Science and Mathematics Education Centre

Tertiary Students' Perceptions of Mobile Technology Enhanced Learning Environments and Associations with Outcomes in New Zealand

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Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of my knowledge and belief, this thesis contains no material previously published by any person except where due acknowledgement has been made.

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ABSTRACT

This thesis describes research that investigated associations between students' perceptions of mobile technology enhanced learning environments and tertiary students' outcomes. A review of the literature examined a range of topics pertaining to the study which encompassed the use of technology in higher education, theoretical approaches to learning, modes of learning, the emerging body of research in mobile learning, learning environment instruments, and the associations between classroom environment and student cognitive and attitudinal outcomes. This study used a modified form of the *Web-based Learning Environment Instrument* (WEBLEI), renamed the *Mobile Enhanced Learning Environment Instrument* (MOBLEI), to gather quantitative data about the associations between students' perceptions of mobile technology enhanced learning environments and student outcomes in a tertiary environment that uses different delivery modes. Qualitative data on students' perceptions were collected by discussion questions added to the MOBLEI questionnaire and through follow-up focus groups. The study has synthesised results from both quantitative and qualitative sources and has provided an understanding as to how students perceive their mobile enhanced learning environments. The research has made a valuable contribution to the field of learning environment research by developing a new learning environment instrument that can be used with confidence in tertiary institutions in New Zealand to evaluate the increasing uptake of mobile technologies that are being used in an effort to enhance learning. It has also been able to provide insight into the associations that exist between students' perceptions of their mobile enhanced learning environments and their attitudinal and cognitive outcomes.

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1. CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

Mobile learning is fast becoming a global phenomenon, resulting in a change to the way education is being delivered. As society is now experiencing 'mobility' in all senses of the word, it is unsurprising that mobile devices are being used by both learners and educators as a natural extension of the tools and technologies available to enhance the learning environment. Mobile learning is now developing its identity as a distinct field of research with its own particular issues and challenges. One of these challenges is how to assess the effectiveness of mobile technology as an educational tool and the ways it can enhance the learning environment.

In this study, a modified form of the *Web-based Learning Environment Instrument* (WEBLEI) (Chang & Fisher, 2003) was used to examine the effect that mobile devices have on student outcomes and the learning experience in a tertiary environment. The WEBLEI was modified and renamed the Mobile Learning Environment Instrument (MOBLEI) (Appendix A). This modified learning environment instrument was used to gather quantitative data about the associations between students' perceptions of mobile technology enhanced learning environments and student outcomes in a tertiary environment that uses different delivery modes: online; face-to-face; and blended. The online students received all their learning resources via the web, while the face-to-face group of students attended classes on-campus and their delivery mode was a combination of lectures and practical classes. The students studying in a blended mode of learning completed their studies off-campus and used resource-based materials such as workbooks.

This study was undertaken in a New Zealand tertiary institution, University College of Learning (UCOL). The researcher's role was to develop the learning environment instrument (MOBLEI), conduct focus groups with students and analyse and report on results. Lecturers were asked to be active participants by administering the MOBLEI and by texting the identified student groups. The lecturers used the texting

software available at UCOL in order to send texts directly from their computer keyboards. Students provided feedback via questionnaires, and were invited to participate in follow-up focus groups.

1.2 BACKGROUND

If society is considered in a mobile context, it is evident that people are continually creating opportunities for learning through the use of mobile devices, by way of conversations, retrieval of information and exploration of real and virtual worlds (Sharples, 2010). As well as their popularity with learners, mobile devices are also receiving attention from educators as they are able to reach out to learners using tools familiar and integral to many people's lives. One mobile tool currently being experimented with within the education arena is the mobile phone via text messaging. Rather than being a sole delivery method, mobile learning aims to provide another layer of support to the students' learning experience, alongside other delivery methods to enhance and support the learning process. With the development and validation of a new learning environment instrument (MOBLEI), this research will contribute to the emerging discipline of mobile learning by providing a reliable way of evaluating the increasing uptake of mobile technologies that are being used in an effort to enhance learning. It will also provide insight into associations between students' perceptions of their mobile enhanced learning environment and their attitudinal and cognitive outcomes.

Proponents of mobile learning believe that it offers learners greater access to information, reduced cognitive load, and improved contact with people and systems (Koole, 2009). Mobile learning has been characterised with words such as "personal, spontaneous, opportunistic, informal, pervasive, situated, private, context-aware, bite-sized, portable" (Traxler, 2009, p. 13). Studies have suggested that learners also use their mobile devices to support a wide range of informal learning activities. The portability and convenience of mobile devices means that they are available for unplanned as well as planned mobile learning activities (Clough, Jones, McAndrew, & Scanlon, 2009). Kukulska-Hulme (2010) describes mobile learning as a "different way of learning that changes the nature of what is learnt, where and how, chiefly by its capacities to take advantage of a learner's specific location and moments of heightened motivation" (p. 353).

There are a number of researchers in New Zealand who have explored the possibilities of using mobile devices within the education environment (Mellow, 2005; Chan & Ford, 2007; MacCallum, 2010). A project using mobile phones as the mobile tool for learning was trialled using a system called StudyTXT led by Dr Peter Mellow from Auckland University of Technology. StudyTXT is a mobile phone on-demand study support system, providing students with 'knowledge bytes' of information about a particular subject they are studying and review them in their own time. Initially StudyTXT was considered a content delivery system only based around rote learning methodologies, however, ways to make the system more interactive have been created to involve principles of constructivism (Mellow, 2005). A trial conducted at Christchurch Polytechnic Institute of Technology (CPIT) used eTXT™, a bulk text messaging system provided by New Zealand Telecom, to distribute questions and archive answers to the questions to work-based learners. The response to the text messaging was 100% return within two hours of the questions being texted out. This has encouraged the institute to make a commitment to using mobile phones to provide better student support and improved learning opportunities (Chan & Ford, 2007). At the Eastern Institute of Technology in the Hawkes Bay, MacCallum (2010) has conducted research to provide insight into some of the factors that may affect the adoption of mobile technology into education, including the attitudes of educators. The factors affecting the adoption of mobile technology were determined from a model that helped "identify constructs such as performance expectancy, effort expectancy, facilitating conditions, attitude, and behavioural intention" (p. 147). Her research suggested that educators need support and help with determining the best way to use mobile technology before they are willing to adopt it.

Kukulska-Hulme and Traxler (2005) have provided discussion on the fitness for purpose of mobile technologies for delivering learning material, along with questions in relation to what kinds of learners will benefit from using this technology, what sorts of subjects and situations are appropriate for this type of delivery method and whether it is it possible to learn via such small devices. There is beginning to be a significant uptake in the use of mobile technologies in schools, polytechnics and universities, both in New Zealand and internationally. This is "having an impact on teaching, learning and the connections between formal and informal learning, work

and leisure" (Kukulska-Hulme, 2005, p. 1). It is therefore important that the effects of these new mobile technologies on learning activities and learner support are appraised and evaluated.

With the implementation of new learning environments, the literature has indicated that not only should attention be given to how learning environments are changed, but also to the conceptions students have about learning and teaching (Entwistle, McCune, & Hounsell, 2003). While mobile technologies have the potential to enrich the learning experience outside the classroom, it is important to consider the quality of this learning environment and how it can affect student outcomes. Fraser's (1998a) review reported that the relationship between the quality of the learning environment and student outcomes became an area of interest about 40 years ago with the research and evaluation activities of Harvard Project Physics (Walberg & Anderson, 1968). The concept of environment, in relation to educational settings, considers such things as the atmosphere, ambience, tone, or climate that is present in a particular setting (Dorman, Fisher, & Waldrip, 2006). The learning environment concept has existed since the 1930s (Chang & Fisher, 2003) and was initially researched in the traditional classroom environment. This led to the development of the *Learning Environment Inventory* (LEI) (Walberg & Anderson, 1968). Moos (1974) began work on social climate scales and devised a scheme for classifying human environments which ultimately resulted in the development of the *Classroom Environment Scale* (CES). The LEI and the CES became widely used and formed the basis for the development of several other instruments commonly used to assess various learning and teaching environments (Lang & Wong, 2006). Examples of these instruments include: *Individualised Classroom Environment Questionnaire* (ICEQ) (Fraser, 1990); *My Class Inventory* (MCI) (Fisher & Fraser, 1981); *College and University Classroom Environment Inventory* (CUCEI) (Fraser, Treagust, & Dennis, 1986); *Questionnaire on Teacher Interaction* (QTI) (Wubbels & Levy, 1993); *Science Laboratory Environment Inventory* (SLEI) (Fraser, McRobbie, & Giddings, 1993); *Constructivist Learning Environment Survey* (CLES) (Taylor & Fraser, 1991); and *What Is Happening In This Class* (WIHIC) (Fraser, Fisher, & McRobbie, 1996) questionnaire. Since the development of these instruments, considerable research has been carried out to develop instruments that are

appropriate and useful for the assessment of technology-rich learning environments and in distance education environments for higher education levels.

Initially, the research was dominated by Australian and USA scholars and focussed on the psychosocial dimensions, such as those aspects that focus on human behaviour in origin or outcome (Boy & Pine, 1988). More recently, studies have been reported from scholars in Europe and Asia on a variety of important issues, helping to create a vibrant and growing interest in learning environments research on a global scale (Wubbels, 2006). "The influence of constructivism and growing use of computers in education is reflected in the number of surveys and inventories that have been developed and tested exploring the influence they are having on learning environments" (Clayton, 2003, p. 162).

Researchers have now developed a variety of valid and widely-applicable questionnaires that can be used to gain an understanding of students' perceptions of their learning environment, as well as practical qualitative instruments (Wubbels, 2006). Fraser (1998b) states that "few fields in education can boast the existence of such a rich array of validated and robust instruments which have been used in so many research applications" (p. 8). Learning environment instruments have scales, each with their own set of items. The construct validity of each scale has been determined by gathering qualitative data from respondents (Chandra & Fisher, 2006). More recently, learning environment research has moved into web-based and distance learning environments, with new instruments being developed for the purpose of evaluating and improving these environments. One of these instruments is the Web-based Learning Environment Instrument (WEBLEI), developed by Chang and Fisher (2003) to gather quantitative data on students' perceptions of their web-based learning environment in a tertiary environment. Four scales are used to measure students' perceptions: access, interaction, response and results. Chang and Fisher's study found the instrument to have factorial validity and the WEBLEI scales to have acceptable reliability and discriminant validity.

From the initial design, the WEBLEI was modified by Chandra and Fisher (2006) to use in a blended environment involving high school students. Although the items were amended or changed to suit this different environment, the total number of

items and number of items per scale were similar to those in the original version of the WEBLEI (Chandra & Fisher, 2006). Chard (2006) selected the WEBLEI as a suitable instrument to study online learning environments in her study of tertiary students involved in mixed mode delivery as it is targeted for web-supported and web-based learning environments, and is designed for a tertiary environment. Because the WEBLEI has been validated in a tertiary environment with students involved in mixed mode delivery, it was identified as having potential, with modification, for application in this study.

From a review of the literature to follow in the next chapter, it is evident that there has been no prior research using an existing learning environment instrument to assess the effect that mobile technologies might have on the learning environment. Traxler (2007) observes that mobile learning has growing visibility and significance in higher education and that the use of wireless, mobile, portable, and handheld devices are gradually increasing and diversifying across every sector of education. Rickards (2003) points out that technology-based futures in education have several issues of certainty – "they will always be linked to the technology that is currently available, which in turn will be partly driven by what people want to use technology for" (p. 121). The potential for the use of mobile technologies will require effective, multi-skilled and enthusiastic teachers to manage the learning environment. This study has assessed this exciting and emergent learning environment by using, and modifying a currently developed instrument, thus making an important contribution to the field of learning environment research.

1.3 AIM AND RESEARCH QUESTIONS

The aim of the research was to explore the associations between students' perceptions of mobile technology enhanced learning environments and tertiary students' outcomes in New Zealand. A series of questions developed from this aim are detailed below.

A modified form of the WEBLEI was developed for use in this study and was named the Mobile Learning Environment Instrument (MOBLEI). Validity and reliability of

instruments is required to assure that they measure what they are intended to measure. This led to research question one:

1. Is the modified learning environment questionnaire a valid and reliable instrument for use in New Zealand?

Once the MOBLEI had been confirmed as a valid and reliable instrument for use in a tertiary institution in New Zealand, it was used to assess what sort of learning environment is created by the use of mobile technology. This gave rise to the second question:

2. What sort of learning environment is created by the utilisation of mobile technology tools?

Three groups of students were categorized according to their mode of learning: online, blended, and face-to-face. Actual and Preferred Forms of the MOBLEI were analysed to understand how students perceived their mobile enhanced learning environment along with attitudinal and self-efficacy perceptions. Students' academic results were also analysed to assess cognitive outcomes. ANOVA was used to differentiate between the students' perceptions in each of the delivery methods groups. This analysis enabled answers to the following questions:

3. What associations exist between students' perceptions of their learning environment and their attitudinal and cognitive outcomes?

4. Are there any differences between how each of the three delivery methods groups perceived the mobile enhanced learning environment?

It is important to consider the quality of this learning environment and how it can enrich the learning experience. This consideration can be obtained from the results of the use of the MOBLEI in answering research questions one to four, however qualitative data obtained from the open ended questions included with the MOBLEI and follow-up focus group questions were also used to answer research question five:

5. Can the learning environment be enhanced through the use of mobile technologies and therefore enrich the student learning experience in a tertiary environment?

1.4 SIGNIFICANCE

This research is significant for a number of reasons. First, it makes a valuable contribution to the learning environment research area by developing a learning environment instrument that can be used to assess the effect that mobile technologies have on a learning environment. Secondly, it validated the instrument for use in tertiary institutions in New Zealand. Thirdly, the research provided new information as to the associations that exist between students' perceptions of mobile enhanced learning environments and students' outcomes in a tertiary institution that uses a range of delivery approaches. Fourthly, the research methodology employed used qualitative data that were interpreted against a background of quantitative data. This allowed the data necessary to determine if there were differences between how each of the groups perceived their mobile enhanced learning environment. Finally, there is enormous potential in the use of technologies such as mobile technologies to enhance the learning experience. Efforts to evaluate this exciting and developing learning environment by using, and adapting a currently developed instrument, will make an important contribution to the research completed thus far.

1.5 OVERVIEW OF METHODOLOGY

This exploratory study utilised both quantitative and qualitative methods for gathering, analysing and reporting data. A purposive approach to sampling was undertaken. All students enrolled in the courses being surveyed were invited to be included in the study and no differentiation was made on the basis of ethnicity, age or gender. These students were categorised into one of three groups according to their mode of learning: online, blended, and face-to-face. The quantitative data were gathered by utilising a learning environment instrument in which scale items were classified and coded. Qualitative data were obtained through the use of open-ended questions attached to the MOBLEI and follow-up focus groups which aided in validating the learning instrument.

Initially, the scale items on the modified learning environment instrument (MOBLEI) and interpretations of those scales were assessed for reliability and validity. The Cronbach alpha test was then used to measure consistency, with the aim of achieving 0.6. Actual and Preferred Forms of the MOBLEI questionnaire were analysed for perceptions on the use of mobile technologies along with attitudinal and self-efficacy perceptions. The quantitative data obtained from the questionnaires, along with students' academic results, were recorded in an Excel spreadsheet and analysed using SPSS. This analysis helped to determine what associations exist between the MOBLEI scales and outcomes. A one way ANOVA was used to differentiate between the method of delivery groups' perceptions. The responses from the open-ended questions and focus groups were examined and compared with quantitative data for consistencies or divergence.

1.6 SUMMARY

The thesis is divided into five chapters. This chapter has provided an overview of the study which was to develop a learning environment instrument that can be used to assess the effect that mobile technologies have on a learning environment. The study validates the instrument for use in tertiary institutions in New Zealand and provides new information about associations between students' perceptions of mobile enhanced learning environments and students' outcomes.

The literature review follows in Chapter Two. It provides a discussion of the learning environment literature and learning environment instruments. Three different delivery modes are discussed and consideration is given to the potential and challenges that each learning mode presents. The possibilities of enhancing these different learning environments have led to a review of mobile learning and the use of mobile technologies in educational institutions, both nationally and internationally.

Chapter Three discusses the methodology. The methodology details the background to the study and describes the quantitative and qualitative approaches used. The chapter also describes the ethical considerations and the procedures followed for the information, consent, confidentiality and the use of results.

Chapter Four presents the quantitative and qualitative findings, using tables to aid interpretation and analysis. It provides evidence for the reliability and validity of the MOBLEI and the results of the students' actual and preferred perceptions of their mobile enhanced learning environment. Associations between students' perceptions of mobile enhanced learning environments and their attitudinal and cognitive outcomes are analysed and the qualitative results gathered via the open-ended questions and focus group responses are presented.

The discussion about the findings follows in Chapter Five and provides an explanation of the results, some limitations of the study, and practical implications. The chapter concludes with a summary of the research and recommendations for future research directions are provided.

2 CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This review begins with a discussion of the integration of technology in higher education. An overview of theoretical approaches to learning is presented to provide a context for different delivery modes and learning environments. It then considers the delivery modes under investigation which include online learning, face-to-face learning, and blended learning. Each of these different delivery modes is examined to provide a background to the discussion on how the use of mobile technologies as a teaching tool can enhance learning. This enquiry leads to a review of the emerging body of research in mobile learning. A review of the learning environments literature and the instruments used for assessing classroom environments has been undertaken to determine what evaluation methods are available to assess the mobile learning environment. As the study of the associations between classroom environment and student cognitive and affective outcomes is an important strand of the learning environments research, and of particular interest in this study, a review of the empirical findings in this research area has been provided.

2.2 INTEGRATION OF TECHNOLOGY IN HIGHER EDUCATION

Technology, in an educational setting, can be something as simple as chalk and blackboard, student notebook and pen, to more sophisticated tools such computers, computer applications and the use of the Internet. It can also include social practices that have been developed to manage tools and settings such as lectures, group activities, labs and field trips (Murphy, Walker, & Webb, 2001). Snart (2010) believes that technology can often be misunderstood as "a rejection of what has come before, when this need not actually be the case at all" (p. 4). He provides an example of students using a notebook and pen to record information and ideas so that they can be remembered and referenced for future study. Students using a notebook computer are using an equivalent but more intricate technology to solve the same problem.

Many technologies used in higher education today include the use and application of methods such as e-learning, online learning, web-based learning or blended learning, each often in combination with learning management systems. Oblinger and Oblinger (2005) assert that as technology changes, educational institutions must also adapt to these changes and that the notion of classrooms as a physical space only, needs to evolve to a concept of learning spaces that are not limited to floors and walls. However, it is important to note that for those students still engaging in face-to-face learning, expectations do include being taught knowledge and expertise from a teacher, but additionally these students expect teachers to use technologies to enhance and support their learning. "The use of technology in higher education should enrich and extend the student's exploration of new territory. Educational technologies are of little value if they do not add richness and dimensionality to the experience of learning" (Weigel, 2002, p. xiii). Reimer (2005) believes that it is not the technology itself that is improving student learning, but rather that the students' needs are being better met through the use of technology. Hagner and Schneebeck (2001) state that higher education institutions are challenged with creating a new institutional environment to accommodate and promote the use of these new technologies.

Rickards (2003) believes that while information and communications technologies can enrich the learning environment and enhance learning, it is of paramount importance that the teacher effectively facilitates the experiences and responds to individual student needs. He also holds that technology cannot replace the role of the effective teacher or facilitator completely – it only enhances what an effective teacher can provide in a classroom. Technology in higher education may work most productively as a learning tool, not only when it is being used, but when reflection takes place as to how and why it is being used (Snart, 2010).

There have been criticisms that higher education has a well-established trend towards non-adoption of new technologies, even though the provision of online courses has altered this picture slightly (Roblyer, McDaniel, Webb, Herman, & Witty, 2010). Hannafin and Land (2000) commented that the post-secondary culture still supports the *sage on the stage* teaching technique. Furthermore, research has suggested that technology integration into the higher education classroom has not

always been successful. Some studies have shown that there were no significant differences between grades of post-secondary students enrolled in computer-mediated courses versus traditional lecture-based courses (Brallier, Palm, & Gilbert, 2007; Rivera & Rice, 2002). Other studies have shown that in-class laptop use had a negative impact on student learning, with students being distracted from the lesson due to spending more time multitasking on their laptops (Fried, 2008; Hembrooke & Gay, 2003).

While there are many different ways to integrate technology into classrooms, it is important that they all focus on learning theory and educational practices. The use of technology should not occur without thinking about how people learn best (Jackson, Gaudet, McDaniel, & Brammer, 2009). Clark and Mayer (2011) point out that too much of a focus on the role of cutting-edge technology may result in ignoring the role of the learner. Mayer (2009) believes in a learner-centred approach to learning with technology and holds that technological innovations require adaptation in ways that will support learning processes. As most universities are experiencing rapid technological changes, continuous shifts in the learning environments, and a new generation of students exhibiting more advanced technological skills (Keengwe, 2007), it is important to consider the opportunities and challenges that educators face in order to effectively use technology to enhance learning. Herrington and Kervin (2007) support this view and believe that:

> Technology presents the opportunity to employ powerful cognitive tools that can be used by students to solve complex and authentic problems. In order for this to occur, however, technology needs to be used in theoretically sound ways, and it needs to be used by students rather than teachers (p. 1).

Jonassen (1994) provides a description of cognitive tools as a set of tools that learners need in order to serve cognitive apprenticeships and believes that when technology is used as a cognitive tool rather than for the dissemination of content and information, it allows students to engage more meaningfully with tasks and to assume ownership of their knowledge, rather than reproducing the teacher's (Jonassen, 1994).

O'Donnell and Sharp (2012) assert that the pedagogical approach which enhances the students' learning experiences should be the driving force behind the technologies integrated into the classroom, not the integration of technology prior to pedagogical considerations. They conducted a study to gain student perspectives on the uses of technologies in higher education to assist educators in improving the pedagogical design of e-learning platforms. The results of their study of 320 students from the Dublin Institute of Technology and Trinity College Dublin indicated that while students were of the opinion that the use of technologies in higher education can beneficially transform learning, they strongly believed that technologies will never replace lecturers. This sentiment is echoed by Georgina and Olson (2008) who claim that technology alone does nothing to enhance pedagogy and that successful integration is all about the ways in which technology tools are used and incorporated into teaching.

