Influences on the adoption of mobile technology by students and teachers

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ABSTRACT

Technology offers new possibilities to provide effective teaching and learning. One of the most recent technologies that has ignited considerable interest by educators is mobile technology. Mobile technology has been quickly adopted in everyday life, and it is common for most people to have, and carry, a mobile device with them at all times. In addition these mobile devices are becoming more and more powerful and taking over tasks that would normally be done on traditional PCs or laptops (Dawabi, Wessner, & Neuhold, 2004). Researchers have started to explore the way mobile technology can be harnessed in the educational arena (see for example Attewell & Gustafsson, 2002; Cobcroft, Towers, Smith, & Bruns, 2006; Seppälä & Alamäki, 2003; Traxler, 2009; Zawacki-Richter, Brown, & Delport, 2009; Zeng & Luyegu, 2011). Despite the interest, little is known about the factors that will impact student and educator adoption of mobile learning. Current studies into mobile learning are mainly small scale trials and pilots with most focussing on student adoption. Factors that affect the mobile learning adoption by educators seem to have been largely ignored.

To address this gap in the literature, the present study has developed two models of student and educator adoption of mobile learning. The models posited that the perceived ease of use and usefulness of mobile technology would mediate the relationship between self-efficacy beliefs, motivation and level of self-direction of students and the intention of students and educators to adopt mobile learning.

A total of 446 students from three tertiary institutes and 196 educators from all New Zealand completed a survey that identified their learning and teaching-related beliefs and attitudes, their intentions to adopt mobile learning, and their perceptions of using mobile technology to support their learning and teaching.

The study found that educators and students are influenced by different factors to adopt mobile learning. Specifically, it found that the self-efficacy beliefs, motivation and self-directedness (students) had varying degrees of influence on ease of use and usefulness perceptions of mobile learning, and overall intention to adopt it. The study also found evidence to suggest that these factors may differ between students of different ages, genders and institute types they attend.

The study also provides recommendations to educators, researchers, learning designers and institutes who wish to implement mobile learning into their curriculum to accommodate and encourage adoption.

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CHAPTER 1: INTRODUCTION

1.1 Introduction to the Study

A recent trend in higher education has been to seek out and integrate new tools into the educational process to facilitate student learning (Lim, 2002). Educators continually search for ways to support student learning that is both engaging and effective. Technology has often been viewed as a way to provide both of these things to the learner. Information and communication technologies (ICT) in particular have been adopted to facilitate a wide range of educational, administrative and support tasks (Akour, 2009). ICT has been seen as a way to provide learners and educators with opportunities to share resources, foster interaction and communication, and provide support outside the classroom. This technology has helped make access to learning easier and often more efficient.

One technology that promises to dramatically change learning is mobile learning. Mobile technology has quickly been adopted in everyday life, and it is common for most people to have, and carry, a mobile device with them at all times. In addition mobile devices are becoming more and more powerful and are replacing some of the tasks that would normally be done on traditional PCs or laptops (Dawabi, et al., 2004). Researchers have started to explore how mobile technology can be harnessed in the educational arena (see for example Attewell & Gustafsson, 2002; Cobcroft, et al., 2006; Seppälä & Alamäki, 2003; Traxler, 2009; Zawacki-Richter, et al., 2009; Zeng & Luyegu, 2011).

While the true value of mobile technology in education is still to be fully realised (Rajasingham, 2011) and most studies into mobile learning have been small scale or one off pilots (Akour, 2009), many researchers suggest that mobile technology has the potential to offer important advantages to both students and educators (Churchill & Churchill, 2008; Cobcroft, et al., 2006). These advantages relate to the nature of mobile technology which provides access to powerful tools that are available when and whenever needed (Herrington & Herrington, 2007; Looi, et al., 2009; Ryu, Cui, & Parsons, 2010).

It is predicted that mobile learning will extend learning into new areas and open up new opportunities. Mobile technology has already established its ability to support social interaction and social constructivist learning processes (Cobcroft, et al., 2006). Bryant (2006) sees mobile learning as a way to 'expand discussion beyond the classroom and provide new ways for students to collaborate and communicate within their class or around the world' (p. 61). Mobile technology also enables students to drive their own learning and explore their own interests since it offers more flexible and accessible learning (Attewell & Gustafsson, 2002; Cobcroft, et al., 2006). With mobile technology learning can be more flexible, ubiquitous and motivating since mobile technology enables 'always-on' learning, accessible to the masses, but tailored to the individual' (Thomas, 2005, p. 5). Moreover, mobile learning may provide educationalists with a way to capture the attention of students that may otherwise be disinterested in more traditional means of education (Sharples, Taylor, & Vavoula, 2005). For example, some studies have explored the use of mobile technology as a highly effective hook which encourages learners and makes learning fun and out of the ordinary (Perry, 2003). The extension of the widely used mobile phone to learning is also thought to be a non-threatening way of introducing technology into learning (Digital Millennial Consulting, 2011). Other studies have described how mobile technology can support learners and reduce dropout rates (Abas, et al., 2011; Bolliger, Supanakorn, & Boggs, 2010, Goh, Seet, & Rawhiti, 2011). Abas, Lim and Woo (2011) showed that the use of SMS to keep students informed about course content, provide them with reminders and tips on how to study effectively and motivate them had the effect of reducing anxiety and the drop-out rate of distance learners. Mobile devices can transport learning outside the classroom as well as encourage learning within the classroom (Straub, 2009). These benefits have made mobile learning extremely interesting to educators and therefore have encouraged interest in the adoption of mobile technology into the educational environment. However to realise the benefits of mobile learning, the adoption process of this new technology needs to be understood and addressed.

1.2 Resistance to Technology

Evidence suggests that acceptance of technology-base learning and teaching may depend on a range of factors such as perceptions of the usefulness by students (Lu & Viehland, 2008); characteristics of students such as learning styles and preference for teaching modes (Hunt, Thomas, & Eagle, 2002; Hsbollah & Idris, 2009; Liaw, 2008; Teo, 2010; Davis, 1989; Venkatesh, Morris, Davis, & Davis, 2003; Suprateek & John, 2003); convenience of technology, quality of the resource, motivation, and perceived ease of use (Grandon, Alshare, & Kwun, 2005). However, the specific factors that influence student adoption of mobile learning are still relatively unknown (Akour, 2009). Students can have very different perceptions about technology and different levels of technological literacy compared to educators and for this reason it is important to consider the student in the adoption of educational technology (Suprateek & John, 2003).

Educator attitudes and perceptions to the integration of technology into teaching also need to be taken into account when introducing new technology. Students may choose to adopt new technology into their learning, but this will be limited by educators who largely control the learning environment (Aubusson, Schuck, & Burden, 2009). Consequently, factors that influence educators' integration of technology into their teaching should be considered along with student adoption. If educators fail to see the benefit of using new technology it will become extremely difficult for that technology to gain traction. Even when the use of new technology is mandated, passive resistance by educators can influence the success of implementation. Resistance by educators could undermine the success of any new initiative.

A major hurdle for bringing technological change to the classroom is the concurrence of educators, since they are the facilitators of the learning activity and therefore the gatekeepers to the means of learning (Aubusson, et al., 2009). According to Mumtaz (2000), factors that influence educator adoption of new technology can include: access to resources, quality of software and hardware, ease of use, incentives to change, support and collegiality in their school, school and national polices, commitment to professional learning and background in formal computer training. Mobile technology adoption by educators, on the other hand, has received very little attention in the literature and little is known about what will influence their adoption of mobile learning (Uzunboylu & Ozdamli, 2011).

1.3 Statement of the Problem

The uptake and integration of technology in the tertiary education sector has been rapid as educators have found ways of using ICT to extend learning opportunities for their students (Oliver, 2003; Tearle, 2003). However, the cost of investing in new technology is expensive and time consuming (Birch & Burnett, 2009; Traxler, 2003). When educators or students resist new technology, the opportunity cost of non-use, wasted effort and resources, and the failure to realise the full benefits of the new technology can drive that cost even higher (Birch & Burnett, 2009; Davis, 1989; Davis & Wiedenbeck, 2001; Hsbollah & Idris, 2009; Verhoeven, Heerwegh, & De Wit, 2011). Consequently, user acceptance is an important factor when considering the introduction of new technology such as mobile learning (Romiszowski, 2004).

While research on the adoption of technology by students and educators may indicate some of the factors that may be important in the introduction of mobile learning, this insight may be too general to be useful to institutional decision-makers considering mobile-learning. The small scale trials and pilots have been undertaken on mobile learning adoption to date (Akour, 2009; Uzunboylu & Ozdamli, 2011; Williams, 2009), while interesting, lack the scale to give substantial confidence in the results. Therefore this study proposes to identify those factors that influence acceptance of mobile learning by both students and educators and build a cognitive framework that models the acceptance of mobile learning for these two groups.

1.4 Aim of This Study

Adopting an information systems perspective, the current study draws on a diverse range of literatures to develop an understanding of the adoption processes of students and educators, and how their beliefs, attitudes and motivation for learning and teaching may influence their adoption of mobile learning.

The main aim of this study is to develop and test a model of student and educator adoption of mobile learning. Specifically, the study asks:

- *To what extent do student and educator perceptions of ease of use and usefulness of mobile learning influence the adoption of mobile learning?*
- *What factors play an influencing role in the perceptions of the students' and educators' adoption of mobile learning?*
- *How do students and educators differ in their attitudes to, perceptions and adoption of mobile learning?*

1.5 Thesis Structure

This thesis comprises seven chapters. The first chapter outlines the background and justification for the study. The problem statement and the broad research question are also briefly introduced.

Chapter 2 reviews the literature that relates to the study. It first builds a case for mobile learning in education and describes where mobile learning sits within the educational context. It also highlights the benefits mobile technology may offer to students and educators. The next section introduces the adoption theory that has been explored by other researchers to investigate user adoption of technology. It identifies existing research into mobile learning adoption and the current gaps in the literature. The third section reviews those factors that may influence the adoption of mobile learning. Measurement of these factors is also reviewed.

Chapter 3 presents the methodology and instruments used in this study. It also introduces the specific hypotheses that will be tested to answer the research questions. Finally, the reliability and validity of the instruments are presented, along with a description of the statistical methods used.

Chapter 4 presents the results of the student questionnaire. There are five parts to this chapter they include: the descriptive statistics; the results from the factor analysis relating to the measures in the model; the results from the testing of the proposed structural models; the results relating to the moderating effects of gender, age and institute attendance; and an analysis of the qualitative comments collected from the survey. Chapter 5 follows the same structure as Chapter 4 and presents the results of the educator questionnaire.

Chapter 6 contains a detailed discussion of the findings, and how they answer the research questions. This chapter also includes the limitations of this study

The last chapter, Chapter 7, draws together this study and includes a number of key conclusions and highlights its contribution to the literature and future avenues for research.

CHAPTER 2: LITERATURE REVIEW

2.1 Overview

Mobile technology has gained increasing focus in academic circles as a way to enable learning that is not confined by time and place. A large number of research activities have looked at how this technology can be harnessed to elicit the potential benefits it affords both students and educators (see for example Aubusson, et al., 2009; Churchill & Churchill, 2008; Cobcroft, et al., 2006; Csete, Wong, & Vogel, 2004; Facer, Faux, & McFarlane, 2005; Herrington & Herrington, 2007; Naismith, Lonsdale, Vavoula, & Sharples, 2005; Sattler, Spyridakis, Dalal, & Ramey, 2010; Yang, Chu, Wang, Yu, & Yang, 2008; Zawacki-Richter, Brown, & Delport, 2007). As these benefits of mobile learning are being clarified so too will researchers need to understand the factors that will influence the adoption of mobile learning. The future adoption of mobile technology will largely depend on whether students and educators believe that mobile technology fits their particular needs. The decision to adopt mobile learning is a complex process with a large number of influencing factors.

This chapter first reviews the literature that investigated the potential of mobile learning to improve learning and teaching, since these benefits justify the need to understand the technology adoption process. It highlights some of the important advantages that mobile technology can offer tertiary institutions and investigates how mobile learning could fit within the existing educational framework. However, these benefits will fail to materialise unless mobile learning is accepted by students and educators. The second part of this chapter introduces adoption theory, which helps to predict and explain future adoption by users. It reviews the way adoption theory has been used to understand student and educator adoption of educational technology. The adoption of technology has been found to be influenced by a number of user characteristics. These characteristics are reviewed to explore their usefulness in predicting the adoption of mobile learning.

