article&id=950

Squire, K., Johnson, K., Holland, W., Nataf, Z., & Klopfer, E. (2002). MIT Games-To-Teach. Design document for: A platform for augmented reality gaming. Environmental detectives. Retrieved 10 June, 2005, from http://cms.mit.edu/games/education/documents/Handheld/Handheld.doc

Statistics New Zealand. (2006). QuickStats about New Zealand. Retrieved from http://www.statistics.govt.nz/Census/2006CensusHomePage/QuickStats/AboutAPlace/SnapShot.aspx?id=9999999&tab=Income&type=region&p=y&printall=true#

Stead, G. (2005). Moving mobile into the mainstream. In H. Van der Merwe & T. Brown (Eds.), *Proceedings of mLearn 2005 4th World conference on mLearning*. Cape Town: mlearn.

Stead, G. (2006). Mobile Technologies: transforming the future of learning. In A. Pinder (Ed.), *Emerging Technologies for Learning* (Vol. 2006, pp. 6-15). Coventry: British Educational Communications and Technology Agency.

Stead, G., & Colley, J. (2008). The power of me: Learning by making your own rich media mobile resources. In J. Traxler, B. Riordan & C. Dennett (Eds.), *Proceedings of MLearn08: The bridge from text to context* (p. 363). Ironbridge Gorge, Shropshire, UK: University of Wolverhampton, School of Computing and IT.

Storberg-Walker, J. (2008). Wenger's communities of practice revisited: A (failed?) exercise in applied communities of practice theory-building research. *Advances in Developing Human Resources, 10*(4), 555-577.

Sutherland, P. (1992). *Cognitive development today. Piaget and his critics*. London: Paul Chapman Publishing Ltd.

Swan, K., Kratcoski, A., & van't Hooft, M. (2007, May/June). Highly mobile devices, pedagogical possibilities, and how teaching needs to be reconceptualized to realize them. *Educational Technology, 47,* 10-13.

Swann, J. (2010). A dialogic approach to online facilitation. *Australian Journal of Educational Technology, 26*(1), 50-62.

Swantz, M. L. (2008). Participatory action research as practice. In P. Reason & H. Bradbury (Eds.), *The SAGE Handbook of Action Research: Participative Inquiry and Practice* (Second ed., pp. 31- 48). London: SAGE Publications.

Talagi, S. (2008). Learning goes mobile. *Western Leader,* p. 4. Retrieved from http://docs.google.com/fileview?id=F.bdd93b03-6a6a-4bf6-b73f-7db9a68876f4&hl=en_GB

Telecom NZ. (2009). Where can I use Telecom's wireless hotspot service? Retrieved 7 July, 2009, from http://www.telecom.co.nz/binarys/telecom_wireless_hotspots_20070822.pdf

The Node Learning Technologies Network. (1999, Spring 1999). The laptop college. Retrieved 21 February, 2001, from http://node.on.ca/ltreport/

Thornton, P., & Houser, C. (2005). Using mobile phones in English education in Japan. *Journal of Computer Assisted Learning, 21*(3), 217-228.

Trafford, P. (2005). Mobile Blogs, Personal Reflections and Learning Environments. *Ariadne,* (44), 9. Retrieved from http://www.ariadne.ac.uk/issue44/trafford/intro.html

Traxler, J. (2007). Defining, discussing, and evaluating mobile learning: The moving finger writes and having writ... . *International Review of Research in Open and Distance Learning, 8*(2), 12.

Traxler, J. (2008). From text to context. In J. Traxler, B. Riordan & C. Dennett (Eds.),

Proceedings of MLearn08: The bridge from text to context (pp. 9 - 11). Ironbridge Gorge, Shropshire, UK: University of Wolverhampton, School of Computing and IT.
Traxler, J. (2009a). Current state of mobile learning. In M. Ally (Ed.), *Mobile Learning: Transforming the Delivery of Education and Training* (pp. 9-24). Edmonton: AU Press, Athabasca University.
Traxler, J. (2009b). Learning in a mobile age. *International Journal of Mobile and Blended Learning, 1*(1), 1-12.
Traxler, J. (2010). Will student devices deliver innovation, inclusion, and transformation? *Journal of the Research Center for Educational Technology (RCET), 6*(1), 3-15.
Traxler, J., & Kukulska-Hulme, A. (2005). Evaluating mobile learning: Reflections on current practice. In H. Van der Merwe & T. Brown (Eds.), *Proceedings of mLearn 2005 4th World conference on mLearning*. Cape Town: mlearn.
Traxler, J., & Kukulska-Hulme, A. (2006). The evaluation of next generation learning technologies: the case of mobile learning. In D. Whitelock & S. Wheeler (Eds.), *Proceedings of the 13th Association for Learning Technology Conference (ALT-C 2006)* (pp. 132-141). Heriot-Watt University, Edinburgh, Scotland, UK: Association for Learning Technology.
Trinder, K., Guiller, J., Marggaryan, N., Littlejohn, A., & Nicol, D. (2008). *Learning from digital natives: bridging formal and informal learning*. Glasgow Caledonian University: The Higher Education Academy.
Tripp, S. D. (1993). Theories, traditions and situated learning. *Educational Researcher, 33*(3), 71-77.
Uden, L. (2007). Activity theory for designing mobile learning. *International Journal of Mobile Learning and Organisation, 1*(1), 81-102.
UMPC Community. (2006). UMPCommunity. Retrieved 9 March, 2006, from http://umpc.com/
Unitec New Zealand. (2010). A Unitec education - Real-world learning. Retrieved 21 August, 2010, from http://www.unitec.ac.nz/?A8C925AA-E8F8-4C80-A082-BFA5D356A9D9
Valcke, M. (2001). Cognitive load: updating the theory? *Learning and Instruction, 11*(4), 147-154.
Vavoula, G. (2007a). *Learning bridges: a role for mobile technologies in education*. Paper presented at the M-Learning Symposium. Retrieved from http://www.wlecentre.ac.uk/cms/index.php?option=com_content&task=view&id=105&Itemid=39
Vavoula, G. (2007b). Learning bridges: a role for mobile technologies in education. *Educational Technology Magazine, 47*(3), 33-37.
Vavoula, G., Pachler, N., & Kukulska-Hulme, A. (Eds.). (2009). *Researching mobile learning*. Bern: Peter Lang.
Vavoula, G., & Sharples, M. (2009). Meeting the challenges in evaluating mobile learning: A 3-level evaluation framework. *International Journal of Mobile and Blended Learning, 1*(2), 54-75.
Vox. (2007). Vox and Nokia Nseries. Retrieved from http://go.vox.com/nokia/
Vygotsky, L. (1978). *Mind in society*. Cambridge, MA: Harvard University Press.
Wadsworth, B. (1996). *Piaget's theory of cognitive development: an introduction for students of psychology and education* (Fifth ed.). White Plains: David McKay.