Georgina and Hosford (2009) believe that the primary task of technology infrastructure is to support both instructional technology and student learning technology. The technology needed to support pedagogy focuses on web-based instructional platforms such as Blackboard, Moodle, WebCT, and incorporates digital learning objects. Littlejohn (2009) concurs with this view and describes how technology has modified the ways lecturers distribute course materials to students; instead of students transcribing notes from the whiteboard, course materials are disseminated through online files, PowerPoint presentations, podcasts, video casts and web links. Furthermore, technologies have made it easier for students to access information outside of the course materials and to conduct research though the use of online journals and databases. Learning-support technology goals consist of creating communities to enable students to share common values, expertise and understanding. These goals have been achieved through technologies such as email, discussion boards, online chat rooms and video conferencing (O'Donnell & Sharp, 2012). While these first generation Web tools provided opportunities for instructor-student as well as student-student real-time and/or time-delayed collaboration, it is the Web 2.0 technologies that have taken interactivity to the next level (Beldarrain, 2006). Web 2.0 refers to the social use of the Web which allow people to collaborate, be actively involved in creating content, to generate knowledge and to share information online (Grosseck, 2009). Clark and Mayer (2011) share the same

perspective and believe Web 2.0 technologies "make learners receivers, producers, and distributors of knowledge" (p. 7). Specific technologies contributing to higher education include weblogs, wikis, media-sharing and social networking sites.

Winer (2003) defines a weblog as a hierarchy of text, images, media objects and data that are arranged in chronological order and are created mostly by one person. Most weblog posts are short, a paragraph or two although some weblog tools provide for longer articles or stories. Weblogs lend themselves to exploratory topics or enhancing writing skills (Kennedy, 2003) as well as student portfolios which keep track of an individual's progress, accomplishments and reflections (Weller, Pegler, & Mason, 2005). From weblogs, a new form of blogging has emerged, known as micro blogging. *Twitter* is the best known micro blogging platform and enables communication via the web by writing short messages restricted to 140 characters (Ebner, Lienhardt, Rohs, & Meyer, 2010). In contrast to a weblog, a wiki is a web-based document which enables users to add and edit content using only their web browser (Bayne, 2008). There are similarities between weblogs and wikis, however, while a weblog is usually the voice of one person, a wiki allows anyone to edit anything so that it represents an interesting mix of many voices (Winer, 2003). Teaching models that integrate weblogs or wikis may provide more learner control and therefore be more effective at delivering instructional strategies that support knowledge construction (Beldarrain, 2006). O'Donnell and Sharp's (2012) study found that many students agreed that using wiki interfaces increased the value of their learning experience. Ebner et al. (2010) believe that collaboration and communication by way of weblogs and wikis enhances traditional education in new and exciting ways. They believe that these technologies have great potential for the future by expanding teaching and learning beyond the classroom.

Social networking sites (SNS) such as *Facebook* are another example of the latest communications technologies that have been widely adopted by students. They have the potential to become a valuable resource to support educational communications and collaborations in higher education and for those educators who view teaching as establishing a relationship with students, *Facebook*-like technologies allow connections to be achieved efficiently and effectively. Due to SNSs being the fastest-growing and most popular of the Internet-based technologies with young

people, it makes sense that so many educational institutions now have their own Facebook pages in an attempt to actively keep in close contact with students (Roblyer et al., 2010).

From the discussion above, it can be seen that while notion of using technology in higher education is not a new concept, the application of the latest information and communication technologies have the potential to make a positive impact on the learning experience. There are issues such as pedagogical appropriateness that need to be considered and as Beldarrain (2006) points out, not all technologies are appropriate for every situation - it is the responsibility of the instructional designers, administrators and technology experts to determine which tool offers the best solution for the particular learning environment.

2.3 THEORETICAL APPROACHES TO LEARNING

As a background to the discussion that follows on the different delivery modes under investigation in this study, it is helpful to provide an overview of the different theoretical approaches to learning. This section begins with the behaviourist viewpoint, moves to a cognitive paradigm and then finally, to the currently widely accepted constructivism.

The behavioural perspective to learning and development had its beginnings with Ivan Pavlov's (1849 - 1936) classical conditioning theory and B.F. Skinner's (1904 - 1990) operant conditioning theory. Other influential behavioural theorists were Edward L. Thorndike (1874 – 1949) with his theory of connectivism; John B. Watson (1878 – 1958) with his emphasis on the importance of the environment; and Edwin R. Guthrie (1886 – 1959) who forwarded learning principles that reflected associationism (Schunk, 2008). Behaviourists believe that instruction should have a specific goal(s) and they strongly support sequencing of instructional materials by first presenting simple facts before moving into more complex information. They believe that if teachers present and sequence instructional materials and evaluate students' achievements, then students will learn more effectively (Gillani, 2003). Education in the first half of the twentieth century was predominated by the behavioural perspective of teaching and learning (McInerney, 2005; McInerney &

McInerney, 2006) where learners were viewed as passive recipients of stimuli from the learning environment, in contrast to teachers who were viewed as a controller of stimuli and a shaper of behaviours through reinforcement. The goal of behaviourist research in education was to determine how external instructional manipulations most effectively affected changes in student behaviours (Liem & McInerney, 2008). McInerney and McInerney report that the principles of behaviourist teaching and learning have been re-explored with the advent of computerised technology being used to support classroom teaching and learning processes. They explain that this is due to computer programs being able to provide realistic simulations of learning situations and opportunities for instant correction and feedback. Gillani concurs with this and believes that there is definitely a place for the use of the behavioural approach to e-learning and that there are situations in which the application of the principles of behavioural theories is the best approach to the development of e-learning environments.

Behaviourist theories were challenged in the late 1950s and early 1960s, with one of the major challenges coming from Albert Bandura's studies on observational learning. Bandura (1977) developed a social cognitive theory that found that people could learn new actions merely by observing others perform them. Observers did not have to perform the actions at the time of learning and reinforcement was not necessary for learning to occur. Social cognitive theory holds that much human learning occurs in a social environment. By observing others, people acquire knowledge, rules, skills, strategies, beliefs, and attitudes (Schunk, 2008).

The cognitive view of learning emphasises the role of thinking processes of the learners (McInerney, 2005) and learners are viewed as active meaning makers through their use of cognitive and meta-cognitive strategies. In contrast, teachers are seen as partners who facilitate the process of meaning making (McInerney & McInerney, 2006). Cognitive development refers to a mental process by which knowledge is acquired, stored, and retrieved to solve problems (Gillani, 2003). Piaget (1952) claimed that the process of intellectual and cognitive development is mental adaptation to environmental demands. Piaget proposed four concepts of this process that consisted of *schema, assimilation, accommodation, and equilibrium.* Piaget used the word *schema* to represent a mental structure that adapts to

environmental patterns. Schemata are the central building blocks of constructivism. They refer to ways of perceiving and thinking that make the world meaningful and, therefore, knowledge of the world is based entirely on these knowledge constructions. *Assimilation* refers to the process by which learners incorporate new information and experiences into the framework of their pre-existing knowledge constructions, thereby making the unfamiliar familiar. *Accommodation* takes place when learners accommodate these new experiences or ideas by bringing their knowledge constructions in line with the new information (Weigel, 2002). The concept of *equilibrium* explains the causes of cognitive reorganisation in response to new learning experiences. When a new learning environment or a new situation is encountered that the learner is not familiar with, a state of disequilibrium is created within the learner's brain that must be internally managed. In order to be in a comfortable state of equilibrium in the mental schemata, the learner has to modify or restructure their schemata to account for the new situation (Gillani, 2003). Other cognitive psychologists who have contributed to the understanding of cognitive learning theories by building on Piaget's original theory are Ausubel (1968), Bruner (1966), and Flavell (1985).

Cognitive development research has had a great impact on the constructivism movement in education and educational technology (Gillani, 2003). Constructivist learning has become a prominent approach since the mid-1990s and represents a paradigm shift from education based on behaviourism to education based on cognitive theory (Collay & Gagnon, 2001). Constructivism is a broad term that is used in different ways by philosophers, teachers, educational psychologists and social researchers (Phillips, 2000). For teachers, it raises questions about the appropriateness of instructions given to students when introducing new material and the approaches to assessment to ascertain students' understanding of a topic. The theory of cognitive constructivism had its origins with Piaget (1896 – 1990) who believed that people have an innate need to understand how the world works and to find order, structure, and predictability in their existence (Eggen & Kauchak, 2004). Ausubel's contribution to the psychology of classroom learning further developed the idea of meaningful learning as being important in the learning process. "The essence of the meaningful learning process is that symbolically expressed ideas are related in a non-arbitrary and substantive (non-verbatim) fashion to what the learner

already knows namely, to some existing relevant aspect of his structure of knowledge" (Ausubel, 1968, p. 37).

Eggen and Kauchak (2004) outline four characteristics that typify a constructivist approach to learning as being: learners construct understanding that makes sense to them; new learning depends on current understanding; social interaction facilitates learning; and meaningful learning occurs within real-world tasks. Duit (1995) believes because students hold preconceptions of the phenomena presented and the scientific concepts and principles taught, there are often many learning difficulties. He considers it is an essential feature of the constructivist view that students' already existing concepts guide their understanding of the information presented by teachers or textbooks.

Constructivism has important implications for teaching. It is powerful because it helps teachers understand why both prior knowledge and interaction with others is so important for developing deep understanding. When instruction is grounded in constructivism, the focus shifts from teachers to students, as it is the students who are the ones constructing the understanding (Eggen & Kauchak, 2004). Bonk and Cummings (1998) purport that conventional face-to-face learning may not fully satisfy the needs of all learners and that in a constructivist learning environment, part of the ownership of learning is shifted from the teacher to the students. Chang and Fisher (2003) believe that constructivist and cognitive perspectives have a strong influence on learning approaches in an online learning environment, an environment where the role of the educator becomes that of an educational facilitator (Sherry & Wilson, 1997) and where the teacher provides guidance and allows students to explore learning materials without restriction. Constructivist theory has several characteristics that are easily adapted for web-based activities. These characteristics include: learner construction of meaning; social interaction to help students learn; and student problem-solving in real world contexts (Abbey, 2000). The online learning environment, which is discussed next, represents a paradigm shift in the learning environment and presents new ways of teaching and learning for both teachers and students (Chang & Fisher, 2003).

2.4 ONLINE LEARNING

The growing use of technology in higher education has meant that online learning is being utilised, to some extent, in many programmes of study. Due to the now widespread role of technology for delivery of on-campus programmes, almost all students at most institutions undertake some form of online or e-learning (OECD, 2005). During the 1990s, educational innovators began developing online course offerings, initiatives that were seen as a threat to enrolments in the traditional on-campus courses. The rapid rise in distance education during this period was seen as partly due to colleges and universities using technology to boost enrolments and compete in a changing educational market (Snart, 2010). Weigel (2002) posits that this preoccupation by many institutions to use technology as a way to reach wider educational markets is a "grave strategic error" (p. xiv) and that the focus should be on how the experience of learning can be enriched. He describes this 'richness' as referring to the overall quality of the information in terms of currency, accuracy, interactivity and relevance.

Clayton (2003) suggests that online learning could be defined simply as "the use by learners and tutors of connected (online) computers to participate in educational activities (learning)" (p. 158). However, he believes that this definition does not adequately explain the full range and use of connected computers in the classroom. Radford (1997) describes online learning as denoting material that is accessible via a computer using networks or telecommunications rather than material accessed on paper or other non-networked medium. Chang and Fisher (2003) provide a definition that portrays online learning as a system and process that connects learners with distributed and online learning materials. They characterise this type of learning environment as one where there is separation of place and time between teacher and learner, between learners, and between learners and learning resources. Zhu, McKnight, and Edwards (2001) offer a similar definition by describing online instruction as any formal educational process in which the instruction occurs when the learner and the instructor are not in the same place and technology is used to provide a communication link between the instructor and students. Clayton (2003) observes that the range of definitions of online learning is a reflection of the variety of ways educators use connected computers in learning.

Chang and Fisher (2003) view the shift in the teaching and learning mode away from the traditional face-to-face environment towards online learning as presenting new challenges for teaching and learning for both teachers and students. Abbey (2000) supports this view and sees online instruction as being very different from traditional teaching in that knowledge is often contextualised to make it real, more interesting and attention gaining. "While contextualisation is important, it does not constitute the majority of instructional strategies that can or should be employed to promote learning" (Abbey, 2000, p. 44). The OECD Centre for Educational Research and Innovation (OECD/CERI) undertook a qualitative survey of practices in 19 tertiary education institutions from 13 countries to better understand e-learning practices and issues at institutional level (OECD, 2005). In this study, the different kinds of online presence were defined as: *web supplemented; web dependent; mixed mode;* and *fully online*. Courses identified as *web supplemented* provided the course outline and lecture notes online, made use of email and provided links to external online resources. *Web dependent* courses required students to use the Internet for online discussions, assessment, online project and collaborative work, but did not significantly reduce the time required to be in the classroom. *Mixed mode* required students to participate in online activities as described above under the *web dependent*. In contrast however, these activities replaced part of the face-to-face teaching and learning even though there was still a significant campus attendance requirement. The study found that *fully online* provision is still very much a minority form of teaching and learning for campus-based universities and that these institutions predicted the continuation of a strong focus on campus-based face-to-face teaching and learning environment.

Whatever the extent of online learning practices, there are both positive and negative pedagogic impacts to be considered in this mode of learning. While it can be difficult to assess the pedagogic impact of online learning, most institutions in the study believed that it improved the students' learning experience. One of the participants in the study (OECD, 2005), Carnegie Mellon University, cited enhanced student learning compared to the traditional model of lectures alone. An example of online learning the university uses is a system called StatTutor which was designed to help students to solve data analysis problems, receive immediate feedback and helpful hints for any difficulties, and provide guidance with statistical problem solving steps.

The university also offers a "Story-Centred Curriculum" which allows students to learn through a simulated work environment where they work collaboratively in virtual groups on authentic projects with assistance from faculties and online tutors. Another institution surveyed, Aoyama Gakuin University, cited flexible access to materials and other resources as being particularly valuable to students who wished to review aspects of a lesson, or for students who did not have a strong grasp of the language of instruction. Aoyama Gakuin University, the Asian Institute of Technology, and Monash University all found that the use of e-learning makes it easier for faculty/student communication and examples cited were that it helps to reduce cultural/personal student shyness, enables faster faculty responses to student queries, enhanced peer learning, and the ability to deliver online lectures and combined classes with remote non-local students. Increased retention and a higher level of attainment were provided as evidence by a number of institutions that online delivery has a positive impact on learning. The results of large-scale and regular student/alumni satisfaction surveys conducted by UCLA Extension and the University of Maryland University College found that there were high levels of satisfaction with the quality and academic rigour of online provision compared to face-to-face or other distance delivery, as a well as an appreciation of enhanced flexibility of access. The University of British Columbia's attainment record for fully online courses was 10-15 per cent better compared to the traditional print version and that at undergraduate level, fully online courses revealed similar grades to face-to-face equivalents.

The OECD study found that negative pedagogic impacts from online learning largely revolved around issues of inconsistency, loss of face-to-face contact and inexperience in designing a course that suits the online mode of learning (OECD, 2005). Many educators have concerns about the barriers that hinder effective online teaching and learning; concerns that include the changing nature of technology, the complexity of networked systems, the lack of stability in online learning environments, and the limited understanding of how much students and instructors need to know to successfully participate (Johnson, Aragon, Shaik, & Palma-Rivas, 2000). Similar issues surrounding online teaching were identified via a collection of 19 case studies considered by Murphy et al. (2001). The researchers were careful not to predetermine the issues and stress that they were only identified after they had

the case account. This was due to their belief that a recurring problem in the educational use of technologies is that "technology is given pole position" (p. 3) which means the technology becomes the leading actor with the users being put in the position of having to adapt to the demands of the technology. They found that while many of the case studies involved more than one issue, these could be easily placed into one of the following four key areas: *student interaction; teaching and assessment; planning and development; and policy issues*. *Student interaction* emerged as a key issue in the case studies with some of the cases, despite having carefully constructed interactive environments, reporting disappointingly low levels of interactivity. Other cases found that initial interaction only led to tension, argument and discord (Murphy et al., 2001). *Teaching and assessment* issues that arose included the appropriate use of online discussion groups. Often academic staff were expected to use a particular approach to teaching without adequate preparation, the reconceptualization of teaching caused by using the technology, and the effects on students and other staff members (Fox, 2001). Other issues arose concerning student resistance towards the introduction of an online discussion group (Tarbin & Trevitt, 2001), and the assessment of students' contributions to online collaborative learning, specifically when tutors attempted to apply criteria that had not been adequately specified in the course information (Goodfellow, 2001). *Planning and development* issues identified in the case studies included the rapid change in type and availability of technologies to both faculty and students, increased need for staff development, the need for careful planning and monitoring of teaching resources (Ravaga, Evans, Fassalaina, & Osborne, 2001), and the search for new technological solutions, specifically for discipline-specific courseware, to the changing needs in higher education (Somekh, 2001). *Policy issues* included the dilemma faced by educators of providing a student-led approach to developing skills in information and communication technology (ICT) in balance with meeting government requirements (Selinger, 2001), and the introduction of policy-led online teaching with insufficient prior thought given to operational consequences (Moss, Fearnley-Sander, & Hiller, 2001).

2.5 FACE-TO-FACE LEARNING

In contrast to online learning, this review now considers the face-to-face learning environment. Traditional face-to-face instructional environments have been

criticised as encouraging passive learning, ignoring individual differences and needs of the learners, and not paying attention to problem solving, critical thinking, or other higher order thinking skills (Banathy, 1994; Hannum & Briggs, 1982). In higher education, traditional class instruction has strongly depended on the delivery of knowledge through lecture presentation (She & Fisher, 2003). Chard and Fisher (2005) describe this environment as being teacher centric, where the teacher imparts knowledge to learners. This view is supported by studies that have shown that teachers talk more than students in this type of learning environment (Relan & Gillani, 1997). Griffin (2006) points out that classroom lecturing puts the lecturer in complete control of the learning situation and seems to cast the learner in an entirely passive role. He describes the formal lecture as providing "almost limitless scope for boredom, and also for the irritation which many feel at being 'lectured at' in any situation of life" (p. 74). However, he acknowledges that lecturing remains a major teaching method in all sectors of the post-compulsory education system. Jarvis (1995) agrees that lecturing is the most commonly employed teaching technique despite the criticisms that have been levelled against it at various times.

There is still compelling evidence to suggest that face-to-face interaction between lecturer and student will always have its place in higher education. O'Donnell and Sharp's (2012) study found that while students expect technologies to be used in higher education, they acknowledge that lecturers form the backbone of tertiary education, and that while technologies can effectively be used to enhance students' learning experience, their use will never replace the lecturers. Analysis of the students' perspectives also showed that while they realised the benefits that can be achieved from using technologies in their education, they still appreciated the benefits of having face to face interaction with peers. An example of this perspective is illustrated by a student comment: "the use of technology should be used in parallel to lectures as the best way of learning is through human interaction" (p. 210). Eighty per cent of the students agreed that attending formal lectures facilitates a deeper understanding of course content than online access. These findings are consistent with those found by Wilson and Christopher (2008). They suggest that e-learning depends on lecturers in order for the whole system to run effectively, from planning and design to management and delivery, as well as being role models and providing guidance for students.

As a learning environment, face-to-face learning remained, until relatively recently, separate from computer-mediated learning environments. Computer-mediated learning environments have grown exponentially as new technologies have created more opportunities for communication and interaction. The widespread adoption and availability of these digital learning technologies has led to face-to-face learning integrating computer-mediated instructional elements, a learning experience that has emerged as 'blended learning' (Graham, 2006). There is evidence that blended learning has the potential to be more effective and efficient when compared to a traditional classroom model (Twigg, 2003) and that students achieve as well, or better, on exams and are more satisfied with the approach (Garrison & Kanuka, 2004).

2.6 BLENDED LEARNING

Blended learning is a concept that has its origins in corporate training and development in the USA in the late 1990s (Clark, 2007). Since then it has grown in popularity in both corporate and educational settings (Huang, Ma, & Zhang, 2008). Georgina and Olson (2008) believe that "the creation and utilisation of the blended course is perhaps the most successful approach to integrating technology into pedagogy" (p. 2). The term 'blended learning' is often used interchangeably with terms such as flexible delivery, mixed mode, and hybrid learning. Snart (2010) believes that these different terms provide a platform to think broadly about how blended learning has emerged as a learning model, including a range of educational precedents such as correspondence education, online learning, field and experimental studies. Bonk and Graham (2006) have conducted extensive world-wide research into the different methods and applications of blended learning used in higher education. Their handbook of blended learning considers global issues and trends and provides individual blended learning situations, both in New Zealand and international settings. The different perspectives that the handbook's contributing authors have towards blended learning make it even more apparent that there is a plethora of definitions for this learning environment.

A useful definition is provided by Graham and Dziuban (2008), who view blended learning as "a learning environment that combines face-to-face instruction with

technology-mediated instruction" (p. 270). They describe face-to-face instruction as involving interactions between instructors and learners who are in the same place, and technology-mediated instruction as using information and communication technologies to mediate the learning experience and interactions where learners and instructors are not in the same physical location. Huang et al. (2008) take a different approach and see blended learning as having three main characteristics: flexibility of providing learning resources; support of learning diversity; and enrichment of the e-learning experience on campus. Littlejohn and Pegler (2007) support this view and see blended learning as allowing a coexistence of conventional face-to-face teaching methods with e-learning activities and resources in a single course. They believe that blended learning fosters integration of different spaces, allowing students to learn on campus, from their work or home environment, and offering flexibility in terms of time when learners can participate in courses, and opens up a range of media resources that can be used for learning.