2.2 Mobile Learning as a Paradigm Shift

Education has undergone a major paradigm shift caused by the emergence of new technology and the advances made in information and communication technologies (Castells, 2006; Kesim & Agaoglu, 2007). Educators increasingly reconfigure their teaching and learning activities to take advantage of new technology and integrate it with existing practices (Rogers, 2000). Mobile technology has the potential to enable new ways of accessing and interacting with learning content not previously possible. The following section examines the potential of mobile learning to bring about change in educational processes. This section will critically evaluate the potential benefits of mobile learning and how it can be used to build learner motivation and enhance learning.

Mobile learning has been defined by a number of researchers, most of who focus on the technology element of it. For example Parsons and Ryu (2006) defined mobile learning as the delivery of learning content to learners utilizing mobile computing devices. Mobile learning has also been described as an extension of elearning (Georgiev, Georgieva, & Smrikarov, 2004; Trifonova & Ronchetti, 2004). O'Malley et al.'s (2003, p. 7) definition; "any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies" is useful because its inclusiveness doesn't prematurely eliminate useful learning devices.

Mobile learning has enabled learning that is no longer confined by location and time. It offers convenient interaction and support that students can control, as described by Soloway (2003) "For the first time in ICT history, we have the right time, the right place and the right idea to have a huge impact on education: handheld computing" (p. 2). The portability of mobile technology it has enabled learning anywhere and anytime (for example, Chen & Kinshuk, 2005; Cobcroft, et al., 2006; Csete, et al., 2004; Johnson, McHugo, & Hall, 2006; Peters, 2009). This portability offers students and educators an opportunity to access content and support at times that are convenient or urgent for the student (Noelting & Tavangarian, 2003; Schreurs, 2006). Several mobile learning trials have looked at how mobile technology enables students to maintain engagement with learning outside the classroom (Garrett & Jackson, 2006; Koeniger-Donohue, 2008). These studies have shown that mobile technology can connect students to other learners, their educators and learning content even when they are outside the classroom.

Mobile technology can be utilised to provide support to students outside the classroom (Kenny, Park, Van Neste-Kenny, & Burton, 2010; Koeniger-Donohue, 2008; Scollin, Healey-Walsh, Kafel, Mehta, & Callahan, 2007; Whittlestone, Bullock, Pirkelbauer, & May, 2008). In particular studies have looked at how mobile learning can be used to support students while they are placed on practicum, and therefore away from their usual classroom environment. For example Garrett and Jackson (2006) described how personal digital assistants (PDA) were used by nursing students to enable them to immediately access clinical expertise and resources remotely and record their clinical experiences in a variety of media (text, audio and images). The students were able to carry the small PDAs with them and connect, upload and download data when needed. Other studies have looked at how mobile learning can help students in specific leaning domains, for example as a way to support second language learners (Chinnery, 2006; Hiroaki, 2004; Thornton & Houser, 2005). Thornton and Houser (2005) found that sending vocabulary lessons to students' phones enabled learners to access learning content more easily. They also indicated that learners felt more connected and supported. These studies and others have shown that mobile learning gives student the opportunity to improve their communication and organisation (Mac Callum & Kinshuk., 2008; Stead, Sharpe, Anderson, Cych, & Philpott, 2006).

The magnitude of the paradigm shift is influenced by the pervasiveness of mobile technology in everyday life and its potential to change practices even in the classroom. In large lecture theatres educators have used mobile technology to receive feedback from students and encourage participation (Leung, 2007; Markett, Sánchez, Weber, & Tangney, 2006; Scornavacca & Marshall, 2007). Students are able to send questions and answers via their mobile device. Allowing students to interact via the mobile devices encourages participation and makes asking and answering questions in a large classroom less intimidating. These studies have found that mobile technology can also be used to encourage student interaction and motivate students learning (Markett, Sánchez, Weber, & Tangney, 2006).

Mobile technology has the potential to enable new ways to of learning and provide more opportunities to learning. Most learning environments now incorporate some form of technology to assist instruction and learning (Harasim, 2000); however this technology must capture the interest of students and motivate them to be more engaged within the learning context (Bae, Lim, & Lee, 2005). Mobile technology is thought to have the ability to build interesting learning environments that engages learners (Shroff & Narasipuram, 2009). The next section reviews studies that have investigated ways in which mobile learning can be harnessed to support student engagement.

2.2.1 Supporting student engagement

Students who are more motivated are more likely to succeed in their learning, compared to students with low levels of motivation who are more likely to disengage (Alderman, 2008; Schiefele, 1991). Motivating learners is, therefore, an important issue for educators. Ramsden (2003, p. 93), stated that "the first principle of effective teaching is ensuring that you capture students' interest, which includes making the learning of unit material a 'pleasure' for students". This concept was further elaborated by Field (2005) who discussed how educators can capture student's attention by actively engaging and developing them and by using outcome-focused learning environments.

The way in which learning is orientated is critical for fostering motivation (Stefanou & Salisbury-Glennon, 2002). A learning environment that is learner-centred is more likely to foster the motivation of students (Vovides, Sanchez-Alonso, Mitropoulou, & Nickmans, 2007). In 1979, Keller conducted a comprehensive review and synthesis of motivational literature that has since become seminal. She identified a number of factors that could be incorporated into educational design to enhance student motivation.

> In brief, we can say that in order to have motivated students, their curiosity must be aroused and sustained; the instruction must be perceived to be relevant to personal values or instrumental to accomplishing desired goals; they must have the personal conviction that they will be able to succeed; and the consequences of the learning experience must be consistent with the personal incentives of the learner. (Keller, 1979, pp. 6–7)

These factors where later developed into the ARCS model (Keller, 1979, 1987, 2008) which focused on four principles of motivation:

- Attention: gaining learner attention,
- Relevance: establishing the relevance of the instruction to learner goals and learning styles,
- Confidence: building confidence in regard to realistic expectations and personal responsibility for outcomes,
- Satisfaction: making the instruction satisfying by managing learners' intrinsic and extrinsic outcomes.

These four principals are explored below and related to characteristics of mobile technology.

2.2.1.1 Attention.

Gaining student attention and building their curiosity is important to motivating student engagement in a learning activity (Keller, 2008). A number of research theories establish the importance of capturing learner curiosity using novel and interesting methods (for example Dooley, Lindner & Dooley, 2005; Ainley, 2006). By capturing student attention and developing their interest and curiosity in the learning environment students experience and enjoy the knowledge acquisition processes to a greater extent (Hardy & Boaz, 1997; Rovai, Ponton, Wighting, & Baker, 2007). Researchers have shown that individuals receive pleasure from activities that have some level of surprise, incongruity, complexity or discrepancy from our expectations or beliefs (Hunt, 1965; Kagan, 1972). Learning that is boring or repetitive will turn off students (Kopp, 1982), however, learning that is too different from an individual's expectations will be ignored and cause anxiety (Pekrun, 1988; Ruthig, et al., 2008; Wilfong, 2006). In addition, students that are asked to do or use something that is unfamiliar or requires a major effort may take a variety of approaches, depending on their level of motivation. Motivated students will focus on the task and learn how to use or complete the activity, whereas less motivated students may simply avoid the task altogether (Vallerand, et al., 1992; Walker, Greene, & Mansell, 2006).

A study by Perry (2003) found that students were excited, and therefore highly motivated, to use mobile technology in their learning. The “toy factor” that mobile technology offered to students was considered a highly effective hook, which encouraged and made the learning fun and out of the ordinary. This “hook” factor, as discussed in Perry (2003), may be effective only in the short term. Belt (2001) argues that once the novelty wears off, students become more confident and comfortable with the device and come to see the devices as working tools, a perspective shared by others (Barker, Krull, & Mallinson, 2005; Le Roux, 2008).

2.2.1.2 Relevance.

Motivation to learn is enhanced and promoted when it is perceived that the knowledge is meaningfully related to a learner’s goals (Keller, 2008). Connections are needed between the instructional environment, including “content, teaching strategies, and social organisation, and the learner’s goals, learning styles, and past experiences” (Keller, 2008, p. 177). Relevance may relate to extrinsic goals such as the need to pass the course, however intrinsic goals may be achieved simply by including activities that are personally interesting and freely chosen by the student.

Herrington and Herrington (2007) described how mobile technology can provide relevant and authentic learning experiences to educators and students alike if approached correctly. As discussed by Traxler (2007), mobile learning is able to provide authentic tasks that can be built around data capture, location-awareness, and collaborative work, even for distance learning students physically remote from each other. Two examples of mobile technology that demonstrate authentic approaches are: AmbientWood, a project set up for children which enabled them to explore and reflect upon a physical environment that had been augmented with digital information provided on a mobile device (Rogers, et al., 2002); and ActiveCampus (Griswold, et al., 2002), a mobile application for tertiary students that enables them to locate and collaborate with fellow students. A study conducted by Chan, Lee, and McLoughlin (2006) explored the use of podcasts created by expert students for novice students. These podcasts were used as a positive way to enhance learning for both the expert and novice students. For example when the expert students made the podcasts they were able to reinforce their own learning by converting it into their own words. The novice students benefited from these podcasts by being able to listen to other students’ podcasts that explained the concepts in different ways to those of the teacher.

Mobile devices such as mobile phones have several tools that can be harnessed to support learning with relative ease. For example, Roschelle, Patton and Pea (2003) explored the use of mobile technology to capture students' attention; in particular, they concentrated on ways that mobile devices can be used to help students and teachers participate socially in teaching and learning. They showed that even less powerful handhelds with slower communication could be used in a number of ways to enhance class discussion and support "informatic participation among connected devices" (Roschelle, et al., 2003, p. 3). For example they demonstrated that mobile technology could be harnessed as a classroom response system where students were able to answer questions in class and send their answers back to the lecturer. The lecturer was therefore able to assess students understanding in an interactive and social way.

2.2.1.3 Confidence.

Motivation to learn is promoted when learners believe they can succeed in mastering the learning task (Keller, 2008). Students who feel in control and expect to do well are more motivated to learn and experiment with new learning environments. Confidence can be developed by providing students with positive learning experiences (Jones, 2009; Weiner, 1972).

A study by Attewell (2005) involving a mentor working with a group of displaced young adults studying ESOL (English for Speakers of Other Languages) showed that after using mobile technology to support their learning they were more confident using other technology, such as computers, than they were before the project. In addition, these students who were initially resistant to ICT were so confident that they were also willing to offer support and assistance to their peers. The study found that using mobile technology enabled them to remove some of the formality of traditional learning. Through student familiarity with similar technology, for example PlayStation and GameBoy, mobile technology helped to engage the learners within the class and maintained their interest levels as well as overall confidence. Other technology, such as podcasting, has also been employed as a way to elevate the anxiety of first year tertiary students (Chan & Lee, 2005) where students are able to listen to course content and refine concepts before and after class.

2.2.1.4 Satisfaction.

Satisfaction from learning and successful outcomes will promote the motivation of students to learn (Keller, 2008). If learners feel good about learning results, they will be motivated to learn. According to Shih and Mills (2007) mobile learning offers the opportunities for learners to use their newly acquired skills and knowledge in a real or simulated setting. By being able to reinforce their learning they are able to sustain their desired learning behaviour, which can produce true satisfaction.

Mobile learning has been shown to give students and educators a sense of satisfaction especially when the technology was easy to use, helpful and relevant in their learning (Chen & Yen, 2007; Gyeung-Min & Soo Min, 2005). Satisfaction, through increased motivation may also effect student achievement. Nihalani & Mayrath (2010) described the development of a statistics application to be used on an iPhone. They found that students who claimed use of the application increased their motivation to study had significantly higher final grades than students who felt the application had no effect on their motivation. The reasons cited by students for increased motivation was "(a) the convenience of accessing material on-the-go or outside of formal study time, (b) the app's concise and easy-to-understand lessons, and (c) the disadvantages of traditional textbooks such as the weight and "wordiness" of content"(Nihalani & Mayrath, 2010, p. 6).

Mobile learning by its ability to capture attention, promote relevance through authentic tasks, improve confidence and increase satisfaction with learning seems to have the potential to enhance student motivation. The following table (Table 1) summarises the four factors of the ARCS model and show how they relate to mobile learning.

Table 1. The four factors of the ARCS model in relation to mobile learning.