Wadsworth, Y. (1998). What is participatory action research? *Action Research International, 2002*(May 3), Paper 2. Retrieved from http://www.scu.edu.au/schools/gcm/ar/ari/p-ywadsworth98.html

Wakabayashi, D., & Auchard, E. (2007). Mobile phones: Google's next frontier. *New Zealand PC World, 23 April*.

Wali, E., Winters, N., & Oliver, M. (2008). Maintaining, changing and crossing contexts: an activity theoretic reinterpretation of mobile learning. *ALT-J, Research in Learning Technologies, 16*(1), 41-57.

Walsh, M. (2008). Worlds have collided and modes have merged: classroom evidence of changed literacy practices. *Literacy, 42*(2), 101-108.

Ward, M. (2004). Log your life via your phone. *BBC News Online, 10 March*. Retrieved from http://news.bbc.co.uk/2/hi/3497596.stm

Webster, M. (2004, January/February). MAINZ Macs. *New Zealand MacGuide, 13,* 28-34.

Weimer, M. (2002). *Learner-centered teaching: Five key changes to practice*. San Francisco: Jossey-Bass.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge: Cambridge University Press.

Wenger, E. (2005). Communities of practice: a brief introduction. (17 July). Retrieved from http://www.ewenger.com/theory/index.htm

Wenger, E., McDermott, R., & Snyder, W. (2002). *Cultivating communities of practice: a guide to managing knowledge*. Boston: Harvard Business School Press.

Wenger, E., White, N., & Smith, J. (2009). *Digital habitats: stewarding technology for communities*. Portland, Oregon: CPsquare.

Wenger, E., White, N., Smith, J., & Rowe, K. (2005). Technology for communities. In L. Langelier (Ed.), *Working, Learning and Collaborating in a Network: Guide to the implementation and leadership of intentional communities of practice* (pp. 71-94). Quebec City: CEFIRO.

Wilson, S. (2006, 17 March). Remixing elearning. Retrieved 11 April, 2006, from http://www.cetis.ac.uk/members/educational_content/past_meetings/16th_Meeting

Windham, C. (2007, May/June). Confessions of a podcast junkie. *Educause Review, 42,* 50-65.

Wineburg, S. S. (1989). Remembrance of theories past. *Educational Researcher, 18*(4), 7-10.

Wingkvist, A., & Ericsson, M. (2009). Current practice in mobile learning: A survey of research method and purpose. In D. Metcalf, A. Hamilton & C. Graffeo (Eds.), *Proceedingd of MLearn 2009: The 8th World Conference on Mobile and Contextual Learning* (pp. 103-111). Orlando, Florida: University of Central Florida, Institute for Simulation and Training.

Wolff, B. (2006). Laptop use in university common spaces. *Educause Quarterly, Number 1*(2006), 74 - 76.

13 APPENDICES

13.1 Consent Form (Students)

13.2 Consent Form (Lecturers)

13.3 Explanatory Statement (Students)

13.4 Explanatory Statement (Lecturers)

13.5 Initial feasibility study and needs analysis for Lecturers.

13.6 Acceptable Use policy

13.7 Initial Student Survey

13.8 Final Student Survey

13.9 Focus Group Questions

13.10 Researcher Reflective Journal Template

13.11 Institutional Permission Letter

13.12 Monash Research Ethics Approval

13.13 Introducing Unitec's eLearning Strategy

13.14 Supporting Media DVD

MONASH University

13.1 Consent Form (Students)

Title: Mobilizing Learning: Wireless Mobile Devices and Web2 in tertiary education.