The pervasiveness of blended learning has led to a diversity of definitions and models and there appears to be no standard or simple framework to support blended learning across different disciplines (Chew, Jones, & Turner, 2008). While the term 'blended learning' was initially used to describe the linkage between face-to-face teaching and e-learning, the term can more usefully be used to represent learning programmes that use a variety of learning approaches (Jones, 2006). A good example of this representation is provided by Rossett, Douglis, and Frazee (2003):

> A blend is an integrated strategy for delivering on promises about learning and performance. Blending involves a planned combination of approaches, such as coaching by a supervisor; participation in an online class; breakfast with colleagues; competency descriptions; reading on the beach; reference to a manual; collegial relationships; and participation in seminars, workshops and online communities (p. 1).

While the term 'blended learning' came into existence in the 1990s, blended learning has been a feature in the New Zealand tertiary education and compulsory schooling sectors for several decades. The Correspondence School has provided primary and

secondary school education to students throughout the country and the Open Polytechnic and Massey University have offered distanced-based education since the 1960s. The core method of delivery for these providers was traditional print-based learning materials. During the 1980s, universities and polytechnics, and some schools, began to explore the use of technology to incorporate into learning materials, such as computer-based learning, television, video and CD-ROMs. By the mid-1990s, internet-based bulletin boards and mixed mode web-based teaching began to be adopted, practices which were encouraged by New Zealand's Ministry of Education's IT-related strategies for the compulsory schooling and tertiary sector (Wright, Dewstow, Topping, & Tappenden, 2006). The Ministry of Education has continued to encourage research and initiatives for using technology to support learning through its partnerships with Ako Aotearoa, (the National Centre of Tertiary Teaching Excellence), the Tertiary Education Commission (TEC) and New Zealand Tertiary Education Organisations (TEOs)(Ministry of Education, 2012).

An example of a borderless blended learning environment is the Cisco Networking Academy, where courses are delivered on-site at participating educational institutions throughout the world, by certified instructors. The Cisco website claims to have the world's largest classroom with over one million students and 10,000 academies in 165 countries (Cisco, n.d.). The Academy, which was established in 1997, has four key features: centralised curriculum development; online delivery of content; on-site implementation of instruction; and standardised assessment of learners. Cisco Systems developed the Academy to prepare students to pass the Cisco Networking Certification examination, a qualification that provides for employment opportunities such as network engineers, network administrators, or information technology specialists (Dennis et al., 2006). The courses are offered in multiple languages and the learning model combines classroom instruction with online curricula, interactive tools, hands-on activities, and online assessments that provide immediate feedback to the learner. Several innovative technologies are used in this model: Cisco Packet Tracer, a simulation tool that allows students to design, build, and troubleshoot virtual networks in a safe environment; Cisco Passport21 to Entrepreneurship which consists of a series of case studies and simulation activities that expose students to critical business and financial skills; Cisco Aspire, an educational game that provides realistic business and networking scenarios in an

engaging virtual environment where students make business and technical decisions to complete projects for clients; online assessments that provide immediate, interactive, personal feedback to students; and social media tools, like Facebook, Twitter, LinkedIn, and the proprietary Academy NetSpace and Club NetAcad sites, that connect students and instructors around the world to one another so they can collaborate and continue learning outside the classroom (Cisco, n.d.).

Garrison and Kanuka (2004) claim that blended learning is a significant departure from traditional face-to-face and distant learning models and that no two approaches or blended model designs are the same. Precel, Eshet-Alkalai, and Alberton (2009) concur that there is ambiguity in the literature and the field regarding the right way to implement blended learning and the optimal proportions between online and face-to-face components in various learning scenarios. As blended learning is now a prevalent delivery method with students valuing the personal qualities of teachers, in combination with a variety of interactive learning opportunities (Griffin, 2006), it may be that the association between classrooms and lecture halls as primary places of learning is ceasing to exist (Slevin, 2008). Lindquist (2006) believes that there is a research opportunity to assess the comparative learning among the three modes of learning by exploring the outcomes of learners in blended learning as well as those who complete their programmes exclusively in the classroom or online. This current study aligns with Lindquist's suggestion by examining the outcomes of learners in online, face-to-face and blended learning in a tertiary environment.

2.7 USE OF MOBILE TECHNOLOGIES IN EDUCATION

As previously discussed, the integration of technology in higher education shows that the term 'technology' can be applied to a wide range of methods and tools. So too, can the term 'mobile technologies' in the context of education. Conventional tools such as textbooks and study guides can be seen as mobile technologies which allow a great amount of flexibility in terms of time, pace and place of study. These can be seen as widely portable and durable technologies and allow students to read them when and where they wish, and also gives them the ability to vary the pace at which they might read. There is also a wide range of non-print media that can be considered as mobile technologies, such as CDs and DVDs (Naidu, 2008). While

these conventional mobile technologies have been researched extensively (Bernard & Naidu, 1990, 1992; Hackbarth, 1996; Heinich et al., 1993; Lockwood, 1998; Naidu, 1994; Naidu & Bernard, 1992; Rigney, 1978), research surrounding the use of more contemporary mobile technologies, such as mobile phones as an educational tool, is still an emerging discipline (Kukulska-Hulme & Traxler, 2005).

Mobile technologies and mobile learning (m-learning) using wireless devices are gaining popularity as they can be used by students to access web servers for real time information from anywhere on or off campus. Mobile learning has an advantage of ease of access over the use of activities such as accessing learning management systems which rely on a computer terminal to interface with the learning material (Mellow, 2005). Mobile devices are anything that is handheld with wireless capabilities in which real time learning with no fixed location or time can occur. This includes devices such as mobile phones, portable digital assistants (PDAs) or Palmtops and iPods (Mellow, 2005). Traxler (2010) extends this definition of mobile devices by including game consoles, digital cameras, media players, netbooks, in-car *sat-nav*, and handheld computers. "Mobile devices are a key feature in many activities carried out by young people: making arrangements, passing on information, passing on gifts in the form of jokes or graphics, sharing and comparing ring tones, texting each other using a still developing new language" (Colley & Stead, 2004, p. 45). These devices are now ubiquitous in society with a large majority of students using mobile phones - at the start of the 2005 university year at Auckland University of Technology, 82% of students reported owning one (Mellow, 2005).

Cochrane (2007) notes that as mobile devices are inherently social and because today's learners are constantly connected to their social networks, educators have the opportunity to harness the educational potential of such an environment. Ally (2009) believes that as more and more people use mobile technologies to complete everyday tasks and transactions, they will also demand access to learning materials using mobile technology. Swan, van't Hooft, Kratcoski, and Unger (2005) conducted research which indicated both teachers and students respond favourably to handheld devices, and that the students are more motivated, collaborate and communicate more, and benefit from having a portable and readily accessible tool.

Kossen (n.d.) makes the following statement which encompasses the benefits and power of m-learning: "A key benefit of m-learning is its potential for increasing productivity by making learning available anywhere and anytime. Because mobile devices have the power to make learning even more widely available and accessible, mobile devices are a natural extension of e-learning". Parsons and Ryu (n.d.) point out that "although in some cases m-learning is seen as simply an extension of e-learning, just another channel for delivering the same content, in fact quality m-learning can only be delivered with an awareness of the special limitations and benefits of mobile devices" (p. 1).

Much of the literature on mobile technologies speaks of these tools being used as additional or supplementary tools in which to enhance the learning process, often with particular reference to processes such as exam preparation and lecture reviews. 'Chunking' of data is particularly suited to mobile devices because of their screen sizes and storage capacity. Learning material is divided into bite size knowledge chunks that can represent essential summarised data that can be used by learners to assist in learning challenging concepts, review material covered in previous classes or as an overview to upcoming lectures. This concept of delivering 'pieces' of information rather than entire blocks of learning material means that m-learning is well suited for enhancing the learning experience rather than being a primary method of delivering courses. Mobile learning provides another layer of support to the student's learning experience (Mellow, 2005). Sharples, Taylor, and Vavoula (2007) agree and point out that "education in the mobile age does not replace formal education, any more than the worldwide web replaces the textbook; rather it offers a way to extend the support of learning outside the classroom, to the conversations and interactions of everyday life" (p. 23).

There have been a number of published pieces of work outlining ways that mobile devices have been used within the education environment, both internationally and in New Zealand. In the United Kingdom, Attewell and Savill-Smith (2005) conducted an m-learning project in which mobile devices were used to provide literacy, numeracy and life skills learning experiences for young adults. The project explored whether the enthusiasm young adults hold for wireless devices such as mobile phones and portable entertainment devices, can be harnessed and redirected

to encourage participation in education and training, in this case literacy and numeracy training. The approach of the m-learning project was to offer small sets of learning experiences on these mobile devices. The study also included a review of the types of activities that have previously been trialled for different mobile devices. Mobile phones were seen to be suited to sending text messages to students reminding them to study for exams. Additionally, they were used for quizzes, picture and sound messaging using multimedia text messaging services (MMS) and word and phrase translations. Research into Personal Digital Assistants (PDAs) or palmtop computers indicated that the distinction between these and mobile phones is becoming less and less obvious. There are a number of hybrid phone-palm devices that include both phone and palmtop functionality. The types of use reported on include science field work for the collection and analysis of data, medical education using them for reflective logs and learning games.

Attewell and Savill-Smith's (2005) project showed that using high-tech tools such as mobile devices is an effective way to attract, motivate and retain non-traditional learners into education and training that they might not otherwise have engaged in. A major finding of this research project, which has implications for institutions wishing to incorporate such delivery techniques, is that a significant amount of training needs to take place for those facilitating the learning to ensure they have both the technical ability and confidence to use the tools and delivery approach in an effective manner.

In another UK study, Colley and Stead (2004) describe a project in which they attempted to meet the challenge of producing a set of innovative games, material and activities for use on mobile devices to enhance maths and English skills. The two platforms trialled were mobile phones and PDAs. Mobile phones were selected as the primary platform as they are the communication tool of choice for most young people and are relatively inexpensive, unlike PDAs where cost is still an issue. The authors did however also note, that the lines between mobile phones and PDAs is becoming blurred as more and more are starting to combine their functionality. An advantage palmtops have over mobile phones is their screen size and ability to store and process larger amounts of data. As in Attewell and Savill-Smith's (2005) project, Colley and Stead (2004) talked of the challenge of designing content that

can stimulate learning using a small platform such as a mobile phone. Small themes of content such as themed quizzes were designed with this in mind and were linked to relevant curriculum topics. The University of Sydney trialled the use of mobile phones with their economic tutors using SMS messaging to conduct classroom-based experiments that help students learn theoretical concepts. While students carry out individual calculations in class, they have to share their work with others in the class to complete further tasks. This information sharing is supported by texting to a central telephone number which allows the information to be pooled and displayed on a screen (Littlejohn & Pegler, 2007). The findings of this initiative were that SMS helped to overcome logistical problems (Cheung, 2004).

Wang, Novak, and Shen (2008) conducted a study in an attempt to discover how Chinese students benefited from mobile learning activities, to what degree they accepted mobile learning as an instructional option, and how designers and instructors could better involve students in mobile learning activities. The study involved 562 students from Shanghai Jiaotong University, who were part of a computer science classroom. Ninety per cent of the class were online students who received instruction at the same time as the on-campus students. The majority of students owned cell phones and palm-top devices, but rarely responded in the physical classroom. In this experiment, the instructor was provided with a specialised station that supported handwriting on the computer screen, SMS messaging, and guided Internet use. Cameras and microphones connected to the computer captured live video of the classroom. A recording program, an integrated part of the mobile phone broadcasting sub-system, recorded the various media components and relayed them in customisable combinations to students. For example, when students connected their mobile phones to the network, they were able to view a live broadcast of the classroom in several different ways. They could view it from the instructor's station which showed the teacher's screen, audio and a small feed of the real-time classroom, or from the perspective of a 'virtual student' where they could view the PowerPoint presentation and audio of the instructor. Additionally, they had the choice of viewing the lesson from the 'front row' which gave them a close-up of the instructor's facial expressions and other body language. During the class, the instructor station displayed messages from both on-campus and online students. These messages were sent via the students' mobile phones as text

messages and enabled students to participate in polls and other in-class activities. The instructor was able to respond by giving oral explanations or through text messages.

Another aspect of the study was to use text messaging for reviewing 'knowledge points'. Knowledge points, which are an endemically Chinese mode of instructional design, are small, clearly defined units of knowledge or skills that students are expected to remember in detail at a later date. In class, the instructor presented the major knowledge points for the session and then showed 10 multiple choice questions on the computer screen. Students were encouraged to answer these questions by sending text messages. Real-world problems related to the knowledge points were also presented and students were encouraged to discuss these through text messages. Wang et al. (2008) believe that successful trials such as this one indicate the potential benefits of mobile learning and hope that they may set an example for pedagogic changes in China's system of higher education.

Another international example of mobile phone use to deliver course content is an initiative conducted by the Cyber University of Japan. The Cyber University, 71% owned by mobile phone carrier, SoftBank Company, offered a course in 2007 entirely via mobile phones. Cyber University, which has government approval to offer bachelor's degrees, became the nation's only university to offer not only all classes via the web, but to also offer a course on the mysteries of pyramids via mobile phones. The content was delivered both over the internet and the mobile phone. Students using personal computers were able to download text with images in the middle, with a smaller video of the lecturer talking in the corner of the screen. In contrast, the content delivered via the mobile phone consisted of streaming video that showed PowerPoint images. The course offered via mobile phone was freely available to the public, although people accessing the material had to pay phone fees and also have access to a SoftBank phone. The university found this method of delivering a course helped to provide educational opportunities for those who found it difficult to attend university due to work commitments, health or disability reasons (Kageyama, 2007).

Duncan-Howell and Lee (2007) provide a comprehensive overview of m-learning initiatives in tertiary settings and note that the majority of initiatives have been university based with few projects conducted in vocational educational settings. The following studies were cited in their review. In the United Kingdom and Europe, m-learning projects were conducted with Master or Science students at the University of Birmingham (Corlett, Sharples, Bull, & Chan, 2005), with students in a teacher training course at the University of Helsinki (Seppala & Alamaki, 2002), and with Alumni of The Open University's Masters in Online and Distance Education (Pettit & Kukulska-Hulme, 2006). Duncan-Howell and Lee (2007) also reviewed projects conducted across South Africa, Australia and Asia. These consisted of mobile innovations to deliver learning to workplaces through four TAFEs in Australia (Ragus et al., 2005), the delivery of English lessons to university students at Kinjo Gakuin University in Japan (Thorton & Houser, 2004), the use of SMS to create channels of communication between lecturer and tutor with first year undergraduate students at Griffith University (Horstmanshof, 2004), the potential use of mobile devices at Deakin Univeristy (Armatas, Holt, & Rice, 2005), the use of SMS with students enrolled in three university programs at the University of Pretoria, South Africa (Brown, 2005), and the use of podcasts by Queensland University of Technology, Curtin University, University of Sydney and Melbourne University. In Canada and the USA, their reviews included a mobile university library website at Athabasca University (Cao, Tin, McGreal, Ally, & Coffey, 2006), m-learning applications linked to existing course websites that were piloted on undergraduate and postgraduate students at the University of Massachusetts (Motiwalla, 2007), the exploration of wireless context-aware computing as a means of creating a learning community at the University of California (Griswold et al., 2004), and the use of podcasts to deliver educational content by Harvard, Yale, John Hopkins University, University of Wisconsin, Penn State University, Brock University and the University of Western Ontario (Duncan-Howell & Lee, 2007).

A project using mobile phones as the mobile tool for learning was trialled in 2005 in New Zealand. This project used a system called StudyTXT led by Dr Peter Mellow from Auckland University of Technology. StudyTXT is a mobile phone on-demand study support system. Students can access 'knowledge bytes' of information about a particular subject they are studying and review them in their own time. This model

poses as a modern incarnation of the traditional flash cards often used for study. The project came about due to resistance from students to use traditional forms of flash cards for study. The lecturer had created paper-based powerpoints, printed them and added them to card for students to review. Feedback from students indicated they would not use this type of medium for study in places such as 'waiting for a bus' and that 'it was not cool to be seen to be obviously studying'. To overcome this resistance, Mellow (2005) designed the StudyTXT system to include key content to fit with a form of technology with which the students were comfortable. Students could then 'snack on their study' when they felt inclined to do so. Initially, StudyTXT was considered a content delivery system only based around rote learning methodologies, however ways to make the system more interactive have been created to involve principles of constructivism. An example of this interactivity was given in the paper outlining law as the topic. An argument for a certain case was presented in a lecture and a following text message would contain scenarios it could be applied to. The students would then have to think about how they could apply the same argument in other cases presented via their mobile phone.

A trial conducted at Christchurch Polytechnic Institute of Technology (CPIT) used eTXT™, a bulk text messaging system provided by New Zealand Telecom, to distribute questions and archive answers to the questions to work based learners. The response to the text messaging was 100% return within two hours of the questions being texted out. This has encouraged the institute to make a commitment to using mobile phones to provide better student support and improved learning opportunities (Chan & Ford, 2007).

Mackay (2006) conducted a SMS research project at Northtec, a rural polytechnic in the Northland region of New Zealand. The study involved students enrolled in a Primary Health Care Nursing module, a clinical module offered to second year Bachelor of Nursing students. Student nurses are placed in a variety of clinical placements and are mentored by nurses within the placement organisations. While on placement, they are also supported by a North Tec nursing lecturer. The objective of the study was to determine whether text messaging was effective in motivating, supporting and enhancing communication with student nurses. ETXT software was used to allow the lecturer to type messages on a computer keyboard

which sent messages directly to the students' mobile phones. Text messaging provided flexibility, as students were able to receive messages and respond depending on the most suitable time and place for them. The researcher found that students felt more supported by text messages sent from the lecturer, they were more motivated to complete assigned tasks in the workbook, and communication was enhanced.

Goh, Seet, and Rawhiti (2011) conducted a study to identify the effectiveness and impact of a persuasive SMS intervention strategy on students' self-regulated learning in first year information systems course at a New Zealand tertiary institution. The study used text terminology and the English language to communicate assignment due dates, reminders about times and rooms for tutorials and lectures, reminders to review a chapter or case study before coming to class, as well as encouraging messages praising students for reaching specific milestones on the course. The SMS were also tailored to individual students and were used to help influence Maori students by using proverbs in Te Reo such as "ka pai/good work". The researchers found that this simple SMS strategy was an effective intervention "for stimulating students' self-regulated learning through better time management and improved extrinsic and intrinsic goals, cognitive and meta-cognitive strategies and values" (p. 15). The effect it had on academic achievement was also encouraging as there was an improvement in final course grades for those students who received SMS intervention.

While higher education is realising the benefits of mobile learning, so too is the New Zealand secondary sector. At Albany Senior High School in Auckland, an acronym has been used to encourage students to use their mobile phones in the classroom situation – BYOD, meaning "bring your own device". Students are able to bring their own mobile phones or laptops to access the school's wireless network and are encouraged to Google the answer to a teacher's question while in class. Additionally, as they work, they use Google chat to ask the teacher and other students' questions. The teachers report that this has advantages for shy students who can share their ideas with the class without having to put their hand up. The chat capability is also extended to after school hours and students are able to send questions to teachers as they are doing homework. The deputy principal of the

school, Mark Osborne believes that if answering a question via a text message after school hours means that students keep learning, then it is worth it, and he views learning as not just taking place between school hours. University of Canterbury Professor of e-Learning, Niki Davis believes that it is only a matter of time before instant messaging is used in most New Zealand classrooms and asserts that the education environment needs to be set up so that innovations actually become helpful to education (Neale, 2011).

The potential application of mobile technologies to learning scenarios is evident from the discussion above. Mobile technology can be accessed by a broad group of users, is not limited by financial constraints and presents an approach to learning that potentially is effective in engaging and motivating students in tertiary education settings (Duncan-Howell & Lee, 2007).

2.8 LEARNING ENVIRONMENTS RESEARCH

Fraser (1986) points out that students spend a vast amount of time over the course of primary, secondary and tertiary education. It has been estimated that 7,000 hours is spent by the end of primary school, and 15,000 hours by the completion of secondary school. When tertiary is added to this, based on a bachelor degree consisting of approximately 5000 hours, a student can expect to have spent 20,000 hours in a classroom or lecture room. This demonstrates the high interest that students have in what happens to them during the course of their education. At tertiary level, students make an expensive investment in their education with New Zealand's combined student debt of $12.19 billion (Crossley, 2012) an illustration of this. With the cost of tuition continuing to rise, students want value for their investment. Garrison and Kanuka (2004) note that not only are students increasingly demanding a quality learning experience, they also want service and convenience. There is growing evidence that sitting in a large lecture hall is not intellectually challenging or worth the commute to campus.

The field of learning environment research has been influenced by the work of several influential researchers. Lewin's (1936) seminal work introduced the concept that personal behaviour is a result of the interactions between the individual and

his/her environment. Murray (1938) followed Lewin's approach by proposing a needs-press model which allows the analogous representation of person and environment in common terms. Personal needs refer to motivational personality characteristics representing tendencies to move in the direction of certain goals, in contrast to environmental press which provides an external situational counterpart which supports or frustrates the expression on internalised personality needs (Fraser, 1998a). Murray's needs press theory was later expanded by Stern, Stein, and Bloom (1956), who concluded that differences also exist between an individual's perceptions, a group's perceptions, and the perceptions of an external observer of a single environment (Wolf & Fraser, 2005).

The relationship between the quality of the learning environment and student outcomes became an area of interest in the late 1960s by Herbert Walberg and Rudolf Moos. Both researchers began seminal independent studies; Walberg with the research and evaluation activities of Harvard Project Physics (Walberg & Anderson, 1968); and Moos with his work on social climate scales (Moos, 1974).

As part of the research activities of the Harvard Project Physics, Walberg developed the widely used Learning Environment Inventory (LEI). The LEI was designed to measure the students' perceptions of the learning environment through 35 scales, each consisting of seven questions. The final version contained 105 statements descriptive of typical school classes and asked respondents to express a degree of agreement or disagreement with each statement using the four response alternatives of Strongly Disagree, Disagree, Agree and Strongly Agree (Fraser, 1998a).