	Definition	The mobile learning effect	Studies that illustrate this effect
Attention	Gaining students attention and building their curiosity is important in motivating a student to engage in a learning activity.	Mobile technology can capture the attention of the students (Novelty effect) Student kept involved with wide range of tools To give students variety of tools which can be used to better meet their needs	Perry (2003) Belt (2001) Barker et al. (2005) Le Roux (2008) Roschelle et al. (2003) Scollin, Callahan, Mehta, & Garcia (2007) Tao, Cheng, & Sun (2009) Frydenberg (2006)
Relevance	Establishing the relevance of the instruction to learner goals and learning styles.	Multiple methods of interaction (supporting Learning Styles) Personal instruction/developed around students needs To provide instruction while students are interacting with the environment	Herrington & Herrington (2007) Traxler (2007) Rogers et al. (2002) Griswold et al. (2002) Chan, et. al (2006) Koeniger-Donohue (2008) Garrett & Jackson (2006)
Confidence	Building confidence in regard to realistic expectations and personal responsibility for outcomes.	Mobile devices can often be less daunting that a computer – the ubiquitousness of mobile phones Devices are their own – used every day (ownership) Feedback or interaction could be accessed when required no matter where and when student is located	Attewell (2005) Chan & Lee (2005) Koeniger-Donohue (2008) Garrett & Jackson (2006)
Satisfaction	Making the instruction satisfying by managing learners' intrinsic and extrinsic outcomes.	Intrinsic motivation such as fun, curiosity and self-determination (learners can chose when to learn)	Chen & Yen (2007) Gyeung-Min & Soo Min, (2005) Nihalani & Mayrath (2010) Huizenga, Admiraal, Akkerman, & ten Dam (2009) Pettit & Kukulska-Hulme (2007)

Mobile learning has the potential to change existing teaching and learning practices (Farooq, 2002; Kesim & Agaoglu, 2007; Rajasingham, 2011; Zawacki-Richter, et al., 2007). Rajasingham (2011) explored the rapid adoption of mobile technology in everyday life and the extensive opportunities mobile technology offers education. However, she cautioned that mobile technology in education had some way to go before it could affect a major shift in education as mobile learning is still in its infancy and is yet to be widely adopted in education. She calls for more development or adaptation of learning theory for mobile learning and critical frameworks to evaluate the use of mobile technologies before mobile learning will revolutionise education. This message has been reinforced by Zawacki-Richter, Brown and Delport (2009) who stated that the difficulty of educators to determine the full effect of mobile learning on the educational environment is due to the limited literature on the benefits of mobile learning. However before the potential benefits can be fully realised we need to understand the factors that influence adoption.

The next section explores how technology adoption theory can be applied to the adoption of mobile learning.

2.3 Technology Adoption in Education

The adoption of technology in education is a complex process with many factors determining the adoption rate, and these factors may differ between educators and students (Mumtaz, 2000). User acceptance has been defined as “the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support” (Dillon & Morris, 1996, p. 5). In the context of mobile learning user acceptance can be expressed as the willingness of educators and students to use their mobile devices to support their teaching and learning.

A number of theories have been developed to explain adoption, including Diffusion of Innovation (Rogers, 2003), the Theory of Reasoned Action (Ajzen & Fishbein, 1980), the Theory of Planned Behaviour (Ajzen, 1991), the Technology Adoption Model (TAM) (Davis, 1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis, & Davis, 2003). Each of these theories is examined in the following section for applicability to understanding and explaining the adoption of mobile learning.

2.3.1 Diffusion of innovation.

According to Rogers (2003, p. 10) "Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system." Rogers claimed that there are four main elements of diffusion: innovation, time, communication channels, and social systems. These include:

- Innovation: the idea, practise or object that is developed that is the focus of the adoption.
- Time: the acceptance rate of the innovation over time.
- Communication channel: how the innovation is introduced or how it is marketed to an individual.
- Social system: the elements (such as individuals, groups, organisations and/or subsystem) that are involved in the adoption of the innovation and their impact on each other.

Of most interest to understanding what factors influence the adoption of technology in an educational setting is Roger’s (2003) element of Innovation as these address the nature of the technology itself. This element highlights those characteristics of the innovation that increase its potential for adoption. The following section examines the relationship between the characteristics of innovation and their influence on adoption.

2.3.2 Innovation characteristics for the adoption of mobile technology.

Rogers (1983, 2003) states that successful adoption of a particular innovation must have the following characteristics: the innovation must be seen to be better than existing technology or practices; it must be compatible with the users’ needs; it should be available to trial as well as visibly being successfully used by others; and it should not be complex to use or difficult to learn. These five characteristics and their implications for the future adoption of mobile technology used for a teaching and learning context are discussed below.

The first of Roger’s (2003) adoption conditions is that new technology must be seen to have an advantage over older technology. The issue of relative advantage has been shown to have a positive relationship with adoption of innovation (Anderson & Harris, 1997; Teng, Grover, & W., 2002; Tornatzky & Klein, 1982). An example of the failure to adopt when no perceived benefits were identified was evident in a study of modern foreign language teacher trainees who were given PDAs which they were directed to use in their teaching (Wishart, 2008). A lack of support and time to fully explore the potential of these devices in the classroom left the trainees preferring to use existing teaching technologies. Time to explore and understand the potential of technology has been found by others to be critical to the acceptance and continued use of new technology (Jeffrey, Hegarty, Kelly, Coburn, Penman, 2011).

The second of Rogers' conditions for adoption is the 'compatibility of the innovation'. Compatibility refers to the degree to which an innovation is perceived as being consistent with the existing values, needs, and past experiences of potential adopters (Hester & Scott, 2008). If an innovation is compatible it will not require the users to drastically alter they ways they already do things therefore making the innovation more appealing. For mobile learning this means that it must be consistent with an individual's current values and experiences. The more compatible mobile learning with the normal practices of students and educators, the smaller the change in behaviour is required. Compatibility will speed the adoption of mobile learning into the educational setting. When a major adjustment to their behaviour is needed, the conflict it creates with existing practices reduces the likelihood of adoption (Veer Martens & Goodrum, 2006). The user's previous experience of using new tools in education will also influence the adoption of mobile technology. A negative previous experience can transfer to the adoption of another (Beckers & Schmidt, 2003). This is particularly problematic in an educational environment where students and educators have often resisted the introduction of new technology (Demetriadis, et al., 2003; Hunt, Thomas, & Eagle, 2002).

Trialability, the third condition of Rogers (2003), is the extent to which the innovation can be tested and experimented with before its introduction. Trialability is extremely important for educators who need to be comfortable with the new technology before they introduce it to their students (Wishart, 2008). Mobile devices have enjoyed extensive diffusion in everyday life; however their use as an educational tool has been limited as considerably more time is needed to explore the way mobile technology can be used to support their teaching and learning (Cobcroft, et al., 2006).

Related to trialability are the characteristics of observability of the innovation. Observability involves prospective users having the opportunity to see the innovation successfully in use before they use it themselves (Rogers, 2003). A number of researchers discuss the hesitance of educators to adopt mobile learning into education as they would rather wait and see others implement it into their course first (Mac Callum & Jeffrey, 2010; MacCallum, 2010; Perkins & Saltsman, 2010).

The final condition identified by Rogers (2003) is the complexity of an innovation. If the mobile technology requires considerable time for the user to learn to use it, it is less likely that educators and students will persevere. The perceived complexity of the technology will also lead to increased uncertainty and perceived risk and this in turn can lead to a resistance to adopt (Tabata & Johnsrud, 2008). According to Sharples, Taylor, and Vavoula (2005), the complexity of mobile learning is intricately linked to the context in which the learning occurs. They explained that the learning experience is influenced by the context, including the time and location of the learning, the learner's goals and motivation, their surroundings and others around them. These factors are especially important in mobile learning where learning can take place anywhere as the added mobility makes it possible to learn in different settings. These settings will demand different tools and needs and it is therefore important to take them into account especially as regards the way they fit the learning context to ensure a positive learning experience (Sharples, Corlett, & Westmancott, 2002).

Rogers' (2003) diffusion model predicts that for the innovation of mobile technology to be adopted in an educational context it needs to show relative advantage over other technologies, such as elearning, and should not be too complex to use. In addition users, especially educators, need to see mobile learning in action and be given a chance to try out the technology themselves. It is important to consider not only the characteristics of an innovation but also the process of adoption. A number of theories have evolved from Roger's original work to explain why individuals accept or resist technologies. The following section examines the most important of these theories and the way they have been developed to model the process of technology acceptance.

2.3.3 Modeling the process of acceptance.

When assessing the diffusion of innovation it is also important to consider the process of user acceptance (Dillon & Morris, 1996). Dillon (2001) raised the concern that the characteristics listed by Rogers (1983) are too loosely defined to provide a sound basis for a complete theory. Specifically Rogers' (2003) model focused more on the diffusion of innovation over time and the different stages of diffusion and does not attempt to explain an individual's acceptance of technology (Akour, 2009). A number of models evolved to fill this gap (Ajzen & Fishbein, 1980; Davis & Wiedenbeck, 2001; Taylor & Todd, 1995; Venkatesh & Davis, 1996; Venkatesh, et al., 2003). These models have been further modified by other researchers to explain the adoption of a wide range of technologies (Venkatesh, et al., 2003).

The three most frequently cited models used to predict technology adoption are the Theory of Reasoned Action (TRA); the Theory of Planned Behaviour and the Technology Adoption Model (TAM) (Akour, 2009). In addition a more recent model, the Unified Theory of Acceptance and Use of Technology (UTAUT), combined an extensive list of adoption models into one model to predict technology adoption (Venkateshet al., 2003). These four models are explored in more detail below.

2.3.3.1 Theory of Reasoned Action (TRA).

The theory of reasoned action (TRA) was first developed by social psychologists Ajzen and Fishbein (1980; Fishbein & Ajzen, 1975) as a way of predicting an individual's behaviour. The theory was applied to a wide range of human behaviours, but when applied to information technology adoption, the TRA model is applied to users adopting technology when they see a positive benefit (outcome) associated with its use (Williams, 2009). In the TRA model, actual behaviour is assessed by an individual's intention to adopt a technology (behavioural intention) (Muilenburg, 2008). The basis of the TRA model is that individuals make decisions about actions based on rational and logical thought (Ajzen & Fishbein, 1980). The behavioural intention in the TRA model is determined by two factors, the attitude and subjective norms of an individual. Attitude is the positive or negative feelings of the individual about performing the behaviour (Venkatesh, et al., 2003). The attitude is formed by the individual's belief and evaluation of the target behaviour. Subjective norms refer to social influence (Muilenburg, 2008). The social influence is the normative belief of the way others expect the individual should behave. If others, who are perceived as important to the individual, feel that the behaviour is important it is more likely that the user will too. Figure 1 depicts the TRA relationship.

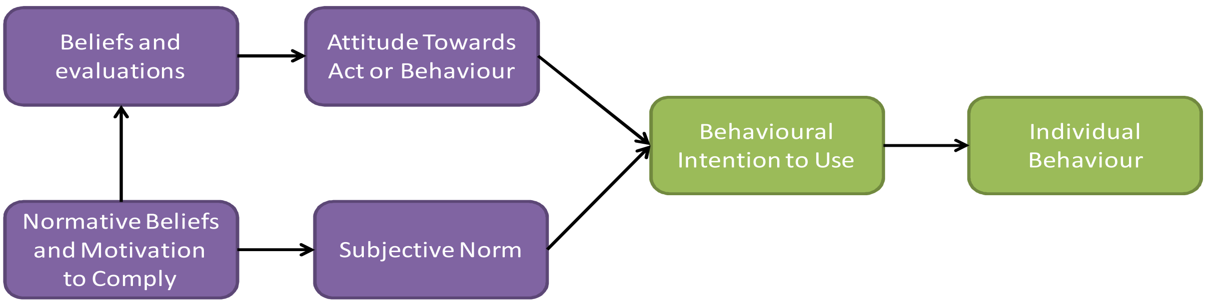


Figure 1: The Theory of Reasoned Action Model. (Source: Fishbein & Ajzen, 1975).

The TRA model has been widely accepted as a way to explain behaviours that are based on individual choice, but there has also been criticism of it (Muilenburg, 2008). The main criticism is that the model does not take into account external barriers, such as social norms, that may influence behaviour (Muilenburg, 2008). Fishbein, Ajzen, and Hornik (2007) argue that the two factors, attitude and subjective norms, as conceptualised in this model are too similar and therefore are measuring the same construct. Along with Dutta-Bergman (2005) they also assert that the position that behaviours are based on logical reasoned behaviour is not always appropriate when considering human behaviour.

2.3.3.2 Theory of Planned Behaviour (TPB).

Based on the criticism of the TRA, Ajzen (1991) proposed an alternative theory called the theory of planned behaviour (TPB). The TPB model included the original two factors in the TRA model; attitude and subjective norm, but also included the factor perceived behavioural control (see Figure 2) (Ajzen, 1991). Perceived control relates to the perception and assessment by the individual of their ability and resources to actually perform the behaviour, specifically the control a user feels when using technology and their belief that they have the necessary resources or ability to use the technology (Wang, Lin, & Luarn, 2006). If users do not feel in control they are less likely to adopt new technology, even if they have a positive attitude towards its use and want to conform to the expectations of others (Spector, et al., 2007). The changes made by Ajzen (1991) however, did not address the criticism of Muilenburg (2008) that the model was too simplistic in nature to truly determine adoption, nor the criticism of Fishbein (2007) that the two original factors were too similar in nature.