NOTE: *This consent form will remain with the Monash University researcher for their records*

I agree to take part in the Monash University research project specified above. I have had the project explained to me, and I have read the Explanatory Statement, which I keep for my records. I understand that agreeing to take part means that I am willing to:

I agree to take part in a focus group discussion ☐ Yes ☐ No

I agree to allow the discussion to be audio-taped and/or video-taped ☐ Yes ☐ No

I agree to attend a weekly tutorial to learn about the WMD and software ☐ Yes ☐ No

I agree to make regular reflections on a blog ☐ Yes ☐ No

I agree to complete 2 questionnaires asking me about the WMD trial ☐ Yes ☐ No

and

I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw at any stage of the project without being penalised or disadvantaged in any way.

and

I understand that any data that the researcher extracts from the interview / focus group / questionnaire / survey for use in reports or published findings will not, under any circumstances, contain names or identifying characteristics.

and

I understand that any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party.

and

I understand that data from the survey and focus group will be kept in a secure storage and accessible to the research team. I also understand that the data will be destroyed after a 5 year period unless I consent to it being used in future research.

Participant's name ____

Signature

____

Date

____

MONASH University

13.2 Consent Form (Lecturers)

Title: Mobilizing Learning: Wireless Mobile Devices and Web2 in tertiary education.

NOTE: *This consent form will remain with the Monash University researcher for their records*

I agree to take part in the Monash University research project specified above. I have had the project explained to me, and I have read the Explanatory Statement, which I keep for my records. I understand that agreeing to take part means that I am willing to:

I agree to integrate the use of a Wireless Mobile Device (WMD) and Social Software into the delivery and assessment of a semester length course that I teach ☐ Yes ☐ No

I agree to take part in a focus group discussion ☐ Yes ☐ No

I agree to allow the discussion to be audio-taped and/or video-taped ☐ Yes ☐ No

I agree to attend a weekly tutorial to learn about the WMD and software ☐ Yes ☐ No

I agree to make regular reflections on a blog ☐ Yes ☐ No

I agree to complete an initial feasibility survey about the WMD trial ☐ Yes ☐ No

and
I understand that my participation is voluntary, that I can choose not to participate in part or all of the project, and that I can withdraw at any stage of the project without being penalised or disadvantaged in any way.

and
I understand that any data that the researcher extracts from the interview / focus group / questionnaire / survey for use in reports or published findings will not, under any circumstances, contain names or identifying characteristics.

and
I understand that any information I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the project, or to any other party.

and
I understand that data from the survey and focus group will be kept in a secure storage and accessible to the research team. I also understand that the data will be destroyed after a 5 year period unless I consent to it being used in future research.

Participant's name ____

Signature____**Date**_______________

November 2006

13.3 Explanatory Statement - Students

Title: Mobilizing Learning: Wireless Mobile Devices and Web2 in tertiary education.

This information sheet is for you to keep.

My name is Thomas Cochrane and I am conducting a research project with Dr Bernard Holkner a Senior Lecturer in the Department of Education towards a PHD at Monash University. This means that I will be writing a theses which is the equivalent of a 300 page book.

You have been chosen to be participants in this research because of your department's willingness to explore the use and potential benefits of Wireless Mobile Devices (WMDs) within your course.

I am conducting this research to find out:
(1). What are the key factors in integrating WMDs within tertiary education courses?

(2). What challenges/advantages to established pedagogies do these disruptive technologies present?

(3). To what extent can these WMDs be utilized to support learner interactivity, collaboration, communication, reflection and interest, and thus provide pedagogically rich learning environments that engage and motivate the learner? I.e. to what extent can WMDs be used to harness the potential of current and emerging social constructivist elearning tools?

Possible benefits
WMDs provide ubiquitous access to elearning resources, increasing student productivity, and tools for enhancing student-to-student and student-to-staff communication.

What does the research involve?
The study involves trialing the use of a wireless mobile device as part of your course over the next semester, reflecting on its use on a blog, a pre-trial questionnaire, a post-trial questionnaire, and a focus group discussion. You will also be using the wireless mobile device to access a secure online learning management system (Moodle).
As a participant in the WMD trial some of your assessment items will be conducted in a different medium to non-participants. For example your primary way of posting to your Blog will be via a WMD rather than a PC. Your main communications device throughout the trial will also be a WMD rather than a PC.
You will be provided with a detailed assessment schedule at the beginning of the course.

How much time will the research take?
It is anticipated that you will be interacting with the wireless mobile device daily as part of your course over the semester. The initial survey should take about 30 minutes to complete, the post-trial survey will take about 45 minutes to complete, and the focus group will take the

form of structured questions and discussion for about an hour and a half. There will also be a weekly two hour tutorial outlining how to use the software and wireless mobile device involved.

Possible risks
The project will involve learning the use of a WMD and web2 services, which will require a minimum of extra time and effort. As WMDs are generally small devices you will need to be attentive to possible risks of theft. Do not leave your WMD in insecure environments. When using insecure online services (such as www.Vox.com), be careful not to reveal any sensitive personal information about yourself or other people.

Can I withdraw from the research?
Being in this study is completely voluntary - you are under no obligation to consent to participation. If you do decide to participate you may withdraw at any stage or avoid answering questions which you feel are too personal or intrusive.

Confidentiality
Survey forms will be kept anonymous, and focus group data will not include any reference to participant names. Data included in the final thesis will not include any information that could identify any participant.

Storage of data
Storage of the data collected will adhere to the University regulations and kept on University premises in a locked cupboard/filing cabinet for 5 years. A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report.

Use of data for other purposes
Your anonymous data may be used in research papers relevant to the study. No identifiable or personal details will be used in such papers.

Results
If you would like to be informed of the aggregate research finding, please contact Thom Cochrane on [redacted] extension 7067 or email [redacted] The findings are accessible for one year.