Moos began work on social climate scales and devised a scheme for classifying human environments. The scheme identified three types of dimensions in the human environment: the relationship dimension, which identifies and assesses the extent of people's involvement in the environment and their support for each other; the personal growth dimension, which assesses the basic directions along which self enhancement and personal growth appear; and the system maintenance and system change dimensions which involves orderliness of the environment, clarity of expectations, control and responsiveness to change (Fraser, 1998a). This led Moos to the development of the Classroom Environment Scale (CES) (Moos, 1979; Moos

& Trickett, 1987), which linked his human environment dimensions to a school setting.

The use of instruments such as the LEI (Walberg & Anderson, 1968) and CES (Moos, 1979) to collect environment data, combined with ideas about the differences in perceptions between individuals and groups (Murray, 1938; Stern, Stein, & Bloom, 1956), stimulated the growing field of learning environments (Wolf & Fraser, 2005).

The LEI and the CES became widely used and formed the basis for the development of several other instruments commonly used to assess various learning and teaching environments (Lang & Wong, 2006). Learning environment instruments have scales, each with their own set of items. The construct validity of each scale is determined by gathering qualitative data from respondents (Chandra & Fisher, 2006). Researchers have now developed a variety of valid and widely-applicable questionnaires that can be used to gain an understanding of students' perceptions of their learning environment, as well as practical qualitative instruments (Wubbels, 2006). Examples of instruments developed through learning environments research include: the *Individualised Classroom Environment Questionnaire* (ICEQ) (Fraser, 1990); the *My Class Inventory* (MCI) (Fisher & Fraser, 1981); the *College and University Classroom Environment Inventory* (CUCEI) (Fraser, Treagust, et al., 1986); *Questionnaire on Teacher Interaction* (QTI) (Wubbels & Levy, 1993); the *Science Laboratory Environment Inventory* (SLEI) (Fraser, McRobbie et al., 1993); the *Constructivist Learning Environment Survey* (CLES) (Taylor & Fraser, 1991); and the *What Is Happening In This Class* (WIHIC) (Fraser, Fisher, & McRobbie, 1996). Since the development of these instruments, considerable work has been carried out to develop instruments that are appropriate and useful for the assessment of technology-rich learning environments and in distance education environments for higher education levels.

According to Lang and Wong (2006) the *Computer Classroom Environment Inventory* (CCEI), developed by Maor and Fraser (1993), is one of the most seminal examples of subject-specific instruments. It consists of five scales assessing: investigation, open-endedness, organisation, material environment and satisfaction.

These scales were developed from the Learning Environment Inventory (LEI), Individualised Classroom Environment Questionnaire (ICEQ) and the Science Learning Environment Inventory (SLEI). The CCEI was seen as unique as it assessed the extent to which inquiry was supported by the use of technology and how technology could support the inquiry approach in the teaching of secondary school science. The CCEI was validated with a sample of 120 grade 11 students in Australia. Further work by Maor (2000) developed the *Constructivist Multimedia Learning Environment Survey* (CMLES). This instrument examined science teachers' perceptions of their inquiry-based and constructivist-oriented multimedia learning environment. Maor and Fraser (1993) validated CMLES among 221 grade 10 and 11 Australian students and also reported a high degree of internal consistency reliability.

The *E-learning Classroom Environment Questionnaire* (ELCEQ) is a modified version of the Computer Classroom Environment Inventory (CCEI). Lang and Wong (2006) developed this questionnaire specifically for use in schools, as other instruments designed for assessing online environments were for tertiary rather than for secondary schools. They administered the questionnaire to gain students' perceptions of their e-learning classroom learning environments. Their study also set out to identify differences in perceptions of the lower secondary science classroom environment between the actual and preferred forms of the ELCEQ.

The WIHIC questionnaire was developed by Fraser, McRobbie, and Fisher (1996) in response to earlier instruments and scales becoming outdated. The WIHIC incorporates scales that previous studies had shown to be good predictors of student outcomes. The original 90-item nine-scale version was refined to a final form (Aldridge & Fraser, 2000) that contained the seven eight-item scales: student cohesiveness, teacher support, involvement, investigation, task orientation, cooperation, and equity. The WIHIC is useful as a tool to measure students' perceptions from a class and personal point of view (Koul & Fisher, 2006). Aldridge, Fraser, and Fisher (2003) have confidence that the WIHIC is a robust questionnaire and point to its frequent use in widely reported studies that have used the instrument in different subject areas, at different age levels and in different countries.

Koul and Fisher (2006) used the WIHIC questionnaire as part of a large-scale study consisting of 1,021 year nine and ten science classes in India. This study provided further support for WIHIC as a valid and reliable instrument in science secondary school classrooms. Margianti (2003) modified the WIHIC for use at university level to a sample of 2,498 computing students in Indonesia. This large study was distinctive as it was one of only a few studies carried out in Indonesia in the domain of learning environments, and one of the first to be carried out at university level in Indonesia with such a large sample. The study confirmed the validity and reliability for the confident use of WIHIC at university level.

The *Web-based Computer Assisted Learning questionnaire* (WBCAL) was developed specifically for exploring students' perception of the web-based computer assisted learning environment (She & Fisher, 2003) and included scales adapted from the *Computer Attitude Scale* (CAS) developed by Newhouse (2001). This scale was based on work by Fraser (1981a) in the *Test of Science-Related Attitudes* (TOSRA).

The *Satisfaction of Web-based Learning* (SWBL) questionnaire was developed to investigate students' satisfaction toward learning with the web-based science flash program. She and Fisher's (2006) study found that the validation data confirmed the reliability and validity of both WBCAL and SWBL for use with secondary school students in Taiwan.

It was in response to the changing trends in teaching and learning in tertiary institutions that led Jegede, Fraser, and Fisher (1995) to develop the *Distance and Open Learning Environment Scale* (DOLES) specifically for university students studying via distance education. The DOLES has five core scales: Student Cohesiveness, Teacher Support, Personal Involvement and Flexibility, Task Orientation and Material Environment, and Home Environment, as well as the two optional scales of Study Centre Environment and Information Technology Resources. Internal consistency reliability and factor structure was confirmed by the administration of DOLES to 660 university students (Fraser, 1998a).

Building on the *Constructivist Virtual Learning Environment Survey* (CVLES) which consisted of three scales, the *Constructivist Online Learning Environment Survey* **(**COLLES) was developed by Taylor and Maor (2000) to investigate the quality of online learning environments from a social constructivist perspective. Its primary purpose was to check that technological determinism did not prevent sound educational judgment. The COLLES has six scales: relevance, reflection, interactivity, tutor support, peer support, and interpretation (Chard, 2006).

The Distance Education Learning Environment Survey (DELES) was developed in 2003 by Walker and was designed to examine distance education environments for tertiary education (Walker, 2003). The scales include: instructor support, student interaction and collaboration, personal relevance, authentic learning, active learning, student autonomy and satisfaction.

Clayton (2003) developed the *Online Learning Environment Survey* (OLLES) for the purpose of exploring the online learning environment for post-secondary students in New Zealand. Clayton drew on previous learning environment instruments (Taylor and Maor's COLLES and Walker's DELES); Moos' social climate dimensions; and constructivist views of learning that environments must promote conceptual change. As a result, eight scales were selected: computer competence, material environment, student collaboration, tutor support, active learning, order and organisation, information design and appeal, reflective thinking. These scales are nearly equally distributed across Moo's three social organisation dimensions. While Clayton recommends the OLLES as a useful tool to monitor the effectiveness of online learning environments, he cautions that at this stage, the instrument should not be regarded as consistent, reliable or valid.

The development of the *Technology-Rich Outcomes-Focused Learning Environment Inventory* (TROFLEI) by Aldridge, Fraser, et al. (2003) drew on the What is Happening in this Class (WIHIC) questionnaire. The development and validation of this instrument was considered important as it was seen as a "widely-applicable and distinctive questionnaire for assessing students' perceptions of their actual and preferred classroom learning environments in outcomes-focused, technology-rich classroom learning settings" (Aldridge, Fraser, et al., 2003, p. 175). The TROFLEI

measures 10 dimensions of the actual and preferred classroom environments at high school level: student cohesiveness, teacher support, involvement, investigation, task orientation, cooperation, equity, differentiation, computer usage and young adult ethos (Aldridge, Fraser, et al., 2003). Aldridge, Fraser, et al.'s (2003) work, which involved Grade 11 and 12 students at an innovative new school, found TROFLEI to be a reliable and valid questionnaire for monitoring outcomes-focused and ICT-rich classroom learning environments and student attitudes. Aldridge and Fraser (2003) confirmed that not only was TROFLEI valid and reliable at the senior high school level, but also across a number of different subjects and learning areas.

Students' attitudes were also investigated in Aldridge, Fraser, et al.'s (2003) study with the development of an attitude instrument. This new instrument used three scales to assess the affective outcomes of technology-rich outcomes-focused learning environments. These scales were: Attitude to Subject; Attitude to Computer Usage; and Student Academic Efficacy. Attitude to Subject was based on a scale from the Test of Science-Related Attitudes (TOSRA) (Fraser, 1981a). The scale, Attitude to Computers, was modified from the Computer Attitude Scale (CAS) (Newhouse, 2001) and the third scale of Student Self Efficacy was based on a scale from the *Morgan-Jinks Student Efficacy Scale* (MJSES) developed by Jinks and Morgan (1999). Aldridge and Fraser (2003) reported that "satisfactory factorial validity, internal consistency reliability and discriminant validity were found for the new attitude instrument for both the individual and class mean as the units of analysis" (p. 63).

Another important instrument that was developed for the purpose of evaluating web-based and distance learning environments is the Web-based Learning Environment Instrument (WEBLEI). The WEBLEI was developed by Chang and Fisher (2003) to gather quantitative data on students' perceptions of their web-based learning environment in a tertiary environment. In their study, the WEBLEI was administered to two groups of Electronic Commerce students from the Curtin Business School at Curtin University in Perth, Australia. The design of WEBLEI was derived from research instruments originating from the LEI, and was developed from Tobin's (1998) work on *Connecting Communities of Learning* (CCL). The CCL was initially used to study the perceptions of mathematics and science

education students enrolled in an asynchronous mode. The WEBLEI uses four scales to measure students' perceptions: access, interaction, response and results. Chang and Fisher's (2003) study found the instrument to have factorial validity and the WEBLEI scales to have acceptable reliability and discriminant validity from a statistical perspective.

From the initial design, the WEBLEI was modified by Chandra and Fisher (2006) to use in a blended environment involving high school students. Although the items were amended or changed to suit this different environment, the total number of items and number of items per scale were similar to those in the original version of the WEBLEI (Chandra & Fisher, 2006). Chandra and Fisher (2009) conducted research using WEBLEI to assess the effectiveness of an innovative website as a teaching model in a blended learning environment at an Australian high school. Chard (2006) selected the WEBLEI as a suitable instrument to study online learning environments in her study of tertiary students involved in mixed mode delivery as it is targeted for web-supported and web-based learning environments, and is designed for a tertiary environment. The WEBLEI was also considered to be the most appropriate instrument by Chard as it is designed to measure learning effectiveness that includes access to materials, interaction, students' perceptions of the environment, and students' determinations of what they have learned (Chard, 2006).

Because the WEBLEI has been validated in a tertiary environment with students involved in mixed mode delivery, it was identified as having potential, with modification, for application in the current study. The attitudinal scales used in conjunction with the TROFLEI in Aldridge and Fraser's (2003) study were also considered useful to investigate students' attitudes to mobile learning environments.

2.9 ASSOCIATIONS BETWEEN CLASSROOM ENVIRONMENT AND STUDENT OUTCOMES

"The term learning environment relates to the psychology, sociology and pedagogy of the contexts in which learning takes place and their influence on pupils' achievement in the cognitive and affective domains" (Doppelt & Schunn, 2008, p. 196).

Wanpen and Fisher (2005) point out that as constructivist epistemology assumes that students learn on the basis of their interaction with their environment, the learning environment can have a strong influence on students' attitudes and learning outcomes. Beginning in the 1970s, the investigation of the predictability of students' cognitive and affective learning outcomes from their perception of classroom environment has received a great amount of attention by learning environment researchers (see reviews of Anderson & Walberg, 1974; Fraser, 1981b, c; Fraser & Walberg, 1981; Walberg, 1976). There is empirical evidence that supports the "predictive validity of student perceptions in accounting for appreciable amounts of variance in learning outcomes, often beyond that attributable to student characteristics such as pre-test performance, general ability or both" (Fraser, 1986, p. 72). While reviews of classroom environment research by Fraser (1998a), Dorman (2002), Goh and Khine (2002), and Khine and Fisher (2003) have defined 10 dimensions of classroom environment research, it is the study of links between classroom environment and student cognitive and affective outcomes that has been one of the strongest area of interest (Dorman, Aldridge, & Fraser, 2006).

Telli and den Brok (2006) comment that finding a clear term to define students' affective outcomes has been a difficult task and has been the subject of debate by researchers. Gronlund (2000) defines affective learning outcomes as those outcomes that focus on individual disposition, willingness, preferences, and enjoyments. Shaffir and Turowetz (1983) provide further explanation of affective outcomes as being attitudes, values, motivation, discipline, thinking and communications skills that are learnt through a process called *socialisation.* They describe this process as occurring when teachers, peers, parents, and media provide models, examples, suggestions and context for appropriate social development. As affective outcomes are expected to occur through informal learning and are supported through social interaction, there is uncertainty as to how effectively these are fostered in a virtual or online learning mode (Cleveland-Innes & Ally, 2007).

Guven (2005) believes that given the increased use of instructional technology and technology rich environments, it is important to gain an understanding of how the use of these technologies are influencing students' attitudes towards learning. Studies by Waxman, Lin, and Michko (2003, cited in Cleveland-Innes & Ally, 2007)

suggested that teaching and learning with technology has a small, positive, non-significant effect on students' affective outcomes when compared to traditional instruction. Similar results were found in Cleveland-Innes and Ally's (2007) study which attempted to assess the affective learning outcomes in online learning environments. Their research tested two delivery platforms, WebCT and Elluminate*Live* for the generation of affective learning outcomes in the workplace. The participants consisted of 101 call centre/help desk staff across 10 different organisations in Western Canada who were taking an online course on customer service. The research tested whether differences in structure and dialogue, as represented in synchronous versus asynchronous delivery methods, would impact online learning outcomes in the affective domain. Their results were inconclusive in relation to the comparison of delivery outcomes, however they found that there may have been differences in the sense of community felt across groups, with a stronger feeling of connection felt by the Elluminate*Live* group through the challenges they experienced together. These findings are consistent with a growing body of research that provides evidence that students' achievements and psychological well-being are improved by organising learners into small communities (Oxley, 2001). Khine (2003) agrees that community imparts a common sense of purpose and defines learning communities as "being characterised by associated groups of learners, sharing common values and a common understanding of purpose, acting within a context of curricular and co-curricular structures and functions that link traditional disciplines and co-curricular structures" (p. 23). Sharples, Taylor, and Vavoula (2007) support this view and believe that the use of instant messaging enables students to create learning communities that are both contextual, in so far as messages relating to locations and immediate needs, yet unbounded since the messages can be exchanged anywhere in the world.

She and Fisher (2003) undertook a study that examined the learning environment created during the use of an online flash science program involving 459 grade 7 to 9 students from 11 middle schools in Taiwan. The study also investigated its impact on students' cognitive and affective learning outcomes among different learning styles and grade levels. Students' cognitive outcomes were found to be higher when students perceived more student cohesiveness, investigation, equity, self-efficacy, and more teacher use of challenging questions.

Wubbels (1993) utilised the Questionnaire on Teacher Interaction (QTI) to investigate interpersonal relationships between science and mathematics teachers and their students in Australia and the Netherlands. The Australian study gathered data about Grade 11 secondary school students' perceptions of the interpersonal behaviour of their science and mathematics teachers and perceptions of teachers that students consider to be their best teacher. The Netherlands study investigated relations between interpersonal teacher behaviour and student achievement and attitudes in Grade 9 physics classes. The results from both of these studies suggested that interpersonal teacher behaviour is an important aspect of the learning environment and that it is strongly related to student outcomes.

A study by Goh and Fraser (1995), which surveyed 39 primary school mathematics classes in Singapore using the QTI and a modified version of *My Class Inventory* (MCI), found that higher cognitive outcomes were associated with better classroom teacher leadership, friendly and helpful classroom environments and teachers that displayed understanding and empathy towards students. They also found that the affective outcome measure was related positively with increased levels of student cohesion and reduced levels of tension in the classroom. Kyriakides (2006) conducted a study of 32 primary schools in Cyprus and found that student responses to the Greek version of the QTI as well as a student questionnaire based on the major findings of teacher effectiveness research helped to explain variance on student achievement in both cognitive and affective outcomes for mathematics and Greek language subjects.

Student achievement and attitudes have also been shown to be improved when there is a similarity between the actual classroom environment and students' preferred classroom environment (Fraser & Fisher, 1983; Wubbels, 1993). Allen and Fraser (2007) went further by undertaking pioneering research to understand how parents and students perceived the learning environment. The WIHIC questionnaire was administered to 520 Grade 4 and 5 students in South Florida and 120 parents. Their study identified associations between students' outcomes (attitudes towards science and achievement in science) and the classroom learning environment as perceived by both parents and students.

From the extensive research conducted over the past 40 years, it is clear that there is a connection between the quality of the learning environment and student learning (Fraser, 1994, 1998a). As the use of mobile technologies in higher education is becoming more prevalent, efforts to assess the associations between students' perceptions of mobile enhanced learning environments and their attitudinal and cognitive outcomes will be of great value to educators and researchers alike.

2.10 SUMMARY

From the discussion above, it is clear that while the use of technology in higher education is not a new concept, the application of the latest information and communication technologies have the potential to make a positive impact on the learning experience. Issues such as pedagogical appropriateness need to be considered thus making it the responsibility of educators to determine which tools offer the best solution for a particular learning environment. The literature reveals that there is a research opportunity to assess the comparative learning among the different modes of delivery by exploring the outcomes of learners in blended learning as well as those who complete their programmes exclusively in the classroom or online. Recent studies surrounding mobile learning suggest that mobile technologies can offer an approach to learning that is effective in engaging and motivating students in tertiary education settings. Further research undertaken to assess this innovative learning environment will make a valuable contribution not only to the emerging research arena of mobile learning, but also to the rich body of existing learning environments research.

3 CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

A review of the literature in the previous chapter has provided insight into how the field of learning environment research encompasses many facets, which include the use of technology, delivery methods, attitudes, perceptions and outcomes of learners, and the instruments used to evaluate these. The discussion considered learning environment questionnaires previously developed by researchers and found that there is a variety of valid and widely-applicable instruments. One of these instruments is the WEBLEI, developed by Chang and Fisher (2003) for gathering quantitative data on students' perceptions of their web-based learning environment in a tertiary learning environment. Because the WEBLEI has been validated in a tertiary environment with students involved in mixed mode delivery (Chard, 2006), it was selected, with modification, to use in this research to assess the effectiveness of mobile technology as an educational tool and the ways it can enhance the learning environment. An examination of the mobile learning literature points to this area of research as being an emerging discipline in its own right. The need to evaluate and assess the mobile learning environment and the tools used is considered critical in order for the sustained deployment and appropriateness of mobile technology in higher education.

This chapter provides a discussion of the research questions and the research design. It describes the development of the modified learning instrument used in this research and explains how and why attitudinal scales were included in the instrument. The methods used for the sample selection, survey distribution, data collection and data analysis are discussed, followed by a consideration of any ethical implications.

3.2 RESEARCH AIM

The aim of the research was to explore associations between students' perceptions of mobile technology enhanced learning environments and students' outcomes in a tertiary learning environment that uses different delivery modes.

3.3 RESEARCH QUESTIONS

As detailed in Chapter One, the aim led to a series of questions which are listed below.

1. Is the modified learning environment questionnaire a valid and reliable instrument for use in New Zealand?

2. What sort of learning environment is created by the utilisation of mobile technology tools?

3. What associations exist between students' perceptions of their learning environment and their attitudinal and cognitive outcomes?

4. Are there differences between how each of the three delivery method groups perceived the mobile enhanced learning environment?

5. Can the learning environment be enhanced through the use of mobile technologies and therefore enrich the student learning experience in a tertiary environment?

3.4 RESEARCH DESIGN

This research used both quantitative and qualitative methods to gather data. This can be described as using mixed methods, with each approach adding something to the understanding of the phenomenon (Ary, Jacobs, & Sorenson, 2010). One of the purposes for conducting mixed methods research is to collect, analyse, and merge results by way of triangulation. Triangulation allows for an examination of the findings to determine whether they converge, are inconsistent, or contradict (Ary et al., 2010). Triangulation has been used in this study through the distribution of a

survey instrument to gather quantitative data and by using focus groups and open-ended questions to gather qualitative data.

A modified form of the WEBLEI, which included attitudinal scales adapted from the TROFLEI, was used to explore associations between students' perceptions of mobile enhanced learning environments and students' outcomes in a tertiary environment in New Zealand. The modified learning environment questionnaire was named the *Mobile Learning Environment Instrument* (MOBLEI) and was designed to determine whether the learning environment questionnaire developed was a valid and reliable instrument for use in New Zealand. Once the MOBLEI had been confirmed as a valid and reliable instrument for use in a tertiary institution in New Zealand, it was used to assess what sort of learning environment is created by the use of mobile technology.

Three groups of students were categorised according to their mode of learning: online (web-based learning), face-to-face (on-campus) and blended delivery (resource based off-campus learning). Actual and Preferred Forms of the MOBLEI were analysed for students' perceptions of the mobile enhanced learning environment along with attitudinal and self-efficacy perceptions. Students' academic results were also analysed to assess cognitive outcomes. A one way ANOVA with the method of delivery as the main effect was conducted to explore any differences that existed between the different groups' perceptions of the mobile technologies to enhance their learning environment.

The qualitative data obtained from open-ended questions included with the MOBLEI and follow-up focus group questions were used to further determine whether the learning environment can be enhanced through the use of mobile technologies and therefore enrich the student learning experience in a tertiary environment. These data provided additional richness to the quantitative data by allowing participants to answer freely as opposed to being restricted to the questions presented in the MOBLEI scales.