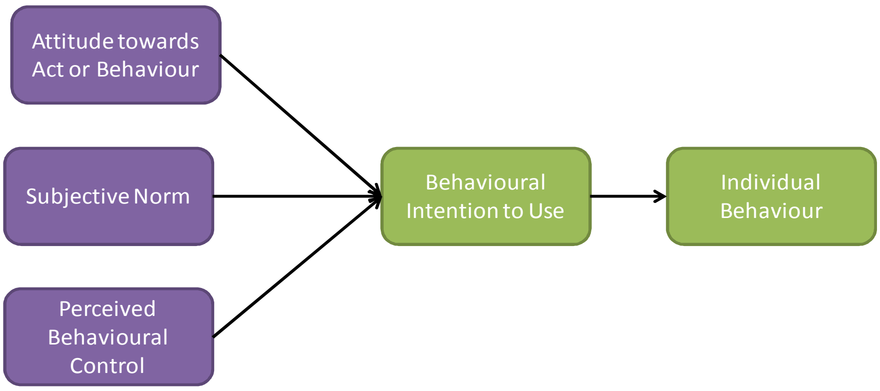


Figure 2: The Theory of Planned Behaviour Model (Source: Ajzen, 1991).

2.3.3.3 Technology Acceptance Model (TAM).

The Technology Acceptance Model (TAM) has a slightly different focus to Rogers' (2003) Diffusion Model in that it focuses not just on the specific type of adoption environment but also on a specific type of innovation (Davis, 1989; Venkatesh, 2003). In addition, the TAM model was developed specifically for technology adoption unlike the TPB and TRA. The TAM focuses on the perceived ease of use and usefulness of the innovation as perceived by the intended user as a way to determine future adoption. Davis (1989) has defined perceived ease of use as the level of difficulty or effort that is needed to use the technology. Perceived usefulness is the level of belief an individual has about whether the technology will produce better outcomes than not using it (Venkatesh & Davis, 1996). It also includes the strength of belief that the technology will provide an advantage (Venkatesh & Davis, 1996). The model states that the innovation should be easy to use (similar to Roger's complexity characteristic) and learn and not so complex that it negates it usefulness (Hackbarth, Grover, & Yi, 2003).

According to the TAM model, an individual's attitudes are the drivers for the adoption of the technology (Straub, 2009). The belief that the technology is easy to use and will be useful to the individual will largely result in users having a positive attitude towards the technology (Saadé & Kira, 2007). A positive attitude will lead to an increased intention by the individual to use the technology. In earlier versions of the TAM, the factor 'attitude' was influenced by perceived ease of use and perceived usefulness. However, later versions of the model removed the attitude construct from the model. When modelling voluntary use of technology it was not found to contribute to the overall power of the model to predict adoption (Koh, Prybutok, Ryan, & Wu, 2010). Figure 3 shows the relationship among the variables in the TAM with the Attitude factor removed.

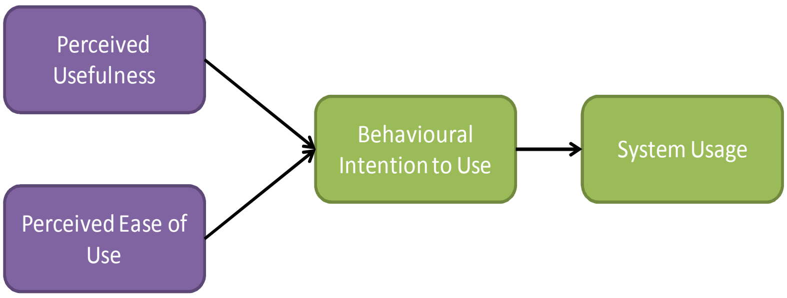


Figure 3: The Technology Acceptance Model (Source: Davis, 1989).

Research has shown that the TAM model can be used to explain approximately 50% of the variance in acceptance levels (Davis, Bagozzi, & Warshaw, 1992). The TAM model has been used extensively in educational settings to determine adoption of instructional technology by educators and students. TAM has also been modified and extended to include a range of additional antecedent variables to improve its predictive powers, such as subjective norms, experience and motivation (Venkatesh, et al., 2003). Even though the TAM has been widely adopted, it has been criticised by some researchers for not giving consistent and conclusive results (Ma & Liu, 2004). With the aim of addressing this criticism Ma and Liu (2004) conducted a meta-analysis of empirical studies with TAM. Based on the assessment of 26 studies they concluded that the TAM does provide a good tool for determining technology adoption. They found evidence of a strong relationship between perceived usefulness and behavioural intention, and between perceived ease of use and perceived usefulness. However, the weaker relationship between perceived ease of use and behavioural intention suggested that perceived ease of use operates through perceived usefulness. Based on this finding Ma and Lin (2004) proposed a new model where perceived ease of use is moderated by perceived usefulness, however, these changes have not being been widely adopted. Despite these criticisms the TAM has continued to be widely used and has shown good predictive capabilities.

2.3.3.4 Unified Theory of Acceptance and Use of Technology (UTAUT).

The development of the Unified Theory of Acceptance and Use of Technology (UTAUT) was an attempt to unify the numerous adoption models that had been developed to help interpret the adoption process (Venkatesh, et al., 2003). The UTAUT incorporates elements from eight different models to produce one model with key aspects from each (Williams, 2009). The UTAUT incorporates the TRA, TPB and TAM. It comprises four factors: performance expectancy, effort expectancy, social influences, and facilitating conditions (Venkatesh, et al., 2003). The performance expectancy factor measures the degree to which an individual perceives that using the system could help improve their performance. This factor has strong similarities to the usefulness construct in the TAM model and has elements of extrinsic motivation at its roots (Venkatesh, et al., 2003). Effort expectancy measures the degree to which an individual perceives the system will be easy to use (Kijsanayotin, Pannarunothai, & Speedie, 2009). The effort expectancy factor is similar to the perceived ease of use construct in the TAM model (Venkatesh, et al., 2003). Social influence measures the degree to which the user believes that others about whom they care feel that they should use the system (Williams, 2009). This construct is similar to the subjective norm construct used in the TRA and the TPB. Lastly the facilitating conditions factor measures the degree to which an individual perceives that support and assistance are available to them to support their use of the system (Williams, 2009). This factor has links to the TPB factor of perceived control. Figure 4 presents the UTAUT model.

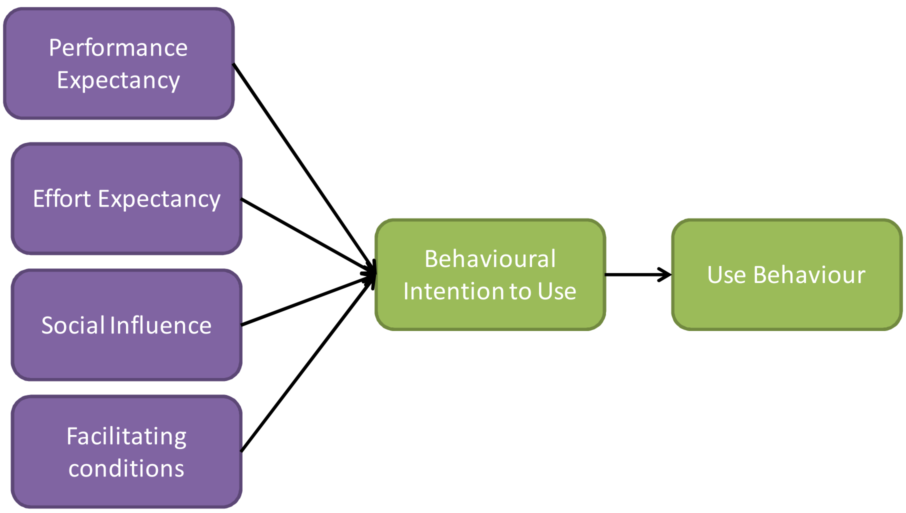


Figure 4: The Unified Theory of Acceptance and Use of Technology (Source: Venkatesh, Morris, Davis, & Davis, 2003).

The development of the UTAUT is fairly new, but it is being used increasingly in studies assessing technology adoption (Teo, 2009b). However, because of the relative newness of this model there is still some concern about the robustness and stability of its measures across settings (Li & Kishore, 2006).

2.3.3.5 Conclusion

These four models cover the most widely accepted adoption models used to study technology adoption. These models have all been used in a large number of studies and have each been modified to include additional constructs that may better determine adoption of specific types of technology.

The following section addresses the application of these models to mobile technology adoption in the educational environment.

2.3.4 Modeling the adoption of mobile learning

Over recent years very few empirical studies have looked at mobile learning adoption in tertiary education. These studies have typically used either TAM or the modified version of TAM (such as the UTAUT) as the basis of their studies. The following section examines these studies.

A number of studies, undertaken to understand the mobile learning adoption of students, have used the TAM as its basis (Akour, 2009; Chen, Chen, & Yen, 2011; Huang, Lin, & Chuang, 2007; Lu & Viehland, 2008; Theng, 2009). These studies confirmed the basic relationships between the three variables of TAM; that perceived ease of use is positively associated to perceived usefulness and behavioural intention; and perceived usefulness is also positively associated to behavioural intention. A few of the studies also included the original variable of attitude in the TAM model and found that attitude towards mobile learning was related to behavioural intention and mediated perceived ease of use and perceived usefulness (Akour, 2009; Huang, et al., 2007; Lu & Viehland, 2008). Overall these finding suggest that if students view mobile technology as being free from effort they are more likely to view mobile learning as useful to their learning and will also more likely adopt mobile learning in the future. In addition, this perception of usefulness will also directly influence adoption of mobile learning. The results also show that students attitude to mobile learning are influenced by both the perception of usefulness of mobile learning and the ease of use of mobile technology. Positive attitudes about the benefits of mobile learning were found to influence the adoption of mobile learning.

Most studies attempting to determine mobile learning adoption have made an effort to extend the adoption model with additional variables to improve the predictiveness of the adoption model. Mobile self-efficacy or prior usages were commonly included in mobile learning adoption studies (Akour, 2009; Chen, et al., 2011; Lu & Viehland, 2008; Theng, 2009). Each of these studies found that mobile technology self-efficacy and prior usage impacted on student confidence when confronted with mobile learning and therefore influenced the perceived ease of use of mobile learning (Lu & Viehland, 2008, Theng, 2009, Akour, 2009, Chen, et al., 2011) and also the perception of usefulness mobile technology to students (Akour, 2009; Chen, et al., 2011; Lu & Viehland, 2008; Theng, 2009). Students who believe that they can use mobile technology to support their learning or have past experience with mobile technology will be more likely see mobile technology to be free from effort and more likely to see it as useful.

Other variables included in these studies and shown to be significant to mobile learning adoption were: the perceived value of mobility and perceived enjoyment (Huang, et al., 2007); the quality of service, extrinsic influence and university commitment (Akour, 2009); the advantage of mobile technology to allow enhanced communication (Theng, 2009); and subjective norm (which links to Ajzen's (1991) theory of planned behaviour and Ajzen and Fishbein's (1980; Fishbein & Ajzen, 1975) theory of reasoned behaviour); and perceived financial resources (Lu & Viehland, 2008). Each of these factors was shown to increase the likelihood of student adoption, however these factors have only been assessed in one study and it is uncertain whether these findings will be replicated.

In addition to the above studies a small number of studies have adapted and modified the UTAUT model. In Wang, Wu and Wang (2009) three of the four original constructs of the UTAUT were tested. These three factors (performance expectance, effort expectancy and social influence) were shown to have an impact on the intention to adopt mobile learning. In particular, performance expectance (similar to the TAM's usefulness variable) and effort expectancy (similar to the TAM's ease of use variable) were found to have the greatest influence on behavioural intention. Wang, Wu and Wang (2009) also included perceived playfulness (related to intrinsic motivation) and self-management of learning into the model; both of these variables were found to have an impact on the intention of students to adopt mobile learning. However a study by Williams (2009), who also adopted the UTAUT model, found no significant relationships between these factors. However, this study was conducted using only podcasting and generalising these findings to the broader category of mobile technology may not be appropriate.