If you would like to contact the **researchers** about any aspect of this study, please contact the Chief Investigator:	If you have a **complaint** concerning the manner in which this research is being conducted, please contact:
Dr Bernard Holkner Senior Lecturer, Faculty of Education Monash University, Australia [redacted]	Human Ethics Officer Standing Committee on Ethics in Research Involving Humans (SCERH) Building 3d Research Office Monash University VIC 3800 Tel: +61 3 9905 2052 Fax: +61 3 9905 1420 Email: scerh@adm.monash.edu.au

Thank you.

[redacted]

Thomas Cochrane

MONASH University

November 2006

13.4 Explanatory Statement - Lecturers

Title: Mobilizing Learning: Wireless Mobile Devices and Web2 in tertiary education.

This information sheet is for you to keep.

My name is Thomas Cochrane and I am conducting a research project with Dr Bernard Holkner a Senior Lecturer in the Department of Education towards a PHD at Monash University. This means that I will be writing a theses which is the equivalent of a 300 page book.

You have been chosen to be participants in this research because of your department's willingness to explore the use and potential benefits of Wireless Mobile Devices (WMDs) within your course.

I am conducting this research to find out:
(1). What are the key factors in integrating WMDs within tertiary education courses?

(2). What challenges/advantages to established pedagogies do these disruptive technologies present?

(3). To what extent can these WMDs be utilized to support learner interactivity, collaboration, communication, reflection and interest, and thus provide pedagogically rich learning environments that engage and motivate the learner? I.e. to what extent can WMDs be used to harness the potential of current and emerging social constructivist elearning tools?

Possible benefits
WMDs provide ubiquitous access to elearning resources, increasing student productivity, and tools for enhancing student-to-student and student-to-staff communication.

What does the research involve?
The study involves trialing the use of a wireless mobile device as part of your course over the next semester, reflecting on its use on a blog, a pre-trial questionnaire, a post-trial questionnaire, and a focus group discussion. You will also be using the wireless mobile device to access a secure online learning management system (Moodle).
As a participant in the WMD trial some of your assessment items will be conducted in a different medium to non-participants. For example your primary way of posting to your Blog will be via a WMD rather than a PC. Your main communications device throughout the trial will also be a WMD rather than a PC.
You will be provided with a detailed assessment schedule at the beginning of the course.

How much time will the research take?
It is anticipated that you will be interacting with the wireless mobile device daily as part of your course over the semester. The initial survey should take about 30 minutes to complete, the post-trial survey will take about 45 minutes to complete, and the focus group will take the form of structured questions and discussion for about an hour and a half. There will also be a

weekly two hour tutorial outlining how to use the software and wireless mobile device involved.

Possible risks
The project will involve learning the use of a WMD and web2 services, which will require a minimum of extra time and effort. As WMDs are generally small devices you will need to be attentive to possible risks of theft. Do not leave your WMD in insecure environments. When using insecure online services (such as http://www.Vox.com), be careful not to reveal any sensitive personal information about yourself or other people.

Can I withdraw from the research?
Being in this study is completely voluntary - you are under no obligation to consent to participation. If you do decide to participate you may withdraw at any stage or avoid answering questions which you feel are too personal or intrusive.

Confidentiality
Survey forms will be kept anonymous, and focus group data will not include any reference to participant names. Data included in the final thesis will not include any information that could identify any participant.

Storage of data
Storage of the data collected will adhere to the University regulations and kept on University premises in a locked cupboard/filing cabinet for 5 years. A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report.

Use of data for other purposes
Your anonymous data may be used in research papers relevant to the study. No identifiable or personal details will be used in such papers.

Results
If you would like to be informed of the aggregate research finding, please contact Thom Cochrane on [redacted] extension 7067 or email [redacted]. The findings are accessible for one year.

If you would like to contact the **researchers** about any aspect of this study, please contact the Chief Investigator:	If you have a **complaint** concerning the manner in which this research is being conducted, please contact:
Dr Bernard Holkner Senior Lecturer, Faculty of Education Monash University, Australia [redacted]	Human Ethics Officer Standing Committee on Ethics in Research Involving Humans (SCERH) Building 3d Research Office Monash University VIC 3800 Tel: +61 3 9905 2052 Fax: +61 3 9905 1420 Email: scerh@adm.monash.edu.au

Thank you.

[redacted]

Thomas Cochrane

13.5 Initial feasibility study and needs analysis for Lecturers.

WIRELESS MOBILE DEVICE NEED ANALYSIS

The information gathered from this questionnaire will be confidential and anonymous, and will be used solely for the purposes of a research Thesis for a PHD at Monash University.

Participant Details:		
Position: UNITEC Tutor/Lecturer.		
Course:		
Location:		
Contact info (optional) Email:	Name:	Phone:

Please answer the following questions.

1. Please describe the underlying pedagogical (teaching/learning) model used in this course.
2. In your opinion, is there a need for providing wireless mobile computing for your students/course? Why?
3. What would a useful learning activity that utilized a Wireless Mobile Device involve?

4. What system requirements (e.g: Palm PDA, PocketPC PDA, smartphone, laptop, tabletPC, Ultra Mobile PC, iPod, PSP, etc…) would be most suitable for these Wireless Mobile Devices?

Why?