3.5 DEVELOPMENT AND DESCRIPTION OF THE MOBLEI

The development of the MOBLEI was based on the modified versions of the WEBLEI (Chandra & Fisher, 2006; Chard, 2006). The WEBLEI was identified as a suitable instrument, with modification, for application in this research as it had previously been validated in a tertiary environment with students involved in mixed mode delivery (Chard, 2006). Attitudinal scales from the Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI) (Aldridge, Fraser, et al., 2003) were also modified and included in the development of the mobile learning instrument. This newly developed instrument was named the Mobile Learning Environment Instrument (MOBLEI) and was designed to assess learning environments with three distinct delivery modes: online; face-to face; and blended delivery.

In the development phase, scale items and attitudinal scales were assessed for relevance to the mobile learning environment and were modified where necessary. This was achieved through a small pilot study with students who were enrolled in a range of programmes using different delivery methods. As a result of the pilot some changes were made to words that may not have been clearly understood by all participants. Tables 3.1 and 3.2 provide details of the changes made from the WEBLEI scale items and the TROFLEI attitudinal scales.

The modifications made to the WEBLEI scales were considered necessary to provide a more meaningful context to the mobile learning environment, however care was taken to retain the same format and essence of the questioning used in the WEBLEI. The predominant changes were those made to the use of vocabulary and these are explained more fully below.

The WEBLEI Access scale (see Table 3.1) is used to elicit responses in regard to the "convenience of accessing learning activities, the efficiency in terms of accessing the learning materials at a location suitable to the student and the autonomy of accessing the learning materials at a time convenient to the student" (Chang & Fisher, 2003, p. 11). Each of the eight Access scale items was modified for use in the MOBLEI. The phrase "learning activities" in item one was changed to "information" as students are more likely to access information rather than take part in learning activities via their

mobile phones. Item two was phrased to be more appropriate for online learning, therefore "online learning" was changed to "course" to provide a wider platform of delivery methods. The next item referred to saving time with travelling and on campus attendance, so this was modified to refer to easier access to the lecturer. Item four replaced being "allowed to work at my own pace" to "have regular contact with my lecturer" to better reflect the use of a mobile phone for learning. Deciding how much to learn in a given period is changed to the lecturer reminding when assessments are due under item five. In item six the word "when" was changed to "how" to once again reflect the mobile nature of the learning in contrast to online learning. Item seven refers to flexibility (of online learning) to meet learning goals so this was changed to ask whether receiving information using the mobile device helped to meet learning goals. Flexibility to explore areas of interest was adapted in item eight to ask whether a mobile device allows extra information to be obtained on areas of interest.

Table 3.1 Modified MOBLEI Access Scale

Access – WEBLEI	**Access - MOBLEI**
1. I can access the learning activities at times convenient to me.	1. I can access information at times convenient to me.
2. The online material is available at locations suitable for me.	2. The course material is available at locations suitable for me.
3. I can use time saved in travelling and on campus class attendance for study and other commitments.	3. Access to my lecturer is easy using my mobile device.
4. I am allowed to work at my own pace to achieve learning objectives.	4. I have regular contact with my lecturer using my mobile device.
5. I decide how much I want to learn in a given period.	5. My lecturer reminds me when assessments are due using my mobile device.
6. I decide when I want to learn.	6. I decide how I want to learn.
7. The flexibility allows me to meet my learning goals.	7. Receiving information using my mobile device helps me meet my learning goals.
8. The flexibility allows me to explore my own areas of interest.	8. The mobile device allows me to get extra information on my areas of interest.

The WEBLEI Interaction scale (see Table 3.2) assesses to what extent students actively participate and interact with one another in order to achieve the learning outcomes (Chang & Fisher, 2003). This scale also consists of eight items, all of which received modification for use in the MOBLEI. Scale item nine changed from

"communication with other students" to "communicate with my lecturer" with item ten receiving a minor change, with the replacement of the word "this learning environment" to "my learning environment". This is because mobile learning in this research is seen as complementary to other delivery methods. In scale items 11 and 12, the meaning of the word "autonomy" was not understood by any of the participants in the pilot test, so this word was changed to "am able to ask". Scale item 13 was changed to ask about lecturer response to queries rather than other students' responses to queries. The interaction with other students was addressed under scale item 14 which was modified from participating in self-evaluations, to communicating with other students, using their mobile device. Scale item 15 was changed from asking about peer evaluations to instead ask about the value of information received from the lecturer. This was due to peer evaluations being an unlikely activity to be carried out through a mobile device. The final scale item was modified slightly to ask about the support provided via positive feedback from the lecturer, rather than the support of a positive attitude from peers.

Table 3.2 Modified MOBLEI Interaction Scale

Interaction – WEBLEI	**Interaction - MOBLEI**
9. I communicate with other students in this subject electronically (email, bulletin boards, chat line).	9. I communicate with my lecturer using my mobile device.
10. In this learning environment, I have to be self-disciplined in order to learn.	10. In my learning environment, I have to be self-disciplined in order to learn.
11. I have the autonomy to ask my tutor what I do not understand.	11. I am able to ask my tutor what I do not understand.
12. I have the autonomy to ask other students what I do not understand.	12. I am able to ask other students what I do not understand.
13. Other students respond promptly to my queries.	13. My lecturer responds promptly to my queries.
14. I regularly participate in self-evaluations.	14. I communicate with other students using my mobile device.
15. I regularly participate in peer-evaluations.	15. I receive valuable information from my lecturer using my mobile device.
16. I was supported by positive attitude from my peers.	16. I have been supported by positive feedback from my lecturer via my mobile device.

The WEBLEI Response scale (see Table 3.3) is used to ask students what their perceptions are of using the online environment and whether they accomplished the learning objectives (Chang & Fisher, 2003). From the Response scale, only five of

the eight scale items were modified for use in the MOBLEI. Scale item 17 was changed to be more specific to a mobile device and replaced the words "tutor" with "lecturer" and "asynchronously" with "whenever I want to". Scale items 18, 19 and 20 remain unchanged as the wording was still appropriate and relevant for the mobile learning environment. Scale item 21 was modified to ask if students found it easy to get together with other students, rather than the specific question about organising a group for a project. Slight modifications were made in scale items 22, as this also referred to project work, and scale item 23 which replaced "web-based environment" with "mobile-enhanced learning environment". The last scale item in the Response Scale was changed to replace a negative question with a positive one, changing the word "boredom" to "satisfaction".

Table 3.3 Modified MOBLEI Response Scale

Response – WEBLEI	**Response - MOBLEI**
17. This mode of learning enables me to interact with other students and the tutor asynchronously.	17. My mobile device enables me to interact with other students and the lecturer whenever I want to.
18. I felt a sense of satisfaction and achievement about this learning environment.	18. I felt a sense of satisfaction and achievement about this learning environment.
19. I enjoy learning in this environment.	19. I enjoy learning in this environment.
20. I could learn more in this environment.	20. I could learn more in this environment.
21. It is easy to organise a group for a project.	21. It is easy to organise a get to together with other students using my mobile device.
22. It is easy to work collaboratively with other students involved in a group project.	22. It is easy to work collaboratively with other students using my mobile device.
23. The web-based learning environment held my interest throughout my course of study.	23. The mobile-enhanced learning environment held my interest throughout my course of study.
24. I felt a sense of boredom towards the end of my course of study.	24. I felt a sense of satisfaction towards the end of my course of study.

The WEBLEI Results scale (see Table 3.4) enables students to determine what they have gained from learning in the online environment. All eight scale items received modification for use in the MOBLEI. WEBLEI scale items 25 and 26 both refer to "lesson" so this was changed to "course" and "content" respectively, to be more relevant to the mobile learning environment. Scale items 27, 28 and 29 were changed to reflect the contact, content and information provided by a mobile device, rather than specific structure and activities that would be provided in an online

learning environment. Scale items 30 and 31 were rephrased to give more meaning for students using a mobile device. The remaining scale item was changed from "quiz in the web-based materials" to "tips … via my mobile device" as it was more likely that lecturers would send out tips or links to web sites rather than expecting students to answer a quiz.

Table 3.4 Modified MOBLEI Results Scale

Results – WEBLEI	**Results - MOBLEI**
25. The scope or learning objectives are clearly stated in each lesson.	25. The learning objectives of my course are made clearer by learning in this environment.
26. The organisation of each lesson is easy to follow.	26. The information provided via my mobile device makes the content easier to follow.
27. The structure keeps me focused on what is to be learned.	27. The contact with the lecturer via my mobile device keeps me focused on what is to be learned.
28. Expectations of assignments are clearly stated in my unit.	28. The content provided via my mobile device helps me with my assignment and test preparation.
29. Activities are planned carefully.	29. Information is delivered via my mobile device in a structured way.
30. The subject content is appropriate for delivery on the Web.	30. The content provided by my lecturer is appropriate for delivery via my mobile device.
31. The presentation of the subject content is clear.	31. The content provided by my lecturer via my mobile device is clear.
32. The quiz in the web-based materials enhances my learning process.	32. The tips provided by the lecturer via my mobile device enhance my learning process.

3.5.1 Attitudinal Scales

Attitudinal scales were administered in the MOBLEI as they were considered useful to answer the part of research question three which asks what associations exist between students' perceptions of their learning environment and their attitudinal outcomes. The attitudinal scales used in the Technology-Rich Outcomes-Focused Learning Environment Inventory (TROFLEI) (Aldridge, Fraser, et al., 2003) were modified for use in the MOBLEI as shown in Table 3.5. The TROFLEI has been described as a "widely-applicable and distinctive questionnaire for assessing students' perceptions of their actual and preferred classroom learning environments in outcomes-focused, technology-rich classroom learning settings" (Aldridge, Fraser, et al., 2003, p.175).

Aldridge, Fraser, et al.'s (2003) work, which involved Grade 11 and 12 students at an innovative new school, found the TROFLEI to be a reliable and valid questionnaire for monitoring outcomes-focused and ICT-rich classroom learning environments and student attitudes. Their research confirmed that not only was the TROFLEI valid and reliable at the senior high school level, but also across a number of different subjects and learning areas.

The scales included in the TROFLEI and modified for use in the MOBLEI are: Attitude to Subject; Attitude to Computers; and Student Self Efficacy. These three scales were seen as useful by Aldridge and Fraser (2003) to investigate students' attitudes. Attitude to Subject is based on a scale from the Test of Science-Related Attitudes (TOSRA) (Fraser, 1981a). The scale, Attitude to Computers, is modified from the Computer Attitude Scale (CAS) (Newhouse, 2001) and the third scale of Student Self Efficacy is based on a scale from the *Morgan-Jinks Student Efficacy Scale* (MJSES) developed by Jinks and Morgan (1999).

Table 3.5 Modified TROFLEI Attitudinal Scales and Items

Attitudinal Scales – TROFLEI	**Attitudinal Scales – MOBLEI**
Attitude to Subject	**Attitude to Course**
1. I look forward to lessons in this subject	1. I look forward to learning in this course
2. Lessons in this subject are fun	2. This course is fun
3. I dislike lessons in this subject	3. I dislike the content of this course
4. Lessons in this subject bore me	4. This course bores me
5. This subject is one of the most interesting school subjects	5. This course contains some of the most interesting work
6. I enjoy lessons in this subject	6. I enjoy this course
7. Lessons in this subject are a waste of time	7. Topics in this course are a waste of time
8. These lessons make me interested in this subject	8. The topics covered make me interested in this course
Attitude to Computers	**Attitude to Technology**
9. I'm good with computers	9. I'm good with technology
10. I like working with computers	10. I like working with technology
11. Working with computers makes me nervous	11. Working with technology makes me nervous
12. I am comfortable trying new software on the computer	12. I am comfortable trying new technologies
13. Working with computers is stimulating	13. Working with technology is stimulating
14. I get a sinking feeling when I think of using a computer	14. I get a sinking feeling when I think of using technology
15. I do as little work as possible using a computer	15. I do as little work as possible using technology
16. I feel comfortable using a computer	16. I feel comfortable using technology
Student Self Efficacy	**Student Self Efficacy**
17. I find it easy to get good grades in this subject	17. I find it easy to get good marks in this course
18. I am good at this subject	18. I am good at this course
19. My friends ask me for help in this subject	19. My friends ask me for help on in this course
20. I find this subject easy	20. I find this course easy
21. I outdo most of my classmates in this subject	21. I outdo most of my classmates in this course
22. I have to work hard to pass this subject	22. I have to work hard to pass subjects in this course
23. I am an intelligent student	23. I am an intelligent student
24. I help my friends with their homework in this subject	24. I help friends with subjects on this course

All three scales were modified for use in a mobile learning environment. The name of the first scale was changed from "Attitude to Subject" to "Attitude to Course". This was to maintain consistency with the terminology used in the modified WEBLEI scale items. Items one to eight received minor modifications, mainly to the terminology used. For example, "subject" changed to "course"; and "lessons" changed to "course", "content" or "topics" where appropriate. The name of the "Attitude to Computers" scale was changed to "Attitude to Technology" to fit more appropriately with students' attitudes to mobile devices. For items nine to 16, the word "computer" was changed to "technology" for the same reason as stated above. The name of the third scale, "Student Self Efficacy" remained the same, with the only modifications made to the items being to change the word "subject" to "course". Reliability and validity of the MOBLEI and the modified attitudinal scales were determined prior to distribution and the results are reported in Chapter Four.

3.6 PARTICIPANT SAMPLE

The study was conducted at the Universal College of Learning (UCOL) in Palmerston North, New Zealand. This is a tertiary Institute of Technology constituting of three regional campuses with a student population of approximately 6,000 which is made up of both on and off campus students. UCOL consists of three teaching faculties with the School of Business and Computing sitting within the Faculty of Humanities and Business. The School of Business and Computing offers programmes of study that are offered in different delivery modes: online, face-to-face, and blended delivery.

Programmes of study in the business and computing disciplines were selected for the study as they utilised the three different delivery modes described above. The programmes ranged from Level 2 to Level 7 on the New Zealand Qualifications Framework, leading to certificate, diploma and degree qualifications. A purposive approach to sampling was chosen so that all students enrolled in the programmes being surveyed were invited to be included in the study and no differentiation was made on the basis of ethnicity, age or gender. These students were categorised into one of three groups according to their mode of learning: online, face-to-face and blended delivery. There was a requirement for all participants to own or have access to a mobile phone if they wished to take part in the research. This was because they

needed to have the capability to receive text messages. Any students not owning, or not wishing to own a mobile phone were not able to participate.

Focus groups were conducted during Semester Two, 2010 and Semester One, 2011. A separate sheet was included in the MOBLEI, giving students the opportunity to be involved in a follow-up focus group. Participants were invited to complete the form indicating if they would like to take part. If they responded "yes", they were asked to provide their name and contact details. These response sheets were kept separately from the MOBLEI to maintain the participants' anonymity. As some students are geographically dispersed throughout New Zealand, a decision was made not to include those participants who lived outside the institution's region for the purpose of the focus groups. This was due to travel constraints by both the researchers and students. Once the participant's location was confirmed, a random selection was made by selecting every fifth name to be invited to take part in a focus group session. The planning and administration of the two focus group sessions is described in detail under the section 3.7.2 Data Collection for MOBLEI Qualitative Data.

3.7 DATA COLLECTION

Data collected for this research were both quantitative and qualitative in nature. Paper based surveys were kept in a locked filing cabinet in the UCOL staff studio. Other data collected through focus groups and academic records were stored electronically while analyses were carried out. All data, both paper-based and electronic, will be transferred to the researcher's supervisor's office at SMEC at Curtin University at the completion of this study. These data will be kept for five years after which time they will be destroyed.

3.7.1 Quantitative Data Collection

The quantitative data were gathered using a survey approach, utilising the MOBLEI in which scale items were classified and coded. Prior to the MOBLEI being administered an information sheet and consent form (Appendix B) was provided to each participant. Participants had the right to withdraw their consent at any time and their anonymity was assured. Procedures were put in place to ensure anonymity by providing coded class lists and questionnaires to lecturers to distribute.

The MOBLEI was distributed to the participants from Semester One 2009 through to Semester One 2011. The method of distribution was dependent on the student's mode of delivery. Where students' learning mode was face-to-face, the MOBLEI was distributed in a scheduled tutorial time by the lecturer. The students engaged in online or blended delivery were sent the Information Sheet and Consent Form, and a printed copy of the questionnaire by post. A pre-paid return envelope was provided for the return of the Consent Form and completed questionnaire. Where blended students attended the UCOL campus for practical observation assessments, the questionnaire was administered and completed after their assessment activity. This increased the likelihood of obtaining responses to the questionnaire from the blended students.

In order to assess cognitive outcomes, the academic results of each participant were recorded and each questionnaire was coded against a class list of student identification numbers. Two types of assessment methodologies - achievement-based and competency-based - were used in the programmes that participants were selected from. If a participant's results were awarded as an achievement-based grade, for example, a range from an A+ grade to an E grade, this was recorded in an Excel spread sheet. However, for those participants whose assessments were competency-based and were awarded a Pass (P) or Not Achieved (NA), the result in the spread sheet was recorded as "Competency". To allow comparison of final results, only those students whose achievement was recorded as a grade were included in the analysis for cognitive outcomes.

3.7.2 Qualitative Data Collection

The qualitative data were obtained through the open-ended questions within the MOBLEI (Appendix A) and follow-up focus group questions (Appendix C). The open-ended questions used in the MOBLEI, as shown in Table 3.3, were adapted from those that were distributed with the WEBLEI.

Table 3.6. Open-ended Questions

1.	What other mobile devices, apart from your mobile phone, would you like to use while studying?
2.	What are the advantages of studying in a mobile enhanced environment?
3.	What are the disadvantages of studying in a mobile enhanced environment?
4.	Are they any suggestions to improve the delivery of the course in a mobile-enhanced mode?

Open-ended questions are particularly useful when there are a range of possible answers and where the researcher may not be able to predict all the possible answers. The use of open ended questions therefore enables participants to give a free response rather than restricting them to a choice from among stated alternatives (Ary et al., 2010).

Qualitative data were also elicited through follow-up focus groups. Focus groups are particularly useful to identify any qualitative similarities and differences among participants in a research environment where a rich body of data can be gathered. This is due to participants being able to respond using their own words, expressions, thoughts and feelings (Stewart & Shamdasani, 1990). Participants for the focus groups were invited to take part by indicating their interest on a separate sheet when completing the MOBLEI. From the students who expressed an interest in taking part in the focus groups, a check was conducted to ensure they were regional students and capable of attending the session on campus. Participants were then chosen by selecting every fifth name. The focus group questions, which were used as prompting questions to elicit responses, are provided in Table 3.7 below and also included in Appendix C.

Table 3.7. Focus Group Questions

1.	Can you describe what mobile technology was used during your programme of study?
2.	In what way was it used?
3.	Do you think the use of mobile technologies enhanced your learning experience? In what way?
4.	Was the amount of contact using the mobile device appropriate?
5.	Was the content delivered using the mobile device appropriate?
6.	Are there any other ways you think they could have been used?
7.	Do you think the contact you received via the mobile device increased your motivation?
8.	Are there any other mobile tools you would like to use eg. ipods, PDA's? In what way do you think they could be used?

Two focus group sessions were carried out, one in 2010 and one in 2011 and consisted of a total of 12 students. The sessions were held in a tutorial room at UCOL and participants were provided with refreshments to encourage a relaxed atmosphere. At each of the two focus group sessions, discussion comments from students were recorded via tape recorder and a scribe. At the commencement of each session, an explanation of the study was given to the participants, including background information surrounding mobile technologies and learning environments. Participants were provided with a separate sheet of paper which asked for their demographic details such as age and gender as well as the learning mode they were currently engaged in.

3.8 ANALYSIS

3.8.1 Analysis of Quantitative Data - MOBLEI

The scale items on the MOBLEI and interpretations of those scales were assessed for reliability and validity. This was achieved by conducting a pilot on students who were enrolled in a range of programmes that used different delivery methods. The Cronbach alpha test was then used to measure internal consistency reliability, with the aim of achieving at least 0.60. This was due to a reliability coefficient of 0.60 or greater being deemed as acceptable (Nunnally, 1978).

Actual and Preferred Forms of the MOBLEI were analysed for perceptions on the usefulness of mobile technologies along with attitudinal and self-efficacy perceptions. Data from the MOBLEI questionnaire were coded and entered as 1 (Never), 2 (Seldom), 3 (Sometimes), 4 (Often), and 5 (Always). The quantitative data obtained from the questionnaires, along with students' academic results, were recorded in an Excel spreadsheet and analysed using SPSS. This analysis helped to determine what associations existed between the MOBLEI scales and students' outcomes. A one way ANOVA was used to differentiate between students' perceptions in each of the different method of delivery groups.

3.8.2 Analysis of Qualitative Data – Open Ended Questions

The responses to the open-ended questions were collected via the MOBLEI. Responses were recorded and stored in a MS Word document. To find common perceptions, issues or concerns, the responses to each question were examined and

compared with quantitative data for consistencies or divergence. A summary of responses from the open-ended questions is provided in Chapter Four of this study.

3.8.3 Analysis of Qualitative Data – Focus Groups

The tape recorded discussions were transcribed and responses were recorded in a MS Word document. As with the open-ended questions, students' perceptions, issues or concerns examined and compared with the quantitative data for any similarities or differences. The results from the focus groups are provided in Chapter Four of this study.

3.9 ETHICAL CONSIDERATIONS

3.9.1 Research Approval

In accordance with the ethical standards required by the Curtin University Human Ethics Committee, the researcher followed the full process in 2008 of obtaining approval for a research procedure involving human subjects (Appendix D). The UCOL Research Committee gave approval for the research to proceed in 2009 (Appendix D).

3.9.2 Informed Consent

The researcher's role was to develop and administer the learning environment instruments, conduct focus groups with students and analyse and report on results. Lecturers were asked to be active participants by texting identified student groups and were provided with written information about the research being undertaken. Students provided feedback via questionnaires, and all students were invited to participate in focus groups. Written information about the research was provided to students prior to the questionnaires being distributed and informed consent of the students was sought at the same time. Students had the right to withdraw their consent to participate at any time.