The above studies had a number of limitations or weaknesses. Some used only small numbers of participants (Theng, 2009; Williams, 2009) or used participants that were very homogeneous in age (Huang, Lin, & Chuang, 2007) or location (only one tertiary institute or class) (Akour, 2009;

Williams, 2009). A number of the studies did not test actual usage of mobile learning but relied on the strength of the adoption model to prove the link between behavioural intention and actual usage (Theng, 2009; Akour, 2009; Huang, Lin, & Chuang, 2007; Wang, et al., 2009). Also only one study focused on New Zealand students (Lu & Viehland, 2008).

A small number of researchers have suggested, but not tested, additional variables that may influence the adoption of mobile learning. Liu (2008) proposed a model that extended the UTAUT model to include three additional variables: self-efficacy, mobility and self-management (similar to Wang, et al., 2009). Liu, Han and Li (2010) also proposed several additions to the basic TAM model, including perceived mobility value; the perceived content quality and perceived system quality; subjective task value of expectancy-value theory which included the attainment value, intrinsic value, utility value, and cost; and readiness for m-learning which included the self-management of learning, comfort with m-learning. However these suggestions have yet to be tested.

Studies focusing on educator adoption of mobile learning have also been mostly small scale, descriptive and qualitative in nature (Aubusson, et al., 2009; Lefoe & Olney, 2007; Lefoe, Olney, Wright, & Herrington, 2009; Seppälä & Alamäki, 2003). Empirical quantitative research of educator adoption of mobile learning has largely been overlooked as researchers have tended to focus on student adoption (Uzunboylu & Ozdamli, 2011). To redress this imbalance, Uzunboylu and Ozdamli (2011) developed the Mobile Learning Perception Scale. This scale included dimensions seeking feedback from educators on three facets of the mobile learning. Sub-dimensions are defined as ‘Aim-Mobile Technologies Fit’, ‘Appropriateness of Branch’ and ‘Forms of M-learning Application and Tools Adequacy of Communication’. The ‘Aim-Mobile Technologies Fit’ dimension is described as the appropriateness of mobile learning goals to the goals of learning activities. The ‘Appropriateness of Branch’ dimension relates to the appropriateness of mobile learning in relation to areas in which educators teach. The dimension ‘Forms of M-learning Application and Tools’ Adequacy of Communication’ relates to the way educators perceive the place of mobile learning in education and the merit of the applications of m-learning for the purpose of communication. This scale is only in the early stages of development, but early results show that teachers exhibited a more positive perception towards mobile learning in relation to these three facets. However the Uzunboylu and Ozdamli model does not build on any existing adoption model and therefore lacks the robustness that other models have developed through extensive use.

Apart from Uzunboylu and Ozdamli’s (2011) work, other studies on adoption by educators have focused on technology adoption in general or elearning adoption rather than specifically mobile learning. The factors assessed by researchers are diverse, however some recurring themes are apparent, namely: computer self-efficacy of educators (Chai, 2011; Chen, 2010; Hammond, Reynolds, & Ingram, 2011; Mueller, Wood, Willoughby, Ross, & Specht, 2008; Teo, 2009b); motivation (Chiu, Sun, Sun, & Ju, 2007; Mueller, et al., 2008; Sørebø, Halvari, Gulli, & Kristiansen, 2009); perceived ease of use and usefulness (Hu, Clark, & Ma, 2003; Ma, Andersson, & Streitht, 2005; Sang, Valcke, Braak, & Tondeur, 2010; Teo, 2011; Teo, Lee, Chai, & Wong, 2009; Teo, Ursavaş, & Bahçekapili, 2011); teaching self-efficacy (Mueller, et al., 2008; Sang, Valcke, Braak, & Tondeur, 2010); perception of ICT in the classroom (Hammond, et al., 2011; Teo, et al., 2009); anxiety (Rahimi & Yadollahi, 2011) and facilitating conditions (Pynoo, et al., 2011).

2.3.5 Conclusion

A number of theories have been developed to model the adoption process. In addition, each of these models have been modified and extended to develop a more robust model of adoption. A range of additional factors have been incorporated into the initial adoption model to improve the predictiveness of the model. These include ICT self-efficacy, teaching ICT self-efficacy, motivation orientation and readiness for self-directedness. The next section reviews these additional factors and their potential to influence the adoption of mobile learning.

2.4. Self-Efficacy

The most commonly assessed factor in student mobile learning adoption models is the construct self-efficacy. Computer self-efficacy stems from the social cognitive theory of self-efficacy belief (Eastin & LaRose, 2000). Self-efficacy relates to the way individuals determine the choices they make regarding the effort, perseverance and anxiety they experience when engaged with a particular task (Usher & Pajares, 2008). Self-efficacy is not synonymous with the concept of self-esteem or self-confidence, though it is a related to both self-esteem or self-confidence and each may impact on the other (Straub, 2009). Self-esteem and self-confidence are considered to take a more general view of one's overall capabilities, whereas perceived self-efficacy relates more specifically to an individual's belief that he or she can complete a specific task given a set of circumstances. According to Wilson, Kickul and Marlino (2007), individuals with high levels of efficacy will have a greater chance of succeeding in the given task. Bandura (1986, 1993, 1997) "holds that self-efficacy is more than a belief in ability level; it also orchestrates the motivation necessary to conduct the behaviour" (As cited in Downey & McMurtrey, 2007, p. 383). Self-efficacy is seen as a key element that determines what activities individuals engage in, the effort they put into pursuing the activity, and the persistence they show in the face of adversity (Downey & McMurtrey, 2007).

According to Bandura (1997) there are four main factors that influence an individual's self-efficacy namely: mastery experiences; vicarious experiences; social persuasion; and physiological and emotional states. A successful outcome will build an individual's belief in their personal efficacy. Alternatively, failure will undermine it. This is especially true if the failure occurs before a sense of efficacy is firmly established. Mastery experience is therefore the most effective way of creating a strong sense of efficacy (Bandura, 2010). A vicarious experience occurs when an individual sees another individual succeeding in a task, and then feels compelled to strive for the same mastery. If an individual sees another failing at a task, the experience may undermine their level of motivation, and then self-efficacy will be reduced (Bandura, 2010). Social persuasion, similar to the social influence variable in the UTAUT (discussed in the previous section), relates to having encouragement, support, receiving positive comments, and other sources of persuasion from others when completing the task. This positive reinforcement helps build confidence and motivation for success, especially when confronted with more difficult tasks. The final factor, the physiological and emotional state, relates to the way an individual assesses their level of confidence by evaluating the way they feel when they contemplate the action. Psychological and affective states affect an individual's perceived self-efficacy. Negative emotions, such as stress and anxiety, need to be managed to help facilitate a positive experience and promote an individual's perceived self-efficacy (Bandura, 2010).

Self-efficacy can also be considered from two perspectives; general and specific self-efficacy (Agarwal, Sambamurthy, & Stair, 2000; Chen, Gully, & Eden, 2004; Downey, 2006; Hasan, 2006; Hasan & Ali, 2006; Hsu & Chiu, 2004; Tzeng, 2009). These two views stem from two different views of self-efficacy (Claggett & Goodhue, 2011). General self-efficacy refers to a general trait that is demonstrated across different situations and tasks (Hasan, 2006; Tzeng, 2009). General self-efficacy focuses more on motivational factors that influence the attitude of users and goes beyond their actual skill in the particular task (Claggett & Goodhue, 2011). General self-efficacy can be transferred to other domains, i.e. general self-efficacy in computing may influence a user's self-efficacy in mobile learning environments as long as people believe that certain skills are shared between these domains (Tzeng, 2009). On the other hand, specific self-efficacy relates more to the individual's belief about a skill they have in a particular task or domain and this is applicable only to that particular domain (Chen, et al., 2004). General self-efficacy is considered as a stable trait that a person carries around from domain to domain at a relatively constant level, whereas specific self-efficacy is more situational and will vary across domains (Chen, et al., 2004). General self-efficacy has been found to be a poor indicator of self-efficacy relating to a particular task but is a good indicator of transference of self-efficacy across different domains (Tzeng, 2009). General self-efficacy is particularly suited for predicting general computing attitudes and performance, such as overall computing ability (Downey, 2006). General self-efficacy influences specific self-efficacy because those with mastery experiences in various tasks may be more confident in their judgment of their abilities in a particular task. In relation to specific computer self-efficacy, it is considered that an individual's past experience in one domain may impact on other domains. It is theorised that if an individual experiences continued success in many different domains, they may have a higher perception of their self-efficacy when encountering novel situations (Downey, 2006). Therefore it is useful to consider self-efficacy from two view points; a user's specific skill in the particular domain and their general confidence and capabilities distinct from actual skill.

Self-efficacy is strongly related to motivational constructs (Moos & Azevedo, 2009). Learners that are highly motivated are more likely to exercise more persistence and effort in their learning and are less likely to give up on their task. So too, are learners that have higher self-efficacy; these learners are more likely to persevere in the face of difficulty (Torkzadeh & Van Dyke, 2002). Learners with lower self-efficacy however, are less likely to engage in challenging activities (Bandura, 1997). Motivation can be increased when learners recognise that they are making progress in their learning. In addition, as learners progress and become more competent, they maintain a sense of self-efficacy for performing well (Torkzadeh & Van Dyke, 2002). Teaching self-efficacy can also effect student motivation. According to Tschannen-Moran, Hoy and Hoy (1998), teachers with higher levels of efficacy related to their teaching, believed that they could control, or at least strongly influence, student achievement and motivation.

2.4.1 ICT self-efficacy.

ICT self-efficacy is a subset of self-efficacy and has been described as an individual's judgment of their capability to use ICT (Compeau & Higgins, 1995). As described in Embi (2007), computer self-efficacy is the measure of a user's confidence to use, understand and apply their computer knowledge and skills. This confidence can be based on, or quite separate from, the individual's skills and abilities to perform the task (Claggett & Goodhue, 2011). ICT self-efficacy is simply a broader view of computer self-efficacy that incorporates both computer and digital communication devices. Higher levels of confidence when using ICT has been shown to be positively related to users having stronger feelings of competence when using a range of computing tools. Users with higher levels of self-efficacy will typically set higher goals for themselves and be more resistant to failure (Claggett & Goodhue, 2011). These users are more willing to use a computer and other technology and are more likely to feel that they will succeed in their tasks when using these tools (Cázares, 2010). On the other hand, users with a low level of confidence are less likely use technology and will typically believe that technology is hard to use (Cázares, 2010).

Computer self-efficacy has been found to have a positive effect on ICT use and adoption of new technology (Vekiri & Chronaki, 2008). Traditional computer self-efficacy has primarily focused on computer interaction, whereas ICT self-efficacy is broader and includes communication tools such as mobile devices. According to Igbaria and Iivari, (1995) an individual's self-efficacy has a positive effect on attitude, use and adoption of technology. In particular, research has found that perceived efficacy for using computers leads to a higher likelihood of using them for both students and educators (Beas & Salanova, 2006; Daniel & Roger, 2009; Ellen, 1991; Ertmer & Ottenbreit-Leftwich, 2010; Hasan, 2003). Self-efficacy influences a user's motivation and the level of effort they apply to a task, which can be independent of the skill the user has with the task (Claggett & Goodhue, 2011).

As described by Kenny, Park, and Van Neste-Kenny (2010), an individuals' assessment of their self-efficacy relies on three interrelated dimensions: magnitude, strength, and generalisability. The magnitude refers to the level of difficulty of the task that an individual feels that they can deal with, that is, individuals with high self-efficacy will feel that they can accomplish more difficult tasks compared to those with low self-efficacy. The strength of self-efficacy relates to the confidence that individuals have that they can achieve the task. Magnitude and strength are related; the magnitude is simply the ability to do the task and the strength is the level of confidence the individual has about completing the task (Claggett & Goodhue, 2011). Generalisability relates to the transfer of an individual's experience to other domains, so that a user's experience from one domain can be applied to a new, but related area (Claggett & Goodhue, 2011). A user with higher levels of self-efficacy generalisability would be able to competently use a wide variety of activities and devices. This can be compared to users with a low self-efficacy generalisability who may perceive their capabilities as limited to particular activity or devices, especially those with which they have had experience.

2.4.1.1 Factors that impact ICT self-efficacy.

Moos and Azevedo (2009) identified two types of elements that affect computer self-efficacy; those related to psychological and behavioural factors and those that are external to the learner such as training, frequency and type of use, and feedback provided. Torkzadeh & Van Dyke (2002, p. 482) summarise the effect that self-efficacy has on academic learning processes;

> At the start of an activity, students hold differing beliefs about their capabilities to acquire knowledge, perform skills, master the material, and so on. Initial self-efficacy varies as a function of aptitude (e.g. abilities and attitudes) and prior experiences... Motivation is enhanced if students perceive they are making progress in learning. In turn, as students work on tasks and become more skilful, they maintain a sense of self-efficacy for performing well.