5. What concepts do learners in your situation need help with: (tick appropriate column, and state areas not covered).

Concept	**Y/N**	**Comment**
• Critical reflection skills		
• Communication skills		
• Time management		
• Organizational skills		
• Group work skills		
• Social Software Tools ○ Blogs, ○ Wikis, ○ RSS Feeds ○ Social Bookmarking ○ Photo Blogging ○ Google Maps ○ Instant Messaging ○ Podcasting		

• OTHER		

6. Have you ever used a Wireless Mobile Device within a teaching/learning environment? (if yes, please state what these were, and whether they were effective or not).
7. What level of computer literacy do your students/lecturers currently have?
8. How would you benefit from having access to social software tools via a wireless mobile device?
9. What would you consider to be the most important design factors in creating useful learning activities utilizing Wireless Mobile Devices and Social Software?
10. What barriers exist to utilizing Wireless Mobile Devices in your course?
Thanks for your time and feedback.

Thom Cochrane

[redacted]

Unitec
Academic Advisor.
Centre for Teaching & Learning Innovation
Ph. 09 8154321 x7067 wk.

13.6 Acceptable Use Policy

THE USE OF COMPUTERS, WIRELESS PDAS, THE INTERNET AND ELECTRONIC MAIL WHILE TAKING PART IN WIRELESS MOBILE DEVICE TRIALS[1]

PERMISSION FORM

UNITEC is pleased to offer students access to a computer network for electronic mail and the Internet, and a wireless mobile device (netbook or smartphone). To gain access to e-mail and the Internet, all students must verify their agreement with the following Acceptable Use Policy by placing their signatures on the form below.

What is possible?

Access to e-mail and the Internet will enable students to explore thousands of libraries, databases, museums, and other repositories of information and to exchange personal communication with other Internet users on campus and around the world. You should be aware that some material accessible via the Internet may contain items that are illegal, defamatory, inaccurate, or potentially offensive.

What is expected?

Students are responsible for appropriate behaviour on UNITEC's computer network. General socially acceptable rules for behaviour and communications apply. It is expected that users will comply with standards and the specific rules set forth below. The use of the network and the smartphone is a privilege, not a right, and may be revoked if abused. The user is personally responsible for his/her actions in accessing and utilising UNITEC's computer resources. The students are advised never to access, keep, or send anything that they would not want their tutors to see.

What are the rules?

Privacy -- Network storage areas may be treated like personal property. Network administrators may review communications to maintain system integrity to insure that students are using the system responsibly.

Storage capacity -- Users are expected to remain within allocated disk space and delete e-mail or other material which take up excessive storage space.

Illegal copying -- Students should never download or install any commercial software, share ware, or freeware onto network drives or disks, unless they have

[1] Modified from an example given by Houston Independent School District. *A Sample AUP Form* [Internet]. 21 November 1997. Available from http://www.rice.edu/armadillo/aupenglish.html.

written permission from the Network Administrator. Nor should students copy other people's work or intrude into other people's files.

Inappropriate materials or language -- No profane, abusive or impolite language should be used to communicate nor should materials be accessed which are not in line with the rules of UNITEC behaviour. A good rule to follow is never view, send, or access materials which you would not want your tutors to see. Should students encounter such material by accident, they should report it to their tutor immediately.

Succinct Advice (while at UNITEC)

These are guidelines to follow to prevent the loss of network privileges at UNITEC.

1. Do not use a computer/PDA/phone to harm other people or their work.

2. Do not damage the computer/PDA/phone or the network in any way.

3. Do not interfere with the operation of the network by installing illegal software, share ware, or freeware.

4. Do not violate copyright laws.

5. Do not view, send, or display offensive messages or pictures.

6. Do not share your password with another person.

7. Do not waste limited resources such as disk space or printing capacity.

8. Do not trespass in another's folders, work, or files.

9. Do notify a tutor immediately, if by accident, you encounter materials which violate these standards of appropriate use.

10. BE PREPARED to be held accountable for your actions and for the loss of privileges if the Rules of Appropriate Use are violated.

11. Do not play games or use the computer resources for other non-academic activities when others require the system for academic purposes.

USER AGREEMENT - 2009

As a student at UNITEC, I have read the above
information about the appropriate use of computers at the school and I understand this agreement will be kept on file at UNITEC. (Questions should be directed to the campus manager for clarification.)

The use of the smartphone is for the duration of the project only, and the smartphone must be returned in the same condition it was received at the end of the project (30November 2009). Students will be responsible for replacing any damaged, stolen or lost smartphones, netbook or accessories (Nokia XM5800 valued at $800NZ, DellMini9 netbook valued at $750NZ).

I agree to use e-mail the Internet, and the supplied smartphone and netbook and accessories while at UNITEC according to the rules outlined above.____

As a user of the UNITEC computer network, I agree to comply with the above stated rules and to use the network in a constructive manner.