3.9.3 Anonymity and Confidentiality

The identity of the participants was protected by assigning a code to each participant's set of responses. A separate sheet of paper was given to students to provide their name and contact details if they wished to be involved in the focus

groups. All written, electronic and digital data were kept in a secure location and only available to the researcher and the academic supervisor.

3.10 SUMMARY

This chapter has provided a description of the methodology and methods used to conduct this study to evaluate the effect that mobile technologies have on a tertiary learning environment that uses different delivery methods. The research questions that have guided this study have been presented. The research design utilised both quantitative and qualitative methods of data collection. Triangulation of data enabled assessment of convergences, inconsistencies or contradictions.

A description of the newly developed modified learning environment instrument (MOBLEI) has been given and justification provided for the inclusion of attitudinal scales. An explanation of the sample, sample selection, survey distribution, data collection, and analysis has been detailed. This chapter concluded with the guidelines followed to adhere to ethical principles. The next chapter presents the results of the quantitative and qualitative research findings.

4 CHAPTER FOUR

RESULTS

4.1 INTRODUCTION

Chapter Three described the methodology used for the study and presented the research questions. This chapter provides the results of the quantitative and qualitative analyses conducted to answer the research questions. It provides evidence for the reliability and validity of the MOBLEI and describes the means and scale results of the instrument. The results of the students' perceptions of the use of mobile technologies as well as their attitudinal and self-efficacy perceptions are provided via analysis of the Actual and Preferred Forms of the MOBLEI and attitudinal scales. The three methods of delivery under investigation include online, face-to-face, and blended, and are referred to as the 'method of delivery' groups in this study. The results of the students' attitudinal and cognitive outcomes are presented. Qualitative data obtained through the open-ended questions and focus groups were obtained to gain further insight into how the use of mobile technologies may enhance the student learning experience in a tertiary environment.

4.2 RELIABILITY AND VALIDITY OF MOBLEI

The Mobile Enhanced Learning Environment Instrument (MOBLEI) was developed by modifying the Web-based Learning Environment Instrument (WEBLEI) originally developed by Chang and Fisher (2003) to gather quantitative data on students' perceptions of their web-based learning environment in a tertiary environment. The WEBLEI uses four scales to measure students' perceptions: Access, Interaction, Response and Results. The Access scale measures how easily students can gain access to learning materials at times and locations suitable to them. The Interaction scale measures the extent to which students participate with each other in order to achieve learning outcomes. The Response scale measures how the students feel about their learning environment and the Results scale measures what students have gained from participating in the particular learning environment. Chang and Fisher's (2003) study found the instrument to have factorial validity and

the WEBLEI scales to have acceptable reliability and discriminant validity from a statistical perspective.

Table 4.1 displays the results of the internal consistency reliability analysis of the MOBLEI using the Cronbach alpha reliability coefficient, and discriminant validity, using the mean correlation of a scale with all the other scales as an index. According to Nunnally (1978), a reliability coefficient of 0.60 or greater is acceptable. In this study, the alpha reliability coefficients ranged from 0.72 to 0.90 for the Actual Form and from 0.75 to 0.90 for the Preferred Form, suggesting that all scales of both versions of the MOBLEI have satisfactory internal consistency.

Table 4.1 Cronbach Alpha Reliability and Discriminant Validity of the MOBLEI

Scales	Items	Alpha Reliability		Discriminant Validity	
		Actual	Preferred	Actual	Preferred
Access	8	0.82	0.81	0.67	0.45
Interaction	8	0.72	0.75	0.69	0.48
Response	8	0.80	0.87	0.67	0.49
Results	8	0.90	0.90	0.68	0.47

n=140

In keeping with past traditions in learning environment research, the mean correlation of a scale with the other three scales was taken as a measure of discriminant validity. “The discriminant validity determines the extent to which a scale measures an unique dimension not covered by other scales in the instrument” (Chandra & Fisher, 2006, p. 469). In this study, the discriminant validity ranged from 0.45 to 0.49 for the Preferred Form. As the mean correlation of scales in this form of the MOBLEI were all less than 0.5, there is an indication that the instrument does have discriminant validity, although somewhat overlapping between the scales.

The mean correlation between the scales on the Actual Form ranged from 0.67 to 0.69 showing that there was a positive correlation between each of the scales. These mean correlations are higher than those reported by Chang and Fisher (2003) of 0.37 to 0.49, however this may be due to this study drawing the sample from only one institution. Based on figures in this study and on Chang and Fisher’ study, it was

determined that the MOBLEI could be used with confidence in a New Zealand tertiary learning environment.

Table 4.2 displays the means and standard deviations of the Actual form of the MOBLEI scale items. The range of possible answers was from 1 to 5, with 1 being the lowest and 5 being the highest. The means are all above 3, indicating that the responses are all between 'Sometimes' and 'Often'. This shows that students found their learning environment favourable.

Table 4.2 Actual Means and Standard Deviations of the MOBLEI Scales

Scale	Means	*SD*
Access	3.51	0.77
Interaction	3.36	0.70
Response	3.43	0.80
Results	3.48	0.98

n= 131

To compare between the Actual and Preferred Forms, a *t* test for equal variances was performed and it was found that there were significant differences on all scales. Table 4.3 indicates that the students would prefer more of everything. Previous research suggests that the closer the learning environment is to the students' preferred learning environment, the more satisfied they will be with their learning environment (Fraser & Fisher, 1983).

Table 4.3 Actual and Preferred Differences of the MOBLEI Scales

Scale	Means		*SD*		Mean Difference (P-A)	*t* value
	Actual	Preferred	Actual	Preferred		
Access	3.51	4.30	0.77	0.60	0.79	13.56***
Interaction	3.36	4.10	0.70	0.60	0.74	14.25***
Response	3.43	4.10	0.80	0.76	0.67	12.12***
Results	3.48	4.23	0.98	0.80	0.75	10.08***

n= 131 *p<.05 **p<.01 ***p<.001

4.3 RELIABILITY AND VALIDITY OF ATTITUDINAL SCALES

Table 4.4 shows that the Cronbach alpha reliability coefficient for the attitudinal scales ranged from 0.78 to 0.85, suggesting that the scales administered with the MOBLEI have satisfactory internal consistency. Possible answers ranged from 1 to 5 with 1 being the lowest and 5 the highest. The means are all above 3 which indicates that the means on all scales are between 'Sometimes' and 'Often', again indicating that students found their learning environment to be a positive one. The standard deviations show that there is agreement between the students who are responding.

Table 4.4 Cronbach Alpha Reliability and Means and Standard Deviations of Attitudinal Scales

Scales	Items	Alpha Reliability	Mean	*SD*
Attitude to Course	8	0.83	3.93	0.60
Attitude to Technology	8	0.85	4.04	0.67
Student Self Efficacy	8	0.78	3.13	0.60

n=140

4.4 ASSOCIATIONS BETWEEN MOBLEI SCALES AND OUTCOMES

Simple and multiple correlations between the MOBLEI scales and student outcomes were performed to determine the associations that may exist between the students' perceptions of their learning environment and their attitudinal and cognitive outcomes. Table 4.5 displays the results of the students' perceptions of their learning environment and associations with their attitudinal outcomes.

Table 4.5 Simple and Multiple Correlations of the MOBLEI Scales with Attitudinal Outcomes

Scale	Attitude to Course		Attitude to Technology		Student Self Efficacy	
	r	ß	*r*	ß	*r*	ß
Access	0.41***	0.28*	0.27***	0.31*	0.12	-0.08
Interaction	0.37***	0.03	0.18*	-0.01	0.10	-0.28
Response	0.39***	0.23	0.17*	0.01	0.28***	0.47**
Results	0.30***	-0.08	0.16*	-0.06	0.19*	0.13
Multiple Correlations (*R*)		0.44***		0.27*		0.34**
R^2		0.19		0.07		0.12

n= 141 *p<.05 **p<.01 ***p<.001

The simple correlation of the MOBLEI scales with Attitude to Course and Attitude to Technology revealed that all scales were positively and significantly related. However the simple correlation for the MOBLEI scales with Student Self Efficacy showed that the Response and Results scales were the only ones with significant values.

The more conservative multiple correlation of the MOBLEI scales with Attitude to Course showed a significant *R* value of 0.44 which shows a strong association between students' perception of their learning environment and their attitude to their course. This is confirmed by the R^2 score of 0.19 which points to the students' perceptions of the learning environment contributing 19% towards their attitude to the course. The beta weight value of 0.28 was significant for the Access scale, indicating that students' perceptions of access to mobile technology contributes most to their attitude to their course. Therefore, the better the access, the better will be their attitude to the course.

The multiple correlation of the MOBLEI scales with Attitude to Technology showed a significant *R* value of 0.27 which shows a positive association between students' perception of their learning environment and their attitude to technology. The R^2 score of 0.07 indicates that 7% of their attitude to technology can be attributed to their perceptions of their learning environment. The beta weight value of 0.31 was significant for the Access scale, the only learning environment scale that was significant. Again, the better the access, the better will be their attitude towards technology.

The association of students' perceptions of their learning environment with self-efficacy was reasonably strong with an R value of 0.34. The R^2 value of 0.12 means that 12% of their perceptions contributed to students' self-efficacy beliefs. The only significant Beta Weight of 0.47 was for the Response scale which indicates that students' perceptions of how they feel about the course, in terms of enjoyment and satisfaction, has an impact on their self-efficacy.

Table 4.6 displays the results of the associations that exist between the students' perceptions of their learning environment and their cognitive outcomes. From the sample of 141 respondents in this study, only 81 students' results were included. This was because students who participated in this study were enrolled in programmes of study that had different assessment methods. These consisted of achievement-based assessment with final results recorded as a grade from A+ to E, and competency-based assessment where students are awarded a Pass or Not Achieved result. To allow comparison of final results, only those students whose achievement was recorded as a grade were included in the analysis for cognitive outcomes.

The simple correlation scores of the MOBLEI scales did not reveal any significant differences. However, the multiple correlation of the MOBLEI scales with cognitive outcomes gave a significant *R* value of 0.34 which shows a reasonably strong association between students' perception of their learning environment and their achievement. The R^2 value of 0.12 indicates that 12% of students' cognitive outcomes can be attributed to their perception of the learning environment. The beta weights for Interaction (0.24) and Response (0.35) were significant which indicates that the more interaction and enjoyment students perceive, the better are their cognitive outcomes.

Table 4.6 Simple and Multiple Correlations of the MOBLEI Scales with Cognitive Outcomes

Scales	Simple Correlation *r*	Multiple Correlation *R* Beta Weights
Access	0.11	0.06
Interaction	0.02	0.24*
Response	0.04	0.35***
Results	0.04	0.08
Multiple Correlations (*R*)		0.34*
R^2		0.12

n= 81

4.5 DIFFERENCES BETWEEN METHOD OF DELIVERY GROUPS' PERCEPTIONS

A one way ANOVA with method of delivery as the main effect was conducted to explore the differences that exist between the different groups' perceptions of the mobile technologies to enhance their learning environment. The three groups at UCOL consist of students studying in online, face-to-face, or blended learning mode. The online students receive all their learning resources via the web, while the face-to-face group of students attend classes on campus with a combination of lectures and practical classes. The students studying in a blended mode of learning complete their studies off campus and use resource-based materials such as workbooks.

As can be seen in Table 4.7, the total means for each scale ranged between 3.13 and 4.04 indicating that all three groups perceived mobile technologies as enhancing their learning environment. The *F* value shows that the Interaction and Response scales were statistically significant. With this ANOVA analysis indicating that there were differences in the mean scores on the dependent variable (delivery) across the three groups, *post hoc* comparisons, using the Tukey honestly significant different (HSD) comparison test, were carried out to determine between which groups the differences and perceptions occurred for the Interaction and Response scales. The *post hoc* analysis showed that the difference occurred on the Interaction scale between the face-to-face and the blended groups. The face-to-face group perceived that the mobile enhanced learning environment assisted in increasing their communication and interaction with their lecturer and fellow students more than the blended group did. For the Response scale post hoc analysis, the difference occurred

between the face-to-face and online groups, again with the face-to-face group perceiving more satisfaction and enjoyment in this learning environment than the online group.

Table 4.7 Method of Delivery Groups' Differences in MOBLEI and Responses

Scales	Delivery	N	Mean	SD	F value	Post hoc
Access					1.00	
	Face to face (F2F)	76	3.60	0.74		
	Online (OL)	30	3.43	0.67		
	Blended (BL)	35	3.44	0.88		
Interaction					4.97**	F2F>BL*
	Face to face (F2F)	76	3.54	0.66		
	Online (OL)	30	3.22	0.64		
	Blended (BL)	35	3.15	0.74		
Response					3.87*	F2F>OL*
	Face to face (F2F)	76	3.62	0.74		
	Online (OL)	30	3.18	0.78		
	Blended (BL)	35	3.33	0.91		
Results					2.23	
	Face to face (F2F)	75	3.66	0.84		
	Online (OL)	30	3.22	0.83		
	Blended (BL)	35	3.44	1.28		
Attitude to Course					0.54	
	Face to face (F2F)	76	3.97	0.54		
	Online (OL)	30	3.85	0.60		
	Blended (BL)	35	3.89	0.70		
Attitude to Technology					0.05	
	Face to face (F2F)	76	4.06	0.65		
	Online (OL)	30	4.04	0.73		
	Blended (BL)	35	4.01	0.68		
Student Self Efficacy					1.43	
	Face to face (F2F)	76	3.17	0.62		
	Online (OL)	30	2.98	0.56		
	Blended (BL)	35	3.19	0.54		

*p<.05 **p<.01

4.6 OPEN-ENDED COMMENTS PRESENTED FROM THE MOBLEI

Open-ended questions were included at the end of the MOBLEI designed to gather further comments and gain a richer understanding of the perceptions of students around the use of mobile technologies and the associated benefits, advantages or disadvantages to their learning experience and environment.

The four questions in the open-ended comments section of the MOBLEI were as follows:

1. What other mobile devices, apart from your mobile phone, would you like to use while studying?
2. What are the advantages that you have encountered of studying in a mobile enhanced environment?
3. What are the disadvantages that you have encountered of studying in a mobile enhanced environment?
4. Are they any suggestions to improve the delivery of the course in a mobile-enhanced mode?

Question one asked students what other mobile devices, apart from their mobile phone, would they like to use while studying. From the 28 responses to this question, many students indicated that they were satisfied with just using their mobile phones. Eight students noted laptops as being their next preferred mobile device. Four students noted ipods as being useful, with another three mentioning ipads or tablets.

Typical responses were as follows:

None – email and text have been great
I am satisfied with just my mobile phone
None. Communication via mobile phone and email I feel is sufficient
No, mobile phones are very helpful
Currently there are no other devices I would like to use
Nothing, I am happy with just my mobile

At the moment I am definitely satisfied with all incoming correspondence.
Currently I use my laptop and mobile internet – these work fine
Iphone – much more portable, instant info, flexibility
Laptops with content optimised for wireless speeds
Wireless enabled ipads and PDA's

As noted in the literature, there is a new generation of students who are exhibiting more advanced technological skills (Keengwe, 2007) and they will expect teachers to use technologies to enhance and support their learning (Oblinger & Oblinger, 2005). There is beginning to be a significant uptake in the use of mobile technologies in higher education, therefore it is important for practitioners to consider fitness for purpose of the mobile technologies to be used, and ask questions such as what kinds of learners will benefit from using this technology, what sort of subjects and situations lend themselves to this type of delivery and whether it is possible to learn via small mobile devices (Kukulska-Hulme & Traxler, 2005).

The second question asked students what advantages they have encountered while studying in a mobile enhanced environment. There were 80 responses to this question and the majority of students indicated that the greatest advantage experienced was increased communication between themselves and their lecturer. A recurring theme was that students appreciated receiving reminders for a variety of class-related activities such as assessment deadlines, advice of when assessments were ready to be collected, changes to timetables, meeting times, and exam dates and locations. Students also commented that they found it an advantage to receive a text about a last minute change instead of having to check emails.

Typical responses were as follows:

When classes have changed I do not need to worry about checking my email
Easier communication ie; room changes and meetings with lecturers and other students
Reminders for deadlines and assessments – convenience
Any changes on the timetable the lecturer can easily inform us through texting

Being able to contact lecturers outside of class with no internet/home phone available for me at home
It is an easier way to communicate with the tutor and other students
Getting welcome texts from your lecturer
Regular updates as to when assignments and tests/exams are on and where being held
It's small and easy to carry on the move
Using text messages to inform students when assignments have been marked and test results are up is helpful
Lecture changes ie; room and when assignments and tests are due
Makes lecturers readily available whenever needed, also a better way to be able organise study groups

These responses are consistent with data obtained from the MOBLEI which found that the means on all scales indicated that students found their learning environment favourable. While the responses from the open-ended question number two indicated that students perceived the increased communication enhanced their learning, it was the quantitative results that were helpful in being able to determine if there were differences in perceptions between the different delivery modes. These results suggested that the face-to-face group perceived that their learning environment assisted in increasing their communication and interaction with lecturers and fellow students more than the blended group did. Furthermore, the face-to-face group perceived more satisfaction and enjoyment in this learning environment than did the online group.

Question three asked participants what disadvantages they had encountered while studying in a mobile enhanced environment. Forty two students provided comments to this question with the majority of disadvantages listed as being distraction and connectivity issues. Students disliked receiving texts during lecture times as this caused distraction not only because they had received a message but because other students' phones may not be on silent, thus causing noise during class time. The main type of connectivity issues that students commented on included a delay in receiving texts that had been sent or not receiving a text that had been sent.

Typical responses were as follows:

> *Distraction and sometimes texts aren't received*
> *Sometimes I receive text messages late ie; sometimes there are delays in sending and receiving*
> *Cellphones ringing/buzzing in one class as we were receiving messages from another lecturer. Ten cellphones buzzing at once was a distraction and discourteous to that tutor*
> *Network coverage issues – not receiving messages*
> *Lack of connectivity sometimes*
> *People need to know how to put their devices on silent. Content loads can be slow.*

Responses to question three provided valuable comments from students regarding perceived disadvantages of their learning environment that were not obtained from the quantitative data. Similar issues to those raised in this research have been found in previous studies which have shown that the use of devices, such as in-class laptops, have had a negative impact on student learning, with students being distracted from their lessons (Fried, 2008; Hembrooke & Gay, 2003). The literature notes the challenges surrounding the use of technology in higher education and cautions that technology needs to be used in theoretically sound ways in order to enhance learning (Herrington & Kervin, 2007).

Question four asked for any suggestions that students might have to improve the delivery of their course in a mobile-enhanced mode. There were 24 responses to this question and the main suggestions included consistency between lecturers in the use of texting; sending texts at a certain time of day, and providing students with credit to enable them to text back to lecturers.

Typical responses were as follows:

> *More texts from all our lecturers not just come of them*
> *I like the idea, just simple texts for me. When it is a huge paragraph that's when I stop reading.*

Make it so it happens at a certain time and day

Lecturers should text as well as email because some people don't have internet at home or may not have a phone

I'm happy being able to do my studies online using moodle. The mobile texts are a nice reminder to submit assignments closer to the time.

All lecturers should send assignment deadlines via text.

Make texting back to lecturers free – sometimes having credit on your phone can be an issue

Give students credit on their phones to ensure can text back to lecturers

Results from the MOBLEI found that there were significant differences on all scales between the Actual and Preferred Forms, indicating that students would like more of everything. This indicates that they would like to see improvements in the areas of Access, Interaction, Response and Results. The responses from the open-ended question number four were useful in highlighting specific ways in which these improvements could be made.

4.7 FOCUS GROUP RESPONSES

When completing the MOBLEI, participants were asked to indicate if they would be willing to take part in a focus group to further discuss their perceptions around the use of mobile technologies. Two focus group sessions were carried out at UCOL with a total of 12 students, one (n= 6) in 2010 and one (n= 6) in 2011. The sessions were conducted in a tutorial room on UCOL premises and tea, coffee and light refreshments were provided to participants. Each session was tape recorded. At the beginning of each session, an overview of the study was given to participants, including an explanation of mobile technologies and learning environments. Participants were also asked to give information on a separate piece of paper on demographic details such as age range, gender and learning mode, ie. online, face-to-face or blended. As the focus groups did not include students studying online, the focus group responses are reflective of participants whose delivery mode was either face-to-face or blended. Seven questions were formulated for the focus group as a prompt to stimulate discussion. Each of the questions is displayed below with selected quotes from the participants' responses.

Question One: Can you describe in what way mobile phones were used by your lecturers during your programme of study?

Mainly for assessment reminders and any class changes
Study tips
Notified when results were ready to collect

Question Two: Do you think the use of mobile technologies enhanced your learning experience?

Really like the reminders
Definitely enhances the whole learning experience
Yes, it made me feel like my lecturer cared about me, and was willing to talk to me using my tools
I liked getting advice after lectures on additional stuff to look up as extra learning
As a distance student I really liked getting texts at different times, felt like I was noticed even though I wasn't on campus much

Question Three: Was the amount of contact using the mobile device appropriate?

I think the amount of contact was great – keep it coming
Would like to see all of our lecturers using it
Bring it on – I always have my mobile with me – is like my baby I can never leave alone.
Could increase frequency of texts
Would be good to get texts that remind you that there is a lecture today and what the topic is going to be and what time

Question Four: Was the content delivered using the mobile device appropriate?

Would be good to have different texting group options, so could choose to belong to a group that is just for assessment reminders, or one that is for assessment reminders and study tips etc.

I was glad that they didn't send us things that I would have needed a smartphone for because I only have a cheap standard mobile phone

Question Five: Are there any other ways you think they could have been used?

Could be good to get a wake up text every morning – save us setting an alarm

I would like it if the library could send us texts when our books were overdue – save on fines.

Would be good to get assessment results sent via text, especially exam results

Question Six: Do you think the contact you received via the mobile device increased your motivation?

Yes – increase to motivation to turn up to things if had a moment of thinking 'oh, I might not bother going to class today'.

Always good to get reminder of stuff.

Yes, feeling noticed and cared about by the lecturer was really good

I felt like it mattered if I came to class or not because if I didn't, I would get a text from my lecturer

Getting a reminder for an assessment got me motivated to get started and hand in on time

Question Seven: Are there any other mobile tools you would to use eg; ipods, PDA's? In what way do you think they could be used?