In relation to psychological factors, a range of studies have found that learner attitude to technology based learning has an impact on their computer self-efficacy. Attitudes are beliefs and feelings about computers considered in terms of positive, negative, or neutral views about the use of ICT (Barbeite & Weiss, 2004). Mediating emotions such as user anxiety, curiosity, enjoyment and perceived control can impact on users' attitudes (Khorrami-Arani, 2001; Wallace, 2000 cited in Khorrami-Arani, 2001). In addition, past experience and computer use can also have an impact on attitudes to ICT use in learning (Kidwell & Jewell, 2008). In terms of adoption, the decisions and judgments individuals make about their capability for undertaking technology tasks, have been linked to computer attitudes which are in turn linked to future technology use (Moos & Azevedo, 2009). These emotions and their influence on self-efficacy and adoption are discussed in the next section.

2.4.1.1.1 Anxiety.

ICT anxiety refers to the fear some people have when using or confronted with the thought of having to use ICT (Barbeite & Weiss, 2004). Computer anxiety is an emotional response usually resulting from a fear that using the computer may have a negative outcome, such as damaging the equipment or looking foolish. Anxiety about using ICT will have a strong impact on self-efficacy and future use of ICT (Agarwal, et al., 2000; Beckers, Wicherts, & Schmidt, 2007; Imhof, Vollmeyer, & Beierlein, 2007; Parayitam, Desai, Desai, & Eason, 2010; Saadé & Kira, 2007; Smith & Caputi, 2007).

The anxiety of users will influence and be influenced by a variety of things. Higher levels of ICT anxiety will have a negative influence on student learning new computing skills (Barbeite & Weiss, 2004; Sun, Tsai, Finger, Chen, & Yeh, 2008; van Raaij & Schepers, 2008) and poorer task performance (Barbeite & Weiss, 2004; Torkzadeh & Van Dyke, 2002). In addition, a user's anxiety will impact on their attitude toward the use of ICT (Teo, 2009a). Past experience also influences anxiety. Previous failure at an activity will predispose an individual to feeling anxiety when approaching the task again (Hasan & Ahmed, 2010).

A number of studies have shown that anxiety towards computers will negatively influence the use and adoption of ICT in their teaching. Phelps and Ellis (2002) argue that a disparity between educator perception of their technological competence and the amount of learning they need to engage in to be able to use computers in their teaching can often be seen as threatening and overwhelming. Educators with high computer anxiety and low computer self-efficacy may have these feelings further exacerbated if they perceive the computer skills of their students to be better than their own. This can make educators feel insecure and disinclined to use ICT for fear of looking stupid or incompetent (Nunan & Wong, 2005). These feelings can be a major barrier to educator adoption of information technologies. This negative attitude to ICT may also cause educators to doubt the usefulness of ICT in teaching and make them reluctant to use it in their teaching (Hennessy, Ruthven, & Brindley, 2005). The anxiety of an educator will affect the extent, and the way technology is used in the everyday instructional practice. Anxiety is an important factor that needs to be managed since technology has the potential to transform the roles which educators play in and outside the classroom (Teo, Lee, & Chai, 2008).

Anxiety and its effect on mobile learning, as opposed to ICT generally, has not been extensively researched (Wang, 2007). On one hand, it is agreed that anxiety will play a role in the adoption and self-efficacy of users of mobile technology, however its role has yet to be tested empirically (Chu, Hwang, Huang, & Wu, 2008). Wang (2007), claims that computer self-efficacy may give insight to mobile self-efficacy, however traditional measures of computer anxiety may not capture the specific characteristics of mobile technology that differ from traditional computer technology.

2.4.1.1.2 Enjoyment and curiosity.

Enjoyment and curiosity are both elements of intrinsic motivation. According to Zhao, Lu, Wang and Huang (2011), a positive perception by an individual of their ability to use ICT will be more likely to induce intrinsic motivation than a negative perception of that ability. Intrinsic motivation is enhanced by positive performance, therefore if users enjoy their experience and are successful they are more likely to be motivated to continue (Deci & Ryan, 2010a). The feedback received will modify an individual's beliefs and mediate their perceived competence relating to ICT (Angeli & Valanides, 2004). As claimed by Angeli and Valanides (2004, p. 31) "in terms of ICT use, attitudes toward ICT affect users' intentions or desire to use ICT. Intentions, in turn, affect actual ICT usage or experience, which modifies beliefs and consequent behaviours or behavioural intentions (future desire) and self-confidence or self-efficacy in employing ICT in learning."

With regard to mobile learning, a number of studies have examined the effects of perceived playfulness and its positive effect on perception and adoption of mobile learning (Gunawardana & Ekanayaka, 2009; Wang, Wu, & Wang, 2009). They found that these factors were strongly related and illustrate the need for making mobile learning content or learning experience one that is enjoyable for the learner.

2.4.1.1.3 Perceived Control.

Perceived control is the feeling of being in control when using technology. A user that feels in control when using technology, will be more willing to experiment and explore the technology. They will also be more likely to feel comfortable and less anxious about their ability to manage if something goes wrong with the technology. It is therefore the user's level of comfort with technology that will influence their use and adoption of technology (Stylianou & Jackson, 2007). According to Morahan-Martin and Schumacher (2007), users' acceptance and comfort with innovative technology appear to be a key factor in a users' level of technological expertise.

Higher levels of control have also been shown to influence users' behaviour and attitudes. Higher levels of perceived control may result in a higher use of varied applications (Morahan-Martin and Schumacher, 2007). Users with higher levels of perceived control will also have a more positive attitude towards computers, with more computer confidence and less computer anxiety because of their greater motivation to master computing situations (Charlton, 2005).

2.4.1.1.4 Previous use and experience.

Prior experience is the amount of time an individual has spent working with computers and the different applications they have learnt to use (Paraskeva, Bouta, & Papagianni, 2008). A user's past ICT experience has been consistently reported in the literature as having a positive relationship with their self-efficacy beliefs (Hasan, 2003; Hasan & Ahmed, 2010; Potosky, 2002). The relationship that past experience has on an individual's self-efficacy has been highlighted in social cognitive theory, which states that prior experience represents the most accurate and reliable source of self-efficacy information about similar tasks (Hasan, 2003).

2.4.1.2 Self-efficacy and adoption of mobile learning.

A large body of research has shown that a user's self-efficacy about computing technology plays a significant role on the adoption of a wide range of learning tools (for example Beas & Salanova, 2006; Daniel & Roger, 2009; Igbaria & Iivari, 1995; Padilla-Meléndez, Garrido-Moreno, & Del Aguila-Obra, 2008; Phelps & Ellis, 2002; Shih, 2006). However self-efficacy has only been examined in a relatively small number of studies on mobile learning adoption (Chen, et al., 2011; Kenny, Park, & Van Neste-Kenny, 2010).

Research has shown that self-efficacy is a mediator between environmental factors and the outcome expectation of users (similar to perceived usefulness in the TAM) and actual use of technology (Akour, 2009). In general, a positive ICT self-efficacy, influenced by a positive attitude towards the use of technology, is associated with the amount of experience users have with technology, and in particular computers (Wilfong, 2006). Users with higher levels of computer use will have higher levels of computer skill and a positive attitude towards the use of ICT (McIlroy, Sadler, & Boojawon, 2007). The experience of computer use is also related to a decrease in the levels of anxiety users have about the introduction of new technology making them more likely to adopt ICT. Past experience of educators using technology also influences their self efficacy about their ability incorporate ICT into their teaching (Mueller, et al., 2008).

In relation to mobile learning adoption and self-efficacy, research has shown that the level of experience a user has will influence their perception of the level of effort they need and the ease of using mobile learning (Wang, et al., 2009). Venkatesh, et al. (2003) described the way effort expectancy was more significant for individuals with less experience. An individual with high self-efficacy was more likely to see mobile learning as requiring less effort and be easier to use. This relationship between self-efficacy, perceived ease of use and adoption of mobile learning has been confirmed in a number of studies (Akour, 2009; Lee, Kim, & Chung, 2002; Lu & Viehland, 2008; Park & Chen, 2007). Park and Chen (2007) found that self-efficacy has a significant effect on perceived ease of use and intention to use. This finding suggests that a user who felt confident about their computing skills would generally demonstrate a higher perception of ease of use when using mobile technology. Theng (2009) also found that not only self-efficacy played an important role in perceived usefulness but also prior experience of using mobile devices. He found that a student with prior experience of using mobile devices would perceive mobile learning as easy to use. This finding was supported by Venkatesh et al.'s (2003) who found that experience played an influencing role IT adoption. In addition, mobile learning can also influence the perception of usefulness of how an individual sees mobile learning (Akour, 2009). As described by Lopez and Manson (1997), self-efficacy has a significant but smaller impact on perceived usefulness than perceived ease use, since perceived usefulness is moderated by ease of use.

2.4.1.3 Conclusion

Overall the evidence suggests that self-efficacy may play a significant role on mobile learning adoption. As attitudes and the confidence of users when using technology will impact on their adoption of new technology, it is logical to infer that self-efficacy too will play a role in mobile learning adoption. In addition to general ICT and mobile self-efficacy it is also important to consider educator self-efficacy about using technology in the classroom. Since the educator is usually the gateway through which new technology is introduced to the learning environment, the way they feel about technology and their ability to use technology to support their learning is likely to influence adoption of mobile learning (Tezci, 2009). If educators resist the inclusion of new technology in the educational environment, it is likely to slow adoption of mobile learning. Therefore the following section explores how the self-efficacy of educators integrating ICT into their teaching will impact their perceptions and future adoption of mobile learning.

2.4.2 Teaching self-efficacy about integrating technology.

Previous research has shown a strong link between teacher efficacy and the ability of educators to change their teaching practices to suit students (Ross, Hogaboam-Gray, & Hannay, 2001). Teaching self-efficacy has also been shown to be linked to student achievement (Ross, et al., 2001). High self efficacy typically means that an educator will try harder to stimulate students learning and autonomy with the focus on students needs and try to modify students' ability perceptions. Educators that have higher levels of teaching self-efficacy will be more likely to seek out new teaching strategies that they believe will help student learning (Perry, VandeKamp, Mercer, & Nordby, 2002). This exploration may also include examining new technologies as a way to enhance the learning of students (Ross, et al., 2001).

Teaching efficacy has been defined as educators' belief that they can influence student performance (outcome) (Henson, 2001). A closely related concept is teaching self-efficacy. This is defined as the belief an educator holds regarding their ability to perform a variety of teaching tasks (Dellinger, Bobbett, Olivier, & Ellett, 2008). The difference between the two concepts is that teaching efficacy draws more on the theory of locus of control and teaching self-efficacy on the theory of self-efficacy. Both of these forms of self-efficacy have been found to influence the integration of technology into their teaching by educators (Baek, Jung, & Kim, 2008), however teaching self-efficacy is a closer in definition to other constructs of self-efficacy considered in this study.

The following section explores the factors that will impact the teaching self-efficacy to integrate ICT into teaching by the educators and how it has been measured in the literature. This is followed by an examination of the role teaching self-efficacy may play in the adoption of mobile learning.

2.4.2.1 Effects of teaching self-efficacy

Previous research has shown that teaching self-efficacy has a strong influence on the integration of ICT into their classroom and their teaching philosophy (Hasan, 2003; Potosky, 2002; Sang, Valcke, Braak, & Tondeur, 2010). However, teaching self-efficacy refers to a broad range of learning activities, of which technology based activities are one. Studies have also found that educators with higher levels of ICT self-efficacy are more likely to use ICT, be more experienced using ICT and have less anxiety (Sang, et al., 2010). Higher levels of ICT self-efficacy, however do not necessarily mean that educators will feel comfortable integrating ICT into their teaching (Baek, et al., 2008; Sang, et al., 2010). ICT self-efficacy and teaching self-efficacy for integrating ICT in teaching are related to the notion of a teacher having self-efficacy in the context of integrating ICT into their teaching practices, but neither adequately captures the construct. There is no agreed term for this construct in the literature, although it has been used in some studies. For the purpose of this study the term 'ICT-teaching self-efficacy' will be used to refer to specific self-efficacy about integrating ICT into teaching.