Student Name (print)____

Student Signature____

Tutor____

DATE:____

WMD model and accessories received (circle appropriate):

- None
- Nokia XM5800 smartphone
- 8GB Memory card
- Serial Number:____
- WLAN Address:____
- AV cable
- Phone Case
- USB Data Cable
- Stereo earphones

NetBook:

1. Dell Mini9 netbook

2. Additional 8GB SD Memory card

3. Serial Number____

4. Charger

13.7 Initial Student Survey

Wireless Mobile Study – pre project questionnaire ArchY2 2009:

QUESTION: (This is an anonymous questionnaire)	**Your Answer: tick or circle most applicable answer/s, or write your answer in the space provided below.**					
1. What is your Student ID number?						
2. What is your age?						
3. What is your gender?	Male	Female				
4. What has been your experience of group work in your course so far?	Very Good	Good	Not Bad	Neither Good nor Bad	Not Good	Terrible
5. Do you have access to a Desktop computer at home?	Yes	No				
6. Do you have access to a laptop computer for bringing to Unitec for your studies?	Yes	No	If Yes – does your laptop have wireless (WiFi) capability?	Yes	No	
7. Have you ever owned a smartphone?	Yes	No				
8. What other mobile devices do you own?	1. PDA 2. Cellphone 3. Cameraphone 4. iPod 5. Sony PSP 6. Other? (specify)					
9. Do you currently subscribe to any Blogs or News Sites?	Yes	No	If Yes – please give your favourite URL:			
10. Do you already have your own Blog?	Yes Where?	No				
11. Have you used any of the following before?:	Twitter	Flickr. com	Del.ico.us	YouTube 1. View 2. Upload	Podcastin g	Instant Messaging
12. What applications do you think will be suitable for use on an smartphone? (Tick or circle all applications you think are appropriate).	○ Email ○ Instant Messaging ○ Video ○ Audio ○ Web Browsing ○ Document editing ○ Document Reading ○ Calendar					

	○ Contacts/Addressbook ○ Notes ○ Accessing online course material ○ Blogging ○ File sharing ○ RSS subscriptions ○ Taking and uploading photos ○ Txt ○ Phone calls

13.8 Final Student Survey

<u>Wireless Mobile Study – end of project questionnaire (Arch2009 Students):</u>

QUESTION: (This is an anonymous questionnaire)	**Your Answer: tick or circle most applicable answer/s, or write your answer in the space provided below.**					
1. What is your Student ID number?						
2. What is your age?						
3. What is your gender?	Male	Female				
4. What has been your experience of group work facilitated by Blogs and RSS?	Very Good	Good	Not Bad	Neither Good nor Bad	Not Good	Terrible
6. It was easy to use the smartphone?	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	
7. This mobile learning experience was fun.	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	
8. Based on my experience during this trial, I would use a smartphone in other courses	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	
9. I would be willing to purchase my own smartphone?	Yes	No				
10. Where did you use the Smartphone? Circle all that apply.	• At home • At Unitec in class • At Unitec not in class • While Travelling • On site while investigating or building your project • Other (specify)					
11. In your opinion, does mobile learning increase the quality of learning?	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	
12. Mobile blogging helped create a sense of community (group work)?	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	
13. Accessing your course blog was easy using the mobile device?	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	

14. Mobile learning increases access to education?	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
15. Communication and feedback from the course tutor/lecturer was made easier?	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
16. Mobile learning is convenient for communication with other students?	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
17. Rate the usefulness of the following applications using mobile devices? (0 = no use, 10 = extremely useful).	o Email o Instant Messaging o Video o Audio o Web Browsing o Document editing o Document Reading o Calendar o Contacts/Addressbook o Notes o Accessing online course material o Blogging o File sharing o RSS subscriptions o Taking and uploading photos o Txt o Phone calls o Twitter				
18. What factors would be most important in deciding upon mobile learning?	a. Cost of device b. Size of the screen c. Size & weight of the mobile device d. Phone integration e. Wireless capability f. The operating system: PocketPC, Palm OS, or Symbian g. Availability of installable applications h. A built-in camera i. Ease of linking to your Blog j. The cost of mobile data k. Other				
19. Do you have any other comments on the mobile project?					

13.9 Focus Group Questions

Focus Group Protocol and questions for Wireless Mobile Device Projects:

Duration and how often
Once per semester (every 6 months), for 60-90 minutes each session.

Participants
Two separate focus groups will be convened at the end of each semester of the project. (1). Representative students involved in the trial, (2). Representative teaching staff involved in the project. All participants will have trialed a Wireless Mobile Device in a social software based learning activity during the semester, and provided written feedback via their blog, and an evaluation survey before the focus group meeting. Some will also have undergone observation by the researcher while using the WMD for various exercises during the project.

Questions for discussion
The main purpose of the focus group is to provide critical reflective feedback on the design and implementation of the learning activities and enhanced communication facilitated by the Wireless Mobile Device (WMD) used in the project. This feedback will provide valuable insights into the design of the following trial, and forms a critical reflective action research cycle of evaluation.

Focus Group Questions:

- How would you rate the effectiveness of the WMD (N95 Smartphone) for accessing your/your students' blogs?
- How user friendly was the interface of the WMD?
- How would you rate the effectiveness of the WMD for increasing communication:
  - Between students
  - Between Students and Tutors/lecturers?
- How useful were the WMDs for accessing course content?
- Describe how the integration into the course of the WMDs may be improved.
- (For Tutors) How would you rate the usefulness of the WMDs for your own teaching?
- What level of interactivity did the WMDs provide?
- What were the benefits of wireless connectivity?
- What were the support requirements for the WMDs?
- What other uses did you find for the WMD?
- In what situations would the WMDs be most effective?

- What do you think worked well, and what would you do differently another time?

Location
UNITEC
The projects will involve various courses from Unitec.

Carrington Rd
Mt Albert
Auckland
09 8154321

Data Collection
Notes will be taken by the researcher during the meeting, and the meeting will also be audio taped.