Smartphones once they are cheaper could be used for heaps more than just reminders

ipods could be good if could download lectures and listen to while on the bus heading home or I couldn't get to a lecture.
Apps for your iphone
Give every student an ipad
An app like Moodle that can run on your iphone with an interface designed to run on a small screen.
Would be good to have access to timetables from your phone

Below is a selection of statements made when participants were asked if there were any additional comments participants would like to add:

Just get all of our lecturers to use it would be great for consistency knowing they will all contact you using texts
Would prefer it if we could reply to the texts without it costing us anything
Could use for texting for organisation wide information; library book overdues, outstanding paper fees, enrolment confirmations, need to enrol for the following years papers.

4.7.1 Summary of Focus Group Discussion

The focus groups were valuable in gaining further perspectives of the students' experiences of their mobile enhanced learning environment. They were also helpful in allowing the quantitative results to be analysed and compared to determine if any of the findings converged, contradicted each other, or were inconsistent.

Students reported that the majority of texts they received were for assessment reminders, study tips and advice on test results. All participants were in agreement that receiving texts had made a difference to their learning experience with comments that they appreciated being noticed by lecturers and had a heightened sensed of being cared about. The students considered the level of contact from their lecturers via texts was very appropriate which is consistent with responses to the MOBLEI Interaction scale. The overwhelming response from participants was for an increase in the use of texts, both in frequency and consistency, i.e. more widely used by all lecturers. These comments confirm feedback received from the open ended questions and quantitative results which showed that students would prefer

more of everything. When asked whether the content of texts were appropriate, the comments were positive and the participants confirmed that they would not want to have too much content sent via text as some did not have phones capable of viewing more than just a text message.

Suggestions of other ways mobile devices could have been used were for administration type advice such as library books being due and receiving exam results. Students all believed that their motivation to study and attend classes had increased through the increased communication they received via texts. Just that fact that their lecturer cared or might notice them not being in class was enough to motivate them to get out of bed in the morning. When asked what other mobile tools they would like to see used and how they would use them, responses varied from smartphones, iPods, and iPads including suggestions for the creation of applications like Moodle that could interface with their smartphones.

Final additional comments from participants confirmed many of the above responses, with students wanting all of their lecturers to use texts as a preferred method of contact, as well as being very keen for the use of texting to be used not just by their lecturers but for organisation wide information receiving texts around enrolment confirmations, library fees, and outstanding paper fees. These comments align with results from the MOBLEI Interaction and Access scales which indicate that students would like more opportunities to participate and interact with lecturers and other students, and have more access to learning materials and course information at times and locations that are convenient to them.

4.8 SUMMARY

This chapter has presented the analyses of the quantitative and qualitative data gathered for this study. The reliability and validation of the MOBLEI and attitudinal scales was confirmed for use in a tertiary institution in New Zealand. Analysis of the Actual and Preferred Forms of the MOBLEI, adapted from the WEBLEI, revealed that the students found their mobile enhanced learning environment favourable and that they would prefer to have more Access, Interaction, Response and Results than they perceived they were experiencing.

Data pertaining to associations that exist between the students' learning environment and their attitudinal and cognitive outcomes were presented. It was found that students who perceived they had good levels of access to mobile technologies had a more positive attitude to their course and towards technology. The results also indicated that students' perceptions of how they felt about their course, in terms of interaction, enjoyment, and satisfaction, had an impact on their self-efficacy. The associations that exist between the students' perceptions of their learning environment and their cognitive outcomes showed that the more interaction and enjoyment students perceive, the better are their cognitive outcomes.

Analysis of the differences between the three methods of delivery (online, face-to-face, blended) showed variances for the Interaction and Response scales. The results indicated that the face-to-face group perceived their mobile enhanced learning environment had assisted in increasing their communication and interaction with their lecturer and fellow students and perceived more satisfaction and enjoyment than the blended group and online groups did.

Qualitative data from open ended questions and focus groups were also presented providing further insight into whether the use of mobile technologies had enriched the students' learning experience. The responses from the open ended questions and focus groups added a rich layer of understanding into students' perceptions and provided confirmation that the mobile enhanced learning environment is a positive one for those students who participated in the study.

5 CHAPTER FIVE

CONCLUSION

5.1 INTRODUCTION

This chapter brings together the data and findings outlined in this study and draws some final conclusions and recommendations for the use of mobile technologies in tertiary learning environments. Practical implications drawn from this study are also discussed and suggestions for further research are provided.

5.2 OVERVIEW OF THESIS

Chapter One introduced the study which used a modified form of the Web-based Learning Environment Instrument (WEBLEI), to examine the impact that mobile devices have on student outcomes and their learning experience in a tertiary environment. The WEBLEI was modified and re-named the Mobile Enhanced Learning Environment Instrument (MOBLEI). This learning environment instrument was used to assess learning environments with three methods of delivery which consisted of face-to-face, online and blended. Chapter One also presented an overview of the entire thesis, including the research aim and research questions, the methodology and the significance of the study.

Chapter Two overviewed a range of the literature pertaining to the study. The integration of technology in higher education was discussed to provide a context for the use of mobile technologies in an educational setting. Theoretical approaches to learning were presented that led to a review of the different methods of teaching and learning that were investigated in the study. The field of learning environments research underpinning the development of the MOBLEI was outlined to provide an historic perspective of the work that has been carried out to date. This included a review of the empirical findings from the important strand of learning environments research which investigated associations between classroom environment and student cognitive and affective outcomes. Finally, to gain an insight into how mobile technologies are currently being used in higher education, a review of the

range of mobile technology teaching initiatives both in New Zealand and other countries was presented.

Chapter Three described the research approach taken and provided a discussion of the research questions and research design. It described the development of the modified learning environment instrument used in this study and provided an explanation of how and why attitudinal scales were included in the instrument. This chapter also provided a description of the mixed methods approach used to conduct the study that used triangulation to examine the research questions from both quantitative and qualitative perspectives.

Chapter Four presented the results of the quantitative and qualitative analyses conducted to answer the research questions. It provided evidence for the reliability and validity of the MOBLEI and the results of the students' actual and preferred perceptions of the use of mobile technologies. Associations between students' perceptions of their learning environment and their attitudinal and cognitive outcomes were analysed and discussed. The differences between the three methods of delivery groups' perceptions of the use of mobile technologies were examined. The open-ended questions and focus group responses were summarised and examined to gain further insight into how mobile technologies can enhance the learning environment.

The current study was conducted at the Universal College of Learning (UCOL), a tertiary Institute of Technology in Palmerston North, New Zealand. The sample included 141 computing and business certificate, diploma and degree tertiary students from the School of Business and Computing at UCOL. The students were studying in different delivery modes: online, face-to-face, and blended. The researcher's role was to develop the learning environment instrument (MOBLEI), conduct focus group sessions with students and analyse and report on results. Lecturers were asked to be active participants by administering the MOBLEI and by texting identified student groups. Students provided feedback via questionnaires, and were invited to participate in follow-up focus groups.

This study is unique in seeking to evaluate a mobile enhanced learning environment that uses different delivery methods. It provides new insight into associations between students' perceptions of mobile enhanced learning environments and their outcomes in a tertiary setting. The findings of the research and the resulting implications and challenges for educators will be of value to tertiary institutions who, when wishing to harness the potential benefits of mobile technologies, are able to do so using a sound pedagogical approach.

5.3 MAJOR FINDINGS OF THE STUDY

The aim of this research was to explore the associations between students' perceptions of mobile technology enhanced learning environments and tertiary students' outcomes in New Zealand. Several research questions were proposed and each one is addressed in this summary of findings.

Research Question 1: Is the learning environment questionnaire developed a valid and reliable instrument for use in New Zealand?

The results in this study that were presented in Chapter Four illustrate that the newly developed MOBLEI is a valid and reliable instrument for use in the tertiary environment in New Zealand. To determine the validity and reliability of the questionnaire Cronbach alpha reliability coefficient and discriminant validity was assessed. The results of this analysis have provided confidence that the scales of the MOBLEI are reliable for use in a tertiary environment in New Zealand.

To determine discriminant validity, the mean correlation of a scale with the other three scales was measured. As the mean correlation of scales in the Preferred Form of the MOBLEI were all less than 0.5, there was an indication that the instrument has discriminant validity, although somewhat overlapping between the scales. The mean correlation between the scales on the Actual Form showed that there was a positive correlation between each of the scales. These mean correlations were higher than those reported by Chang and Fisher (2003) however it is suggested that this could be due to this study drawing the sample from only one institution.

Attitudinal scales included with the MOBLEI were also analysed for reliability using the Cronbach alpha reliability coefficient. This ranged from 0.78 to 0.85 thus confirming the scales administered with the MOBLEI had satisfactory internal consistency. This study therefore provides a valuable contribution to the learning environment field of research by confirming the reliability of both the MOBLEI scales and the attitudinal scales for use in tertiary institutions in New Zealand.

Research Question 2: What sort of learning environment is created by mobile technology tools?

The responses from the Actual Form of the MOBLEI were analysed to determine students' perceptions of their mobile learning environment. As students responded with "Sometimes" or "Often" to all of the four scale items of Access, Interaction, Response and Results, there was the clear implication that students found the mobile enhanced learning environment a positive experience.

From an examination of the responses to each of the scales, it can be determined that students liked the level of access to course materials and their lecturer and at times and locations suitable to them. They enjoyed the interaction the environment provided allowing them to communicate and receive feedback from their lecturer easily. They felt that the mobile enhanced environment enabled them to work collaboratively with others and they also felt satisfied and motivated throughout their course. They believed that the content and objectives were easy to follow and the contact with their lecturer resulted in keeping them focused and well prepared for assessments. These results are consistent with Mackay's (2006) ETXT study where students felt more supported by text messages sent from the lecturer and were more motivated to complete workbook tasks. They also confirm Cochrane's (2007) view that as mobile devices are inherently social they have enormous potential for educators to harness opportunities for increased interactions with lecturers and fellow students.

A *t* test for equal variances was performed to compare the differences between the Actual and Preferred Forms. It was found that there were differences on all scales suggesting that students would prefer more of everything. This is an important

finding for educators to consider when designing a learning environment, as previous research (Fraser & Fisher, 1983) has also shown that the closer one can get to the students' preferred learning environment, the more effective will be the learning in terms of achievement and attitude.

Research Question 3: What associations exist between students' perceptions of their learning environment and their attitudinal and cognitive outcomes?

Simple and multiple correlations of the MOBLEI scale were performed to analyse the associations that may exist between the students' perceptions of their learning environment and their attitudinal and cognitive outcomes.

Multiple correlations of the MOBLEI scales with Attitude to Course were performed and these showed a showed a strong association between students' perception of their learning environment and their attitude to their course. The R^2 score revealed that 19% of students' perceptions of their learning environment can be associated with their attitude to the course. Analysis using beta weights suggested that students' perceptions of access to mobile technology affected their attitude to their course. This indicates that the students appreciated the convenience and autonomy of accessing learning activities and materials in a location that was suitable to them, and that the use of mobile technologies had a positive effect on their attitude to the course overall.

The multiple correlations of the MOBLEI scales with Attitude to Technology showed some association with students' perception of their learning environment and their attitude to technology. The R^2 indicated that 7% of their perceptions can be attributed to their attitude to technology. The beta weight value was once again significant for the Access scale, indicating that the more access students have to mobile technologies, the better will be their attitude towards technology.

The association of students' perceptions of their learning environment with self-efficacy was found to be reasonably strong with the R^2 value indicating that 12% of students' perceptions of their learning environment were associated with self-efficacy. The beta weight value was significant for the Response scale, indicating

that the students' perceptions of how they felt about the course, in terms of interaction, enjoyment, and satisfaction, had an impact on their self-efficacy. These results indicate that it is important to provide a positive learning environment in order to give students a heightened sense of self confidence.

Associations that exist between the students' perceptions of their learning environment and their cognitive outcomes were also examined. The simple correlation scores of the MOBLEI scales did not suggest any significant differences. However the multiple correlation of the MOBLEI scales with cognitive outcomes showed a reasonably strong association between students' perceptions of their learning environment and their achievement. The R^2 value indicated that 12% of students' cognitive outcomes can be attributed to their perception of the learning environment. The beta weights showed that the more interaction and enjoyment students perceive the better are their cognitive outcomes. This finding is consistent with previous research (Goh & Fraser, 1995; Wubbels, 1993) which found that higher cognitive outcomes were associated with interpersonal teacher behaviour, as well as friendly and helpful classroom environments.

Research Question 4: Are there differences between how each of the three delivery method groups perceived the mobile enhanced learning environment?

From the analyses conducted to discover if there any differences between the three delivery method groups' perceptions of the use of mobile tools, it was determined that the Interaction and Response scales were statistically significant. *Post hoc* tests revealed that the differences occurred for the Interaction scale between the face-to-face and the blended groups. The face-to-face group perceived that the mobile enhanced learning environment assisted in increasing their communication and interaction with their lecturer and fellow students more than the blended group did. This may be due to face-to-face students appreciating the ability of technology to add another layer of communication to the face-to-face interaction they already have with lecturers and peers (O'Donnell & Sharp, 2012). The blended learning group received learning materials via print-based workbooks, attended on-campus block courses and communication with their lecturers was via email, phone, as well as receiving texts as part of this study. The reason why they may not have found the

additional text communication as beneficial as the face-to-face students could be due to them being more content with their existing range of learning resources and communication tools. The literature supports this view, with Littlejohn and Pegler (2007) believing that blended learning allows a coexistence of conventional face-to-face teaching methods with e-learning activities and resources in a single course, thus allowing students flexibility in terms of when they can participate in courses, and the range of media resources that they can use for their learning.

The Response scale post hoc analysis showed that the difference occurred between the face-to-face and online groups, again with the face-to-face group perceiving more satisfaction and enjoyment in this learning environment than the online group. The literature suggests that traditional class instruction is teacher centric (Chard & Fisher, 2005), thus placing the learner in a passive role and having a higher propensity for boredom (Griffin, 2006). The face-to-face group may have responded more positively than the online group to the mobile learning environment due to the opportunities it provided them to take a more active role in their learning. As the online group of students were more in control of when and where their learning took place, and were able to take part in online discussion forums, they may not have found the additional text communication as necessary or as valuable to their overall learning experience as the face-to-face group. This view can be supported by research conducted by the Organisation for Economic Co-operation and Development (OECD) Centre for Educational Research and Innovation which found that there was enhanced student learning for online students compared to the traditional model of lectures alone. The results of large-scale and regular student/alumni satisfaction surveys found that there were high levels of satisfaction with the quality and academic rigour of online provision compared to face-to-face or other distance delivery, as well as an appreciation of enhanced flexibility of access (OECD, 2005).

Research Question 5: Can the learning environment be enhanced through the use of mobile technologies in order to enrich the student learning experience in a tertiary environment

Open-ended questions were included at the end of the MOBLEI and gathered further perceptions of the students' experiences of the mobile enhanced learning environment. Students stated that other mobile devices they would consider using in their study were mainly laptops, followed by iPods and iPads respectively. Rickards (2003) provides a perspective that technology-based futures in education will always be linked to the technology that is currently available, which will be driven by what people want to use the technology for. There is no doubt that mobile devices will continue to gain popularity, not only to complete everyday tasks and transactions (Ally, 2009), but to demand greater access to learning materials anywhere, anytime (Mellow, 2005).

The main advantages provided by students were the increased level of communication and the receiving of texts for reminders about assessments and timetable changes. These advantages were also cited in Attewell and Savill-Smith's (2005) UK study. They found that mobile phones were suited to sending text messages to students reminding them to study for exams and as an effective way to attract, motivate and retain students.

The disadvantages encountered were predominantly around distractions due to texts being received during class time and connectivity issues. This was valuable feedback to receive as lecturers were unaware of the consequences of sending a text message out to an entire class of students at a time when they were in a timetabled class. This created distractions to other students due to the text message notification tone, and an unnecessary distraction for the lecturer when students felt compelled to check their messages in class time. Connectivity issues arose with some students not receiving a text that had been sent to them. This problem can be one of the drawbacks of text messaging in that there is no certainty that a text has been received. Due to this, it is necessary for lecturers to be mindful that a total reliance on text messaging could be a risk when providing important information - consideration may need to be given as to whether a combination of communication methods such as email and posts on learning management course sites would be required.

Suggestions for improvements were consistency in the use of mobile devices by lecturers and the provision of credit so that students could respond to texts without the financial constraints of not having available credit on their phones. The students in this study appreciated the increased interaction and enjoyment that their learning environment provided, so much so, that they would have liked all their lecturers to have communicated in the same way. This is an important consideration when designing a mobile enhanced learning environment to ensure that all teaching staff are aware of the need to co-ordinate and plan how and what they will communicate to students in a consistent way. While research has shown that a large majority of students have access to a mobile phone (Mellow, 2005), there are still financial constraints for students when it comes to being able to respond to a text from a telecommunications provider that is not part of their pre-paid plan. In this study, students were not expected to respond to texts, however it is apparent they would have liked the opportunity to respond. This is a consideration that faculty may need to have when preparing budgets to support a mobile enhanced learning environment.

The focus group sessions provided further valuable insight into the students' experiences of their mobile enhanced learning environment. The participants in the focus groups were in agreement that receiving texts had made a difference to their learning experience and that the level of contact and content was very appropriate, with all participants clearly indicating they would like to receive more communication from all of their lecturers. Focus group participants indicated they would also find it beneficial to receive communication via texts relating to administration matters.

The responses from the open-ended questions and focus groups provided a rich layer of data to interpret along with the quantitative data gathered via the MOBLEI questionnaire. These responses have confirmed that the mobile enhanced learning environment is a positive one for those students who participated in the study. They also provided valuable feedback for educators and have implications for the future delivery of mobile enhanced learning environments in a tertiary context.

5.4 IMPLICATIONS FOR PRACTICE

This study utilised the MOBLEI, open-ended questions, and focus groups to gather students' perceptions of their learning environment and associations that may exist between their perceptions and their attitudinal and cognitive outcomes. The results and conclusions drawn provide valuable information for educators.

From the study, it is clear that students found the mobile enhanced learning environment a positive experience. However, for the successful integration of mobile technologies into higher education, educators need to give careful consideration to the design, planning, implementation, and evaluation of the mobile tools used. The literature revealed that pedagogical appropriateness must be considered when deciding on how and when to use mobile tools. The research found that when the differences between the actual and preferred students' perceptions were compared, students preferred to have more on all four of the Access, Interaction, Response and Access scales. This is an important finding for educators as the closer one can get to the preferred learning environment, the more effective will be the learning. The results showed associations between students' perceptions of their learning environment and their attitude to their course, their attitude to technology, and with their self-efficacy. These results indicate that it is important to provide a positive learning environment in order to improve students' attitudinal and self-efficacy outcomes. The research was also helpful in determining that there were associations between students' perceptions of their learning environment and their cognitive outcomes. Therefore, if educators focus on building friendly and helpful classroom environments, it is likely that students' cognitive outcomes will be higher.

Another consideration that educators need to allow for when integrating mobile technologies is the learning mode of the students. The research found that students studying in a face-to-face learning mode perceived that the mobile enhanced learning environment assisted in increasing their communication and interaction with their lecturer and fellow students more than those studying in blended mode. The face-to-face group of students also perceived a higher level of satisfaction and enjoyment in this learning environment than did the online students. These findings are important as they indicate that while the integration of mobile technologies is of benefit to

those students studying in an online or blended mode, the use of mobile tools are even more appreciated by those students who study on campus. Therefore, educators can be confident that even when face-to-face students have ready access to, and contact with lecturers and other students on a regular basis, they are likely to still greatly benefit from the extra layer of support that mobile tools can provide.

Students' responses to the open-ended questions and feedback from the focus groups also highlighted issues that educators need to pay attention to when using mobile technologies. The timing of when text messages are sent to students is essential, as it was revealed in this study that when students received texts during lecture time, distractions were experienced by the other students and the lecturer. The ability to respond to texts was considered desirable by the students, however due to insufficient credit on their phones, they were unable to. Additionally, consistency in the use of the mobile tools was deemed important by students and as discussed in the previous section, students enjoyed the additional communication and interaction to the extent that they would have liked all of their lecturers to have communicated in the same way. The issues raised suggest that a consistent and planned approach by educators is needed when designing, planning and implementing a mobile enhanced learning environment, along with appropriate institutional financial support to allow students to take full advantage of the mobile tools being used.

Prior to this research, a validated and reliable learning environment instrument to assess the effect that mobile technologies in particular might have on a learning environment did not exist. The literature noted the importance of appraising and evaluating the effects of mobile technologies on learner activities and learner support. Previous researchers have also asserted that it is important to consider the quality of the learning environment and how it can affect student outcomes. A review of the learning environments research suggests that students are increasingly demanding a quality learning experience that includes a high level of service and convenience. The newly developed MOBLEI will be of great benefit to educators by providing them with a valid and reliable instrument that can be confidently used to assess students' perceptions of mobile enhanced learning environments in tertiary institutions in New Zealand that use different delivery modes.

5.5 SIGNIFICANCE

This research is significant for a number of reasons. It has made a valuable contribution to the learning environment research arena by developing a learning environment instrument that can be used with confidence to assess the effect that mobile technologies have on a tertiary learning environment in New Zealand. The study has provided a new perspective on the associations that exist between students' perceptions of mobile enhanced learning environments and students' outcomes in a tertiary institution that uses a range of delivery approaches. Additionally, the research methodology employed used qualitative data that were interpreted against a background of quantitative data. This allowed the data necessary to determine if there were differences between how each of the groups perceived the use of the mobile devices. Finally, there is enormous potential in the use of technologies such as mobile technologies to enhance the learning experience. The evaluation of this emerging learning environment, by using the MOBLEI, has made an important contribution to the work completed thus far.