2.4.2.2 Factors that impact ICT-teaching self-efficacy

Despite the benefits of using ICT in education some educators still resist the inclusion of technology in their teaching (Hu, et al., 2003; Mahdizadeh, Biemans, & Mulder, 2008; Sang, et al., 2010). The reasons for resistance to ICT inclusion is influenced by a range of factors, including accessibility of hardware and relevant software, the nature of the curriculum, personal capabilities and constraints such as time (Albion, 1999; Hammond, et al., 2011; Sang, et al., 2010). However research has shown that the self-efficacy beliefs of educators have the biggest impact on their resistance to the inclusion of ICT into their teaching (Albion, 1999).

There is a substantial body of research identifying factors that influence the self-efficacy of educators to integrate ICT. Many of the factors that influenced ICT self-efficacy will also influence ICT-teaching self-efficacy, but it is important to remember that they are distinct concepts and higher levels of ICT self-efficacy will not necessarily result in higher levels of integration of technology in their teaching. Oliver (1993) described this distinction where new teachers who have had some form of formal training in the use of computers as a personal tool and exhibited higher levels of ICT self-efficacy did not show any difference in their level of technology integration compared to their peers who had not had the training. It is therefore important to consider educators self-efficacy in terms of their teaching rather than just in general. Therefore ICT-teaching self-efficacy has been shown to be influenced by the level of anxiety educators feel when having to use ICT in the classroom, their level of enjoyment they have when using ICT in teaching, the level of control they feel they have when using ICT in their teaching and the level of past experience they have had using ICT in the classroom (Hammond, et al., 2011; Sang, et al., 2010). Other factors have also been shown to specifically influence ICT-teaching self-efficacy these include; the specific beliefs of an educator about whether they are able to use computers as an instructional tool (Hammond, et al., 2011; Mueller, et al., 2008) and teaching philosophy (Albion, 2001; Vannatta & Fordham, 2004), past positive experiences with computers (Albion, 2001; Mueller, et al., 2008; Sang, et al., 2010), past training or workshops attended relating to ICT use in teaching (Vannatta & Banister, 2009; Vannatta & Fordham, 2004) and the level of assistance they have from others (Mueller, et al., 2008).

2.4.2.3 The measurement of ICT-teaching self-efficacy.

An early attempt to measure the ICT-teaching self-efficacy was the Microcomputer Utilization in Teaching Efficacy Beliefs Instrument (MUTEBI). This measure was developed by Enochs, Riggs and Ellis (1993) and it divided self-efficacy into two subscales; Personal Self-efficacy and Outcome Expectancy. Personal Self Efficacy was defined as “teachers’ beliefs in their own ability to utilize the microcomputer for effective instruction.”(p. 2). Outcome Expectancy on the other hand related to a teachers’ self-reported belief regarding their responsibility for students’ ability or inability to use computer technology in the classroom. This measure showed good validity and reliability however little subsequent research has been undertaken to substantiate these constructs.

A number of later studies have also developed measures of ICT-teaching self-efficacy, however, these too have not been widely adopted. The first by Wang, Ertmer and Newby (2004) was a measure called Computer Technology Integration Survey (CTIS) that included 21 positively worded statements relating to perceived confidence in successfully integrating technology into teaching practices. Mueller, et al. (2008) also developed a measure with 16 statements relating to their attitudes towards ICT use in education and their ability to use ICT in teaching. These two studies are among the very small body of research that had attempted to identify and develop specific measures that could be used to measure teachers' self-efficacy beliefs about technology integration.

2.4.2.4 ICT- teaching self-efficacy in the adoption of mobile learning

While there has been an extensive body of literature on ICT-teaching self-efficacy in terms of general use of ICT in the classroom, no reference could be found on how this could impact adoption within the context of mobile learning. However, it is likely that ICT-teaching self-efficacy will play as significant a role in mobile learning adoption as it does in general technology adoption.

2.5.3.5 Conclusion.

ICT teaching self-efficacy plays an important role in the use of technology in education, however a substantial gap exists in the literature on the influence of ICT-teaching self-efficacy of the adoption of mobile learning.

Motivation is strongly linked with a user's self-efficacy (Yi & Hwang, 2003). According to Bandura (1986, 1993) heightened self-efficacy and a positive outcome expectation has a positive effect on intrinsic motivation and leads to further learning. Self-efficacy enables a student to develop their skills, resulting in the feeling of being successful and confident about learning (Schunk & Zimmerman, 2008). In particular a student with higher levels of ICT self-efficacy will often feel more motivated to learn new technologies and explore new ways in which they use these technologies in their own learning (Fardal & Tollefsen, 2004). A user who is a highly motivated learner will be more willing to explore and spend time learning new technology (Yi & Davis, 2003). The next section examines how motivational orientation influences mobile learning adoption.

2.5 Motivation in Education and its Role in Adoption

2.5.1 Motivation.

The level of enjoyment and enthusiasm expressed by individuals in their work and study has a major effect on their behaviour to seek out ways to develop their skills, exercise creativity and become more involved in what they are doing (Amabile, Hill, Hennessey, & Tighe, 1994). The concept of a "labour of love" which drives human behaviour can be described as the "the motivation to engage in work primarily for its own sake, because the work itself is interesting, engaging, or in some way satisfying" (Amabile, et al., 1994, p. 950). Personal motivation can therefore have major impact on how an individual approaches their learning and teaching. In addition, it can have a major influence on their use of technology to support their learning and teaching. The following section first introduces the concept of motivation and its effect on how students and educators approach their teaching and learning. In addition it will also discuss the influence of motivation on the adoption of mobile learning.

2.5.2 Motivation and how it is measured

Motivation theory is a broad field and includes a large number of different theories that aim to explain and interpret motivation, for example, motivation has been described in terms of: goal setting theory (Locke & Latham, 1990), self efficacy (Bandura, 2010), achievement motivation (Heckhausen & Heckhausen, 2008), intrinsic versus extrinsic motivation (Deci & Ryan, 2010a), self-determination (Deci & Ryan, 2010b), self-regulation (Schunk & Zimmerman, 2008), and expectancy theory (Vroom, 1994).

A common thread that runs through many studies is the identification of internal and external orientations of motivation. For example, according to the self-determination theory (Deci & Ryan, 1985; Deci, Vallerand, Pelletier, & Ryan, 1991), motivation can be broadly conceptualised as being intrinsically or extrinsically oriented. Intrinsic motivation has been defined as an individual's readiness to engage in an activity for no reason other than sheer enjoyment, challenge, curiosity, pleasure, or interest (see for example Elliot, et al., 2000; Guskey, 2001; Shroff & Vogel, 2009). Conversely extrinsic motivation relies on external rewards and encouragement (see for example Hidi, 2000; Hunt, 1965; Rienties, Tempelaar, Van den Bossche, Gijselaers, & Segers, 2009; Rovai, et al., 2007; White, 1959).

The measurement of motivation has produced a range of inventories that aim to assess individual motivational orientations to work and study. The following section will discuss the three most widely used inventories namely: Harter's (1981) intrinsic/extrinsic scale, Vallerand, Pelletier, Blais, Briere, Senecal, and Vallieres' (1992) Academic Motivation Scale (AMS) and Amabile et al.'s (1994) Work Preference Inventory (WPI).

One of the leading researchers in intrinsic and extrinsic motivation is Harter (1980; 1981) who defined intrinsic motivation as the opposite of extrinsic motivation. Harter's (1981) intrinsic/extrinsic scale was developed to assess children's intrinsic versus extrinsic orientation toward learning and mastery in the classroom. The 30-item scale measures the degree to which the motivational orientation for classroom learning is determined by intrinsic interest, in contrast to an extrinsic interest in learning. The scale draws on five dimensions that were used to assess the intrinsic and an extrinsic poles, they are; (a) learning motivated by curiosity versus learning in order to please the teacher, (b) incentive to work for one's own satisfaction versus working to please the teacher and get good grades, (c) preference for challenging work versus preference for easy work, (d) desire to work independently versus dependence on the teacher for help, and (e) internal criteria for success or failure versus external criteria (e.g., grades, teacher feedback) to determine success or failure. Strong parallels can be seen between Harter's scale and goal theory. Goal or achievement motivation typically refers to two types of goals people can hold during task performance namely: (1) learning goals, in which individuals seek to increase their competence, to understand or master something new, and (2) performance goals, in which individuals seek to gain favourable judgments of their competence or avoid negative judgments of their competence (Dweck & Elliott, 1983; Nicholls, 1984). Goal orientation therefore has strong similarities to Harter's (1981) preference for challenging work versus preference for easy work. A criticism of Harter's work is that it does not take into account amotivation (Fairchild, Horst, Finney, & Barron, 2005; Smith, Davy, & Rosenberg, 2010). Amotivation is the lack of motivation where individuals are neither motivated intrinsically or extrinsically. Additional issues highlighted surrounded the construct, convergent and discriminant validity of the seven-factor structure of Hater's scale (Cokley, Bernard, Cunningham, & Motoike, 2001; Vallerand, et al., 1993).

The Academic Motivation Scale (AMS) was developed by Vallerand, Pelletier, Blais, Briere, Senecal, and Vallieres (1992) as a way to measure college students' motivation for achievement. This scale differed from Harter's scale since it focused on college students rather than children. This scale was originally written in French and later translated into English. The scale assessed the intrinsic and intrinsic motivation of students to learning along with a new measure called amotivation. Amotivation is defined by Vallerand et al. (1992) as a condition whereby the student lacks any intention to act or achieve, that is, the student is not motivated internally nor via external stimulus to learn. The AMS scale has been sub divided into seven subscales assessing three types of intrinsic motivation, namely: (a) to know, (b) to accomplish things, and

(c) to experience stimulation; three types of extrinsic motivation, namely (a) identified regulation, (b) introjected regulation, and (c) external regulation. The AMS has strong links to the theory of self-determination that proposes “that humans have an innate desire for stimulation and learning from birth, which is either supported or discouraged within their environment” (Fairchild, et al., 2005, p. 332). According to Deci and Ryan (2000) amotivation to extrinsic motivation to intrinsic motivation are placed along a motivational continuum that reflects the degree of self-determined behaviour. This scale has been used in a large number of studies (see for example Chen, Jang, & Branch, 2010; Cokley, 2000; Smith, et al., 2010; Villacorta, Koestner, & Lekes, 2003), however there are a number of studies that have queried the validity of the scale. Criticism includes questioning the view that intrinsic motivation is the opposite of extrinsic motivation. Later research has shown that individuals can be both intrinsically and extrinsically motivated.

Based on these criticisms and those of Harter (1996), an alternative to the Academic Motivation Scale (AMS), the Work Preference Inventory (WPI), was developed by Amabile et al., (1994). The WPI measures intrinsic and extrinsic motivation but takes a different view on the relationship between these two orientations. Amabile et al., (1994) queried the legitimacy of considering intrinsic and extrinsic motivation as being mutually exclusive constructs at opposite ends of a motivational continuum as self-determination theory had suggested. Rather the WPI argues that intrinsic and extrinsic motivation is distinct processes and that one type of motivation orientation does not necessarily exclude the other (Amabile, et al., 1994). This view has been corroborated in a number of studies (for example Covington & Muëller, 2001; Fairchild, et al., 2005; Lepper & Henderlong, 2000).

The WPI scale developed by Amabile et al., (1994) was intended to assess both academic and work motivation. In the development of the scale Amabile et al., (1994) wanted to identify the key components underlying intrinsic and extrinsic motivation and therefore develop an inventory that would capture these components. Based on an extensive literature review, Amabile et al., (1994) identified five elements each for intrinsic and extrinsic motivation. The five elements that related to intrinsic motivation were self-determination, competence, task involvement, curiosity, and interest. The elements that related to extrinsic motivation were valuation concerns, recognition concerns, competition concerns, a focus on money or other tangible incentives, and a focus on the dictates of others. These ten elements were then statistically assessed using undergraduate and adult samples and this resulted in a seventh version of the 30-item inventory. Based on a factor analysis of the two primary scales of intrinsic and extrinsic motivation they determined two subfactors or secondary scales for intrinsic motivation (Challenge and Enjoyment) and two for extrinsic motivation (Compensation and Outward). The WPI has two forms; one for students and one for adult workers with slight rewording of 5 items to make it more relevant to the intended audience (Amabile et al., 1994). The WPI scale has been adopted in a number of studies looking at student motivation (for example Mills & Blankstein, 2000; Weiling & Ping, 2009) and teaching staff motivation (Mueller, et al., 2008; Sang, et al., 2010).