Expected outcomes
Utilizing feedback from the two main stakeholder groups will provide a good indication on the impact of the WMDs on learning. Involving representative staff from UNITEC in the evaluation process will provide an element of peer review into the research and also provide feedback on the pedagogical usefulness of the WMDs. The feedback gained from the focus groups will enhance that gained through written evaluations and observations, and also provide opportunity for further clarification of any issues.
Following collation of the data from the focus group, participants will be given newly developed learning activities utilizing WMDs and social software tools to evaluate during the following semester. These will then be compared to earlier projects.

Researcher Details
Thomas Cochrane
Centre for Teaching & Learning Innovation, UNITEC
[redacted]

13.10 Researcher Reflective Journal Template

Having never been a 'dear diary' type person, rather, goal and event driven, my reflective journal takes shape around key reflective events (experiences/moments/events):

Date:	17May
REFLECTIVE EVENT	
Description	
Pedagogical Implications/Outcomes	
Change	
Reinforcement	
Development (growth)	
Relevance/LINKS	
To the Research Project	
To my Teaching Practice	
REFERENCES	

13.11 Institutional Permission Letter.

May 2006

Permission Letter for “Mobilizing Learning: Wireless Mobile Devices and Web2 in tertiary education.”

Thomas Cochrane
Faculty of Education
MONASH UNIVERSITY VIC 3800

Dear Mr Cochrane,

Thank you for your request to recruit participants from Unitec for the above-named research.

I have read and understood the Explanatory Statement regarding the research “Mobilizing Learning: Wireless Mobile Devices and Web2 in tertiary education” and hereby give permission for this research to be conducted.

Yours Sincerely,

Dr Jurg Bronnimann
Dean Teaching and Learning Unitec

13.12 Monash Research Ethics Approval

Subject: Monash Human Ethics: CF07/0181 - 2007/0061 - Approval
Date: Fri, 02 Feb 2007 12:55:55 +1100
From: SCERH
To: Bernard Holkner, [redacted]

Dr Bernard Holkner
Faculty of Education
Clayton Campus

2 February 2007

CF07/0181 - 2007/0061: Mobilizing learning: Wireless mobile devices and web2 in tertiary education

Dear Researchers,

The above research project has been considered by the Standing Committee on Ethics in Research Involving Humans (SCERH) and accelerated approval has been granted for this project. This approval will be ratified at meeting A1/2007 on 6 February 2007. It is possible that issues may be raised by the Committee at that meeting. If you do not hear anything further you may assume that approval for the project is confirmed.

Terms of approval
1. This project is approved for five years from the date of this letter and this approval is only valid whilst you hold a position at Monash University.
2. It is the responsibility of the Chief Investigator to ensure that all information that is pending (such as permission letters from organisations) is forwarded to SCERH, if not done already. Research cannot begin at any organisation until SCERH receives a letter of permission from that organisation. You will then receive a letter from SCERH confirming that we have received a letter from each organisation.
3. It is the responsibility of the Chief Investigator to ensure that all investigators are aware of the terms of approval and to ensure the project is conducted as approved by SCERH.
4. You should notify SCERH immediately of any serious or unexpected adverse effects on participants or unforeseen events affecting the ethical acceptability of the project.
5. The Explanatory Statement must be on Monash University letterhead and the Monash University complaints clause must contain your project number.
6. Amendments to the approved project: Changes to any aspect of the project require the submission of a Request for Amendment form to SCERH

and must not begin without written approval from SCERH. Substantial variations may require a new application.
7. Future correspondence: Please quote the project number and project title above in any further correspondence.
8. Annual reports: Continued approval of this project is dependent on the submission of an Annual Report. Please provide the Committee with an Annual Report determined by the date of your letter of approval.
9. Final report: A Final Report should be provided at the conclusion of the project. SCERH should be notified if the project is discontinued before the expected date of completion.
10. Monitoring: Projects may be subject to an audit or any other form of monitoring by SCERH at any time.
11. Retention and storage of data: The Chief Investigator is responsible for the storage and retention of original data pertaining to a project for a minimum period of five years.
All forms can be accessed at our website
www.monash.edu.au/research/ethics/human/index.html

We wish you well with your research.

Mrs Lyn Johannessen
Acting Human Ethics Officer (on behalf of SCERH)

Cc: Mr Thomas Cochrane

13.13 Introducing Unitec's eLearning Strategy

17 September 2009

The Leadership Team has recently approved in concept Unitec's eLearning strategy. While some components of the strategy are still awaiting budget approval, this information is intended to convey the key elements of the strategy. Consultation on its development has been comprehensive with a working party comprising faculty representatives as well as key people from Te Puna Ako, the Library, IT and Academic Development talking with and listening to many people and groups across the institution.

Context

Learning technologies or eLearning are critical components of a reconceptualised approach to teaching and learning at Unitec. The new strategy involves the utilisation of a range of learning technologies as integral parts of contemporary and engaging teaching and learning experiences. The development of the eLearning strategy is closely aligned with Unitec's living curriculum initiatives (including curriculum as conversation and assessment renewal), academic and information literacies development and the learning commons as a means and place for learning enhancement. It also aligns with the redevelopment of teacher qualifications.

The eLearning strategy takes into consideration analyses of: current capacity and attitudes at Unitec; recent developments in learning technologies; current local and global circumstances and provision; and predictions about the future of society, learning and technology. It also aims to enhance Unitec's contribution to achieving Government's goals of 'improving connections to support economic transformation', 'improving transfer and application of knowledge', and 'building relevant skills and competencies for productivity and innovation' - Tertiary Education Strategy, 2007-2012.