5.6 LIMITATIONS

A limitation could be the sampling technique. Due to a purposive approach to sampling, all students enrolled in the programmes being surveyed were invited to be included in the study and no differentiation was made on the basis of ethnicity, age or gender. While students were categorised into one of three groups, depending on their mode of learning, it may have been interesting to consider how the students' perceptions of their mobile enhanced learning environment differed depending on their ethnicity, age or gender. Another limitation pertaining to the sample group is that it came from one tertiary institution in New Zealand potentially leading to sample bias. It is possible that the participants who responded may not be typical of other tertiary institutions in New Zealand.

Another limitation of this research may have been the small sample size. The sample of 141 students represented tertiary students studying business and computing subjects at certificate, diploma and degree programmes level. A larger sample size may have allowed generalisation of findings across other tertiary environments.

5.7 SUGGESTIONS FOR FURTHER RESEARCH

This research has provided valuable insights into the associations that exist between students' perceptions of mobile technology enhanced learning environments and students' outcomes in a tertiary institution in New Zealand. While numerous research possibilities present themselves, the four suggested research directions that follow seem to be both important and most likely to advance knowledge and contribute to further research.

First, it is suggested that this study could be replicated in another tertiary institution to allow for comparison of results. Furthermore, if such a study were undertaken in a tertiary institution from another country, the MOBLEI could potentially become a valid and reliable instrument for use in an international context.

Secondly, research attempts could be made to extend the study by using the MOBLEI to evaluate a mobile enhanced learning environment in New Zealand with a sample that includes multiple tertiary institutions. This would not only build on the findings from this study, but would also help to overcome the possible limitations identified above that may have resulted from the sample group and sample size. It would also provide opportunities for collaborative research with academics from other tertiary institutions.

Thirdly, a study that examines gender and generational groups' perceptions of a mobile technology enhanced learning environment would be of value to educators. It would be interesting to examine the differences that age and gender might have on students' responses to using mobile tools and whether there are differences in attitudes between different age groups and gender. Such a study could lead to a greater understanding of whether gender and/or age are associated with the use of mobile technologies and perceptions of the learning environment.

Finally, research could be conducted to investigate the use of other mobile devices that are becoming ubiquitous amongst tertiary students. For example, tablets such as the iPad are gaining popularity with many students, and have the potential to be effective in engaging and motivating students in tertiary education settings.

Research efforts to explore and assess how these mobile tools are being used in tertiary environments will not only extend the current study, but will advance knowledge in the emerging mobile learning domain and make a further valuable contribution to the rich body of knowledge that exists in the field of learning environment research.

5.8 FINAL COMMENTS

This study set out to contribute to the understanding of associations between students' perceptions of mobile technology enhanced learning environment and tertiary students' outcomes in New Zealand. An additional aim of the study was to develop and validate a modified learning environment instrument that could be used with confidence in tertiary settings in New Zealand. In undertaking this study I believe the interpretation and understanding that was developed could provide valuable information to educators and others in the field of education and research.

The consideration of students' perceptions of mobile technology enhanced learning environments through both quantitative and qualitative methods acknowledged the complexity of learning styles and tertiary provider delivery methods. As Wanpen and Fisher (2005) state, the provision of effective learning environments is considered an important factor that can enhance learning. It is therefore vital to gain an understanding of the associations between students' perceptions of their mobile technology enhanced learning environment and their outcomes. The insights gained from this study could help to increase the confidence of those providing education to be more creative when embarking on initiatives that include the use of mobile technologies.

Resource and time constraints continue to place pressure on tertiary providers to meet the needs of their students in a way that is responsive and contemporary. If education is provided to students in a way that enhances their learning experience, there is a greater possibility that students will be more engaged in their learning and they will maximise their cognitive outcomes. Creatively exploring and developing new ways of delivering education is essential and this study has shown that students' perceptions of the mobile technology enhanced learning environment were positively

associated with their attitude to the course, attitude to technology, their self-efficacy, and academic achievement.

The growth in students who are technologically competent continues to challenge tertiary providers to deliver education in a way that meets their needs. In keeping with the changing technological landscape, delivery methods and tools will continue to change shape and some in existence today will disappear altogether. All methods of teaching contribute an important aspect to students' learning and achievements, however, it is clear from this study that those students involved in face-to-face learning placed a high value on the use of mobile tools to enhance their learning.

Studies like this will continue to extend our knowledge on preferred learning environments and ways to enhance learning experiences, attitudes and cognitive outcomes. This study has shown that mobile technologies have the potential to enrich the learning experience. As it is important that educators have the ability to effectively evaluate and appraise the effect that these technologies have on the learning environment (Kukulska-Hulme, 2005), the MOBLEI will go some way towards providing tertiary educators and researchers with a valid and reliable tool to assess this exciting and emergent learning environment.

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APPENDICES

APPENDIX A

Mobile Enhanced Learning Environment Instrument

MOBILE-ENHANCED LEARNING ENVIRONMENT INSTRUMENT

Directions for Respondents

This questionnaire contains statements related to your learning in a mobile-enhanced learning environment. You will be asked how often each practice takes place.

There are no 'right' or 'wrong' answers. Your opinion is what is wanted.

Think about how well each statement describes what the mobile-enhanced learning environment class is like for you.

The '**Actual'** column is to be used to describe how often each practice actually takes place. The **'Preferred'** column is to be used to describe how often you would like each practice to take place (a wish list).

Draw a circle around

1	if the practice takes place	**Never**
2	if the practice takes place	**Seldom**
3	if the practice takes place	**Sometimes**
4	if the practice takes place	**Often**
5	if the practice takes place	**Always**

Be sure to give an answer for all questions. If you change your mind about an answer, just cross it out and circle another.

Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Simply give your opinion about all statements.

Section A – Background Information

For each statement/question, please tick the ☐ box which best represents you.

1. Gender

   ☐ Male ☐ Female

2. Age

   ☐ 20 and under ☐ 21 – 25 ☐ 26 – 30 ☐ 31 – 35 ☐ 36 and above

3. How is your programme of study delivered to you?

   ☐ Face to face, on campus

   ☐ Solely online off campus

   ☐ Distance with some face to face on campus component

4. Where do you spend most of your time studying?

   ☐ Home

   ☐ UCOL Campus

   ☐ Workplace

   ☐ Library

   ☐ Other _____

Code: _____

Section B - MOBILE-ENHANCED Learning Environment

For each statement, please **circle** the number which best represents your answer.

ACCESS	ACTUAL					PREFERRED				
	Always	Often	Some times	Seldom	Never	Always	Often	Some times	Seldom	Never
1. I can access information at times convenient to me.	5	4	3	2	1	5	4	3	2	1
2. The course material is available at locations suitable for me.	5	4	3	2	1	5	4	3	2	1
3. Access to my lecturer is easy using my mobile device.	5	4	3	2	1	5	4	3	2	1
4. I have regular contact with my lecturer using my mobile device.	5	4	3	2	1	5	4	3	2	1
5. My lecturer reminds me when assessments are due using my mobile device.	5	4	3	2	1	5	4	3	2	1
6. I decide how I want to learn.	5	4	3	2	1	5	4	3	2	1
7. Receiving information using my mobile device helps me meet my learning goals.	5	4	3	2	1	5	4	3	2	1
8. The mobile device allows me to get extra information on my areas of interest.	5	4	3	2	1	5	4	3	2	1

MOBILE- ENHANCED Learning Environment (Cont)

INTERACTION	ACTUAL					PREFERRED				
	Always	Often	Some times	Seldom	Never	Always	Often	Some times	Seldom	Never
9. I communicate with my lecturer using my mobile device.	5	4	3	2	1	5	4	3	2	1
10. In my learning environment, I have to be self-disciplined in order to learn.	5	4	3	2	1	5	4	3	2	1
11. I am able to ask my tutor what I do not understand.	5	4	3	2	1	5	4	3	2	1
12. I am able to ask other students what I do not understand.	5	4	3	2	1	5	4	3	2	1
13. My lecturer responds promptly to my queries.	5	4	3	2	1	5	4	3	2	1
14. I communicate with other students using my mobile device.	5	4	3	2	1	5	4	3	2	1
15. I receive valuable information from my lecturer using my mobile device.	5	4	3	2	1	5	4	3	2	1
16. I have been supported by positive feedback from my lecturer via my mobile device.	5	4	3	2	1	5	4	3	2	1

MOBILE- ENHANCED Learning Environment (Cont)

RESPONSE	ACTUAL					PREFERRED				
	Always	Often	Some times	Seldom	Never	Always	Often	Some times	Seldom	Never
17. My mobile device enables me to interact with other students and the lecturer whenever I want to.	5	4	3	2	1	5	4	3	2	1
18. I felt a sense of satisfaction and achievement about this learning environment.	5	4	3	2	1	5	4	3	2	1
19. I enjoy learning in this environment.	5	4	3	2	1	5	4	3	2	1
20. I could learn more in this environment.	5	4	3	2	1	5	4	3	2	1
21. It is easy to organise a get to together with other students using my mobile device.	5	4	3	2	1	5	4	3	2	1
22. It is easy to work collaboratively with other students using my mobile device.	5	4	3	2	1	5	4	3	2	1
23. The mobile-enhanced learning environment held my interest throughout my course of study.	5	4	3	2	1	5	4	3	2	1
24. I felt a sense of satisfaction towards the end of my course of study.	5	4	3	2	1	5	4	3	2	1

MOBILE- ENHANCED Learning Environment (Cont)

RESULTS	ACTUAL					PREFERRED				
	Always	Often	Some times	Seldom	Never	Always	Often	Some times	Seldom	Never
25. The learning objectives of my course are made clearer by learning in this environment.	5	4	3	2	1	5	4	3	2	1
26. The information provided via my mobile device makes the content easier to follow.	5	4	3	2	1	5	4	3	2	1
27. The contact with the lecturer via my mobile device keeps me focused on what is to be learned.	5	4	3	2	1	5	4	3	2	1
28. The content provided via my mobile device helps me with my assignment and test preparation.	5	4	3	2	1	5	4	3	2	1
29. Information is delivered via my mobile device in a structured way.	5	4	3	2	1	5	4	3	2	1
30. The content provided by my lecturer is appropriate for delivery via my mobile device.	5	4	3	2	1	5	4	3	2	1
31. The content provided by my lecturer via my mobile device is clear.	5	4	3	2	1	5	4	3	2	1
32. The tips provided by the lecturer via my mobile device enhance my learning process.	5	4	3	2	1	5	4	3	2	1

Open-Ended Questions

Please write your responses in the space provided below. Your comments could provide an explanation of previous responses and/or additional information you may wish to provide.

1. What other mobile devices, apart from your mobile phone, would you like to use while studying?

   _____
   _____
   _____
   _____

2. What are the advantages that you have encountered of studying in a mobile enhanced environment?

   _____
   _____
   _____
   _____

3. What are the disadvantages that you have encountered of studying in a mobile enhanced environment?

   _____
   _____
   _____
   _____

4. Are they any suggestions to improve the delivery of the course in a mobile-enhanced mode?

   _____
   _____
   _____
   _____
   _____

Focus Group (Optional Attendance)

The most common purpose for running focus groups is to gather participants further thoughts and feelings on a particular issue or topic in a shared environment. During this session you will be asked questions relating to the use of mobile technologies on which to provide your feedback on.

I would be interested in attending a brief focus group session at the UCOL campus in Palmerston North.

☐ No
☐ Yes I can be contacted on: Phone: (__) _____
Email: _____

Section C – Attitudinal Scales

Attitude to Course	Always	Often	Sometimes	Seldom	Never
1. I look forward to learning in this course	5	4	3	2	1
2. This course is fun	5	4	3	2	1
3. I dislike the content of this course	5	4	3	2	1
4. This course bores me	5	4	3	2	1
5. This course contains some of the most interesting work	5	4	3	2	1
6. I enjoy this course	5	4	3	2	1
7. Topics in this course are a waste of time	5	4	3	2	1
8. The topics covered make me interested in this course	5	4	3	2	1

Attitude to Technology	Always	Often	Sometimes	Seldom	Never
9. I'm good with technology	5	4	3	2	1
10. I like working with technology	5	4	3	2	1
11. Working with technology makes me nervous	5	4	3	2	1
12. I am comfortable trying new technologies	5	4	3	2	1
13. Working with technology is stimulating	5	4	3	2	1
14. I get a sinking feeling when I think of using technology	5	4	3	2	1
15. I do as little work as possible using technology	5	4	3	2	1
16. I feel comfortable using technology	5	4	3	2	1

Student Self Efficacy	Always	Often	Sometimes	Seldom	Never
17. I find it easy to get good marks in this course	5	4	3	2	1
18. I am good at this course	5	4	3	2	1
19. My friends ask me for help on in this course	5	4	3	2	1
20. I find this course easy	5	4	3	2	1
21. I outdo most of my classmates in this course	5	4	3	2	1
22. I have to work hard to pass subjects in this course	5	4	3	2	1
23. I am an intelligent student	5	4	3	2	1
24. I help friends with subjects on this course	5	4	3	2	1

APPENDIX B

Information Sheet and Consent Form

Mobile Technologies and the Impact on Tertiary Learning Environments

Information Sheet for Questionnaire

As a student who is undertaking tertiary education in either a distance, online or face to face mode, you are invited to take part in a questionnaire to share your perceptions and your participation in this arena. The research is being conducted by Catherine Snell-Siddle, Universal College of Learning, Palmerston North. This research is being conducted for the purpose of partial fulfilment of a Doctorate in Science Education.

The aim of the research is to explore the impact that mobile technologies may have on students learning environments and outcomes, including your actual and preferred perceptions and experiences.

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question
- withdraw your consent to participate at any time during the research
- ask any questions about the study at any time during participation
- provide information on the understanding that your identity will not be revealed
- be given access to a summary of the project findings when it is concluded

All information gathered for the purpose of the research will be treated confidentially and your identity will not be revealed. The researcher does not expect any harm to come about as a result of taking part in the research. Non-participation will not affect your grades. Collected data will be stored securely by the researcher and information collected will be destroyed at the end of the research.

This project has been reviewed and approved by the Curtin University Human Ethics Committee in Perth, Western Australia, and UCOL's Research Ethics Committee.

Should you have any questions, please contact myself on (06) 9527133 or email c.snell-siddle@ucol.ac.nz., or my supervisor, Dr Darrell Fisher on +61 8 9266 3110 or email D.Fisher@curtin.edu.au. Please indicate on the tear off slip overleaf if you agree to participate in the research and return in the pre-paid envelope provided as soon as possible. You will then receive the questionnaire in the post.

Yours sincerely

Catherine Snell-Siddle
UCOL

Mobile Technologies and the Impact on Tertiary Learning Environments

Participant Consent Form

This consent form will be held for a period of five (5) years

I have read the information sheet and have had the details of the study explained to me. Any questions I have had have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree to participate in this study under the conditions set out in the information sheet.

Name _____

Signed _____ Date _____

Mobile Technologies and the Impact on Tertiary Learning Environments

Information Sheet for Focus Group

As a student who is undertaking tertiary education in either a distance, online or face to face mode, you are invited to take part in a focus group to share your perceptions and your participation in this arena. The research is being conducted by Catherine Snell-Siddle, Universal College of Learning, Palmerston North. This research is being conducted for the purpose of partial fulfilment of a Doctorate in Science Education.

The aim of the research is to explore the impact that mobile technologies may have on students learning environments and outcomes, including your actual and preferred perceptions and experiences.

The focus group may take up to one hour of your time and your participation is entirely voluntary. It is anticipated there will be around 6-10 participants in your focus group. The focus group will be held at a time that is convenient to all participants and refreshments will be provided. This focus group session will be facilitated by Sue Ireland and the session will be audiotaped.

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question
- withdraw your consent to participate at any time prior to the focus group or during the focus group session
- ask any questions about the study at any time during participation
- provide information on the understanding that your name will not be used unless you give permission to the researcher
- be given access to a summary of the project findings when it is concluded
- ask for the audio tape to be turned off at any time during the focus group

All information gathered for the purpose of the research will be treated confidentially and your identity will not be revealed. The researcher does not expect any harm to come about as a result of taking part in the research. Participation or non-participation will not affect your grades. Collected data will be stored securely by the researcher and information collected will be destroyed at the end of the research.

This project has been reviewed and approved by the Curtin University Human Ethics Committee in Perth, Western Australia, and UCOL's Research Committee.

Should you have any questions, please contact Catherine Snell-Siddle on (06) 9527133 or email c.snell-siddle@ucol.ac.nz, or my supervisor, Professor Darrell Fisher on +61 8 9266 3110 or email D.Fisher@curtin.edu.au. Please indicate on the tear off slip overleaf if you agree to participate in the research and return in the pre-paid envelope provided as soon as possible.

Yours sincerely

Catherine Snell-Siddle
UCOL

Mobile Technologies and the Impact on Tertiary Learning Environments Study

Participant Consent Form

This consent form will be held for a period of five (5) years

I have read the information sheet and have had the details of the study explained to me. Any questions I have had have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree to not disclose and to keep confidential anything discussed in the focus group.

I agree/do not agree to the focus group being audiotaped.

I agree to participate in this study under the conditions set out in the information sheet.

Name _____

Signed _____ Date _____

APPENDIX C

Focus Group Questions

Focus Group Questions

The interview will be framed at the beginning of the session, including an explanation of mobile technologies and learning environments.

Below is an outline of topics to be covered with suggested questions.

The researcher will also ask the participants to give information on a separate piece of paper on demographic details such as age range, gender and learning mode (eg; online, blended, face to face).

1. Can you describe in what way mobile phones were used by your lecturers during your programme of study?

2. Do you think the use of mobile technologies enhanced your learning experience? In what way?

3. Was the amount of contact using the mobile device appropriate?

4. Was the content delivered using the mobile device appropriate?

5. Are there any other ways you think they could have been used?

6. Do you think the contact you received via the mobile device increased your motivation? In what ways?

7. Are there any other mobile tools you would like to use eg; ipods, PDA's? In what way do you think they could be used?

Summary and Conclusion

General overview - summary of questions and answers

Have we missed anything? What advice do you have for me?

APPENDIX D

Ethics Approval

memorandum

Curtin University of Technology

To	Catherine Snell-Siddle, SMEC
From	Pauline Howat, Coordinator for Human Research Ethics, Science and Maths Education Centre
Subject	Protocol Approval **SMEC20080040**
Date	24 July 2008
Copy	Darrell Fisher, SMEC
	Divisional Graduate Studies Officer, Division of Science and Engineering

Office of Research and Development

Human Research Ethics Committee

TELEPHONE 9266 2784
FACSIMILE 9266 3793
EMAIL hrec@curtin.edu.au

Thank you for your 'Form C Application for Approval of Research with Minimal Risk (Ethical Requirements)' for the project titled "*MOBILE TECHNOLOGIES AND THEIR IMPACT ON TERTIARY LEARNING ENVIRONMENTS. THE EFFECT OF DIFFERENT DELIVERY APPROACHES*". On behalf of the Human Research Ethics Committee I am authorised to inform you that the project is approved.

Approval of this project is for a period of twelve months **24th July 2008** to **23rd July 2009**.

If at any time during the twelve months changes/amendments occur, or if a serious or unexpected adverse event occurs, please advise me immediately. The approval number for your project is **SMEC20080040**. *Please quote this number in any future correspondence.*

Pauline

PAULINE HOWAT
Coordinator for Human Research Ethics
Science and Maths Education Centre

Please Note: The following standard statement must be included in the information sheet to participants:
This study has been approved by the Curtin University Human Research Ethics Committee (Approval Number SMEC20080040). If needed, verification of approval can be obtained either by writing to the Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University of Technology, GPO Box U1987, Perth, 6845 or by telephoning 9266 2784.

J:\office\Pauline\ETHICS\Ethics Approval Letter\Snell-Siddle.doc

memorandum

Curtin University of Technology

To	Catherine Snell-Siddle, SMEC
From	Pauline Howat, Coordinator for Human Research Ethics, Science and Maths Education Centre
Subject	**PROTOCOL APPROVAL - EXTENSION SMEC20080039**
Date	14 August 2009
Copy	Darrell Fisher, SMEC

Office of Research and Development

Human Research Ethics Committee

TELEPHONE 9266 2784
FACSIMILE 9266 3793
EMAIL hrec@curtin.edu.au

Thank you for keeping us informed of the progress of your research. The Human Research Ethics Committee acknowledges receipt of your Form B progress report for the project *MOBILE TECHNOLOGIES AND THEIR IMPACT ON TERTIARY LEARNING ENVIRONMENTS: THE EFFECT OF DIFFERENT DELIVERY APPROACHES.*

Approval of this project has been extended for the year to **8th July 2010.**

Your approval number remains **SMEC20080039.** Please quote this number in any further correspondence regarding this project.

PAULINE HOWAT
Coordinator for Human Research Ethics
Science and Maths Education Centre

Please Note: The following standard statement must be included in the information sheet to participants:
This study has been approved by the Curtin University Human Research Ethics Committee (Approval Number SMEC20080039). If needed, verification of approval can be obtained either by writing to the Curtin University Human Research Ethics Committee, c/- Office of Research and Development, Curtin University of Technology, GPO Box U1987, Perth, 6845 or by telephoning 9266 2784.

J:\office\Pauline\ETHICS\Form B Approv \Snell-Siddle.doc

16 July 2009

Catherine Snell-Siddle

School of Business and Computing

UCOL

Dear Catherine

Mobile Technologies and their impact on tertiary learning environments

Thank you for submitting a research application for this project. I am pleased to advise that your application has now been approved.

On behalf of the subcommittee, I would like to wish you all the best for this research.

Yours sincerely

Dr Marian Bland

Chair, UCOL Research subcommittee

Manawatu: UCOP ALMERSTON NORTH Cnr King and Princess Streets, Private Bag 11022, Palmerston North 4442, New Zealand, Fax 06 952 7023 Phone 06 952 7000
Wairarapa: UCOWAIRARAPA 143- 159 Chapel Street, PO Box 698, Masterton 5840, New Zealand, Fax 06 946 2302 Phone 06 946 2300
Whanganui: WHANGANUI UCOll 6 Rutland Street, Private Bag 3020, Wanganui 4540, New Zealand, Fax 06 965 3802 Phone 06 965 3800
General and Course Information Phone 0800 46 82 65 Email enquiry@ucol.ac.nz Website www.ucol.ac.nz