The project will be iterative and interactive and therefore not all aspects of the implementation plan are currently defined. However, it is based on one powerful pedagogical idea – that the eLearning strategy will support Unitec's decision to reconceptualise all programmes within a commitment to 'living curricula '.

Key Components of the Strategy

The strategy statement of work is a comprehensive document that includes specifics of the implementation plan including timelines, benefits, risks, decisions yet to be made, monitoring and quality processes, costs and more. Key components of the strategy are:

Objectives

The strategy aims to achieve the following objectives:

- To create authentic learning conversations that enable graduates to succeed in the 21st century
- To set and maintain at least minimum standards for learning capability
- To configure, implement and train staff in the use of Moodle
- To support learning environments that embed academic literacies
- To provide accessible environments and creative solutions for students' access to online tools via Wireless Mobile Devices (WMDs)
- To enhance wireless computing infrastructure
- To eventually hand over the project to faculties and support units for 'business as usual'

operation

Specific Focus

The strategy focuses on three key areas:

a) Staff Capability

Developing capability through creation, implementation and monitoring of departmental plans and supporting systems to fully integrate eLearning into the new curricula.

- Identifying departmental representatives to act as facilitators of change and involving them in an Etienne Wenger workshop on learning theory, communities of practice and eLearning in February 2010. Providing ongoing release time so they can support the development of departmental eLearning capability
- The development of an eLearning Diagnostic Matrix to assess staff capabilities and professional development needs and to support eLearning progression
- Specifying institutional principles for eLearning
- Three stage implementation and training programme designed to develop staff capability and confidence with Moodle and eLearning

b) Student Capability and Access

Student access to information on utilisation of eLearning resources will be made available along with the provision of equipment required for eLearning.

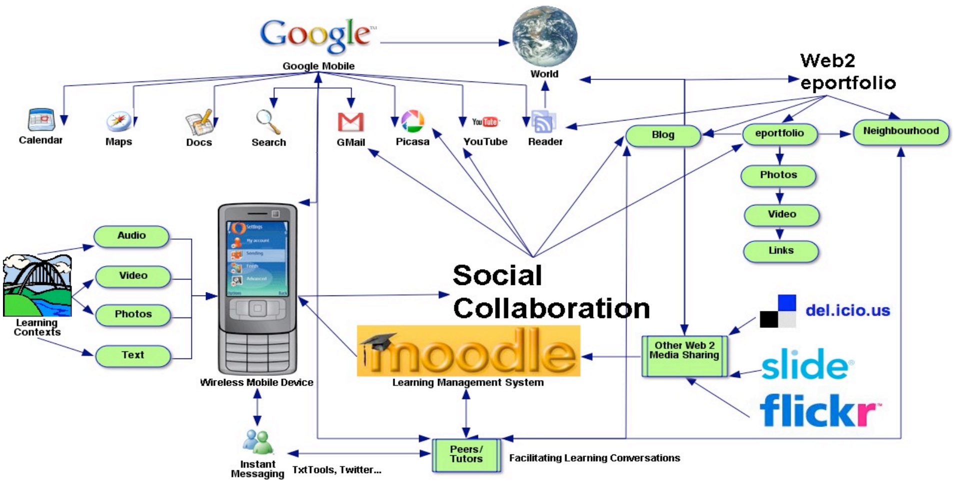
- Increasingly, students are expected to own WMDs and use these for class, tutorial and study sessions
- Provision for students with hardship issues will be made at an institutional level
- Digital and information literacy skills tuition will be provided for all students as required either directly through the programme or through additional support either online or through the library/TPA learning centre/IT

c) Infrastructure Changes

1. The delivery of WMD will be led by an evaluation of benefits to determine which programmes a wireless approach will apply to and determine how the utilisation of various devices will scaffold across the years a course is delivered
2. Investment in wireless infrastructure will be made to improve coverage, capacity and connection speed
3. The sequential movement of staff computers to WMDs will be undertaken

Implementation

Details on the implementation phases will become clearer as the decisions are made at Department and Faculty level as to when courses and programmes will come on line.



Any specific questions on the strategy are welcome and should be directed to Linda Keesing-Styles, the Dean Teaching and Learning.

13.14 Supporting Media DVD

The DVD included with the Thesis contains a local website with offline versions of the online media and supporting documentation (Google Docs and Wiki pages) referred to in the body of the Thesis. Also available online at: http://web.me.com/thom_cochrane/MobileWeb2/.

Computer requirements for viewing the DVD content are:

- Screen resolution 1024 x 768 or higher
- Quicktime 6 or higher installed: http://www.apple.com/quicktime/download
- Audio card with speakers attached for video content
- Web browser with Adobe Flash installed
- Adobe Reader for reading included PDFs

To access the DVD content, open the **index.html** page on the DVD in your chosen web browser.

DVD Contents:

- Mlearning Definition
- Project Map
- Concept Map
- Videos
  - Compilations of student and staff Vodcasts (Online video recordings) are collated on YouTube, giving a visual, multimedia overview of each different mlearning journey.
- Wiki Pages
  - A wide range of informative wiki pages were created throughout the course of the research supporting the various research papers and presentations at conferences, workshops, and associated tutorials. These represent significant points of

reflection and evaluation of the research projects and document the development of the overall research.

- Project Outlines
- Critical Success Factors
- Conclusions
- Research Outputs