2.5.3 The role of motivation in learning

Intrinsic and extrinsic motivation will influence how a student approaches their learning. A student who completes a learning activity to get a grade is considered extrinsically motivated, while a student completing the same activity with a genuine interest in learning is said to be intrinsically motivated (Green & Sulbaran, 2006). Typically students that are more intrinsically motivated are more likely to display a higher conceptual understanding of the material, better learning strategies, use more problem solving skills, and have more enjoyment in their learning (for example Beffa-Negrini, Cohen, & Miller, 2002; Carlton & Winsler, 1998; Czubaj, 2004; Hung, Chou, Chen, & Own, 2010; Malone, 1981). Students that are intrinsically motivated are driven to engage in activities that will enhance their own learning. They are likely to seek out and rehearse new information, organise their knowledge and relate it to what they already know, and apply what they have leant in different contexts. Through their learning, they experience a sense of self-efficacy for learning and are not held back by apprehension (Schunk, Pintrich, & Meece, 2008).

In regards to students' adoption of mobile learning, intrinsic and extrinsic motivation has not directly been considered as a driver of adoption, but rather adoption models have considered that technology itself is strongly motivating. Intrinsic motivation is typically operationalised in terms such as its perceived ease of use (Davis, et al., 1992; Gefen & Straub, 2000; Lee, Cheung, & Chen, 2005), enjoyment (Davis, et al., 1992; Fagan, Neill, & Wooldridge, 2008; Lee, et al., 2005; Teo, Lim, & Lai, 1999; Zhang, Zhao, & Tan, 2008), computer playfulness (Venkatesh, 2000) and personal innovativeness (Lai & Chen, 2011). On the other hand extrinsic motivation is operationalised as perceived usefulness (Fagan, et al., 2008; Gefen & Straub, 2000; Lee, et al., 2005; Teo, et al., 1999).

Motivation has not been directly assessed in technology adoption model generally only the behavioural aspects of motivation have been assessed. Yet given its known influence on directing behaviour and its relationship to self-efficacy this seems to be a significant gap in the literature.

2.5.4 The role of motivation on the adoption of educators

What motivates educators to adopt technology into their teaching is a complex issue. The motivation of educators is seen as a major factor in the adoption of technology and therefore has been an area of research for a large number of scholars and researchers (Baek, et al., 2008; Caspi & Gorsky, 2005; Chen, 2010b; Hu, et al., 2003; Mahdizadeh, et al., 2008). These motivational factors can result from either external or internal factors (Feldman & Paulsen, 1999). Feldman and Paulsen (1999) identified intrinsic motivational factors such as: the need of an educator for competence and self-determination, their valuing of activities that interest and challenge them and their need to seek out opportunities to learn and achieve. Educators that are intrinsically motivated would adopt technology not because they are required to but rather to obtain job satisfaction, to satisfy the need for competence, and for enjoyment (Sørebø, et al., 2009). Cook, Ley, Crawford, and Warner (2009), describe external motivators as incentives or rewards that are offered as inducements to urge educators to adopt a specific institutional technology, task or goal. Such incentives include non-salary rewards such as stipends, course releases, technology training, administrative support and recognition for their efforts. However, only educators that are extrinsic motivated would be motivated by these incentives, educators that were intrinsically motivated may in fact be de-motivated by these incentives (Schifter, 2000). Issues that reduce the motivation of educators to introduce and use new technology in their teaching include; increased workload caused by the use of new technology, limitations with the medium, the lack of adequate support and policies, and a poor fit between technology and some students (Beckers & Schmidt, 2003).

With regards to mobile technology adoption in the tertiary environment there is little focus on the motivation of educators to introduce this new technology to their students. Where studies have been done, looking at motivational factors of educators in regards to mobile technology use, they are in usually related using mobile technology to support their own learning, in particular its use as a support for the training of educators.

2.5.5 Conclusion

Motivation can be described from multiple points of view, however, intrinsic and extrinsic motivation tend to be the most common. These motivational orientations have been measured using a number of different inventories that have been satisfactorily used for student and educator motivation orientations. Motivation was found to have an impact on how students and educators approach learning and teaching. Additionally, motivational orientation influences the perception of the role of technology in supporting their learning and teaching. However, there is a gap in the literature relating to motivational orientations and mobile learning adoption.

A learner's motivation often has strong link to their level of self- directedness. A student that is strongly motivated will also typically show a high level of self- directedness. It is therefore logical to consider the role of self- directedness on a learner's adoption of mobile learning. The next section will describe the role of self- directedness and the influence it may play in the adoption of mobile learning.

2.6 Self-Directed Learning

Self-directed students take responsibility for their own learning and are not overly reliant on others for support (Brookfield, 2009). Autonomous learning and self-directedness are considered to be core adult learning principles (Fulton, 2003; Loyens, Magda, & Rikers, 2008). Adult learners are expected to be self-motivated and able to work independently of educators. Being self-directed does not imply learning in isolation (Loyens, et al., 2008). Rather, learning can take place in association with others in the learning environment and include others such as educators and other students (Knowles, 1975, 1990). A learner that is self-directed has been defined as a student that:

> exhibits initiative, independence, and persistence in learning; one who accepts responsibility for his or her own learning and views problems as challenges, obstacles; one who is capable of self-discipline and has a high degree of curiosity; one who has a strong desire to learn or change and is self-confident; one who is able to use basic study skills, organize his or her time and set an appropriate pace for learning, and to develop a plan for completing work; one who enjoys learning and has a tendency to be goal-oriented. (Guglielmino & Guglielmino, 2003, p. 73).

The level of self-directedness a student has may play a role in their adoption and perception of technology in education. When technology requires the learner to be self-directed it is less likely that students with low levels of self-directedness would be willing to use this technology (Fisher, King, & Tague 2001). Others argue that technology can be used to build students self-directedness (Long, 2003).

The following section reviews definitions of self-directedness and its impact on learner behaviour. This is followed by an evaluation of self-directedness measures. Finally, the role of readiness for self-directed learning in student adoption of educational technology is examined.

2.6.1 Models of self-directed learning.

SDL theory has evolved over time resulting in complex interrelations of concepts and definitions that relate to both learners' personal characteristics and their social contexts (Lawlor & Donnelly, 2010). Brockett and Hiemstra (2005), Candy (1991) and Garrison (1997) have all proposed models of SDL. These three models each focus on different aspects of self-directedness but collectively contribute to a more complete understanding of it. Each of these models is discussed below.

Brockett and Hiemstra's (2005) Personal Responsibility Orientation (PRO) model has two major components: self-directed learning as an instructional method and learner self-directedness as a personality characteristic. These two components represent the internal and external sources of self-directedness (Leach, 2000). The PRO model (see Figure 5) starts with the concept of personal responsibility. Personal responsibility is the acceptance and ownership that a learner takes for their own learning (Conole, de Laat, Dillon, & Darby, 2008). The level of personal responsibility of a learner has two dimensions. The first is the external dimension, which relates to the process or instructional method. This is the characteristic of the teacher-learner transaction and relates to the learner's willingness and ability to take control of their learning (Conner, Carter, Dieffenderfer, & Brockett, 2009; Leach, 2000). This dimension is called the self-directed learning dimension. External factors such as: needs assessment; evaluation; learning resources; facilitator roles and skills; and independent study are all factors in the level of self-directedness a student exhibits (Guglielmino & Hillard, 2007). The internal dimension however, involves the personal characteristics and personality of the student that predisposes them to take control of their learning (Leach, 2000). Personality characteristics (referred to as learner self-directedness in the model) are internal to the learner and are those personal qualities that enable them to exhibit a "desire or preference for assuming responsibility for learning" (p.24). The two are integrated as self-directedness in learning.

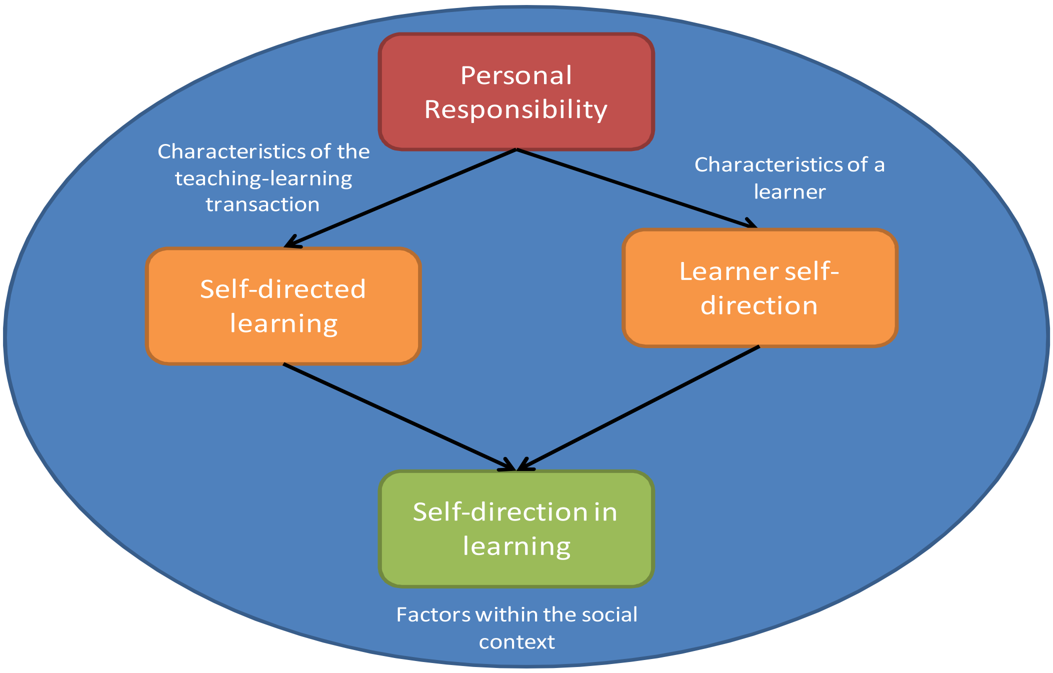


Figure 5: The Personal Responsibility Orientation (PRO) Model. (Source: Brockett and Hiemstra, 1991).

Self directedness "is viewed as a characteristic that exists, to a greater or lesser degree, in all persons and in all learning situations" (Brockett and Hiemstra, 1991, p. 11). Knowles (1975,

1990) described the extremes of this continuum such that at one end you have a student that is strongly teacher-orientated (pedagogical) and the other side a student that is self-directed (andragogical). A pedagogical learner would be more comfortable in a teacher driven environment where the teacher would identify their learning outcomes and formulate and plan how they will be able to reach these outcomes. A pedagogical learner would require a well-structured, clearly defined learning environment, such as a lecture or tutorial. On the other hand, an andragogical learner would prefer to determine their own learning needs and be willing to take responsibility for achieving their own learning outcomes (Knowles, 1990).

An alternative to the PRO Model is one developed by Candy (1991). This model takes a constructivist sociological viewpoint (Lawlor & Donnelly, 2010). There are some similarities between Candy's and the PRO model in that both models identify the importance of a social context and recognise that SDL can be a process or a method of education. Candy, however, also believes that SDL can be a goal, outcome or product of learning. Leach (2009) widens this view of SDL to include four distinct but related phenomena, namely: (1) self-management, the willingness and capacity to conduct one's own education, (2) personal autonomy, a personal attribute, (3) learner control, a mode of organising instruction in formal settings and (3) autodidaxy, the individual, non-institutional pursuit of learning opportunities in the natural societal setting.

Early SDL theory argues that as people mature they become more willing and able to manage their own learning and will prefer to learn in an environment that supports this approach (Knowles, 1975). Candy (1991, p. 309) however, suggests that, the autonomy of students is likely to "vary from situation to situation," and that educators need to be aware that the level of self-directedness a student shows in one area many not necessarily flow into another area. Candy (1991) highlights the need for orientation, support and guidance to enable and help develop student's self-directedness.

Garrison's (1997) model was developed a few years after that of both Brockett and Hiemstra (2005) and Candy (1991). Garrison's (1997) model included aspects from both other models, but also included learner motivation and its influence on self-directedness. Garrison's model (Figure 6) had three overlapping dimensions: (a) self-management (task control), which focuses on the student identifying their own learning goals and their management of their own learning, (b) self-monitoring (cognitive responsibility), this is the processes where students are responsible for the constructing their own personal meaning (i.e., integrating new ideas and concepts with previous knowledge and (c) motivation (entering and task), students self initiation and maintenance of effort toward learning and the achievement of cognitive goals (Garrison, 1997). As described by Garrison's (1997, p. 26), "motivation reflects perceived value and anticipated success of learning goals at the time learning is initiated and mediates between context (control) and cognition (responsibility) during the learning process". Intrinsic motivation in particular has been shown to have a mediating effect on the dimensions of self-management and self-monitoring (Anderson, 2007). Student motivation will influence choice in deciding to participate (entering motivation) and the effort put into staying on task (task motivation) (Lodewyk, Winne, & Jamieson-Noel, 2009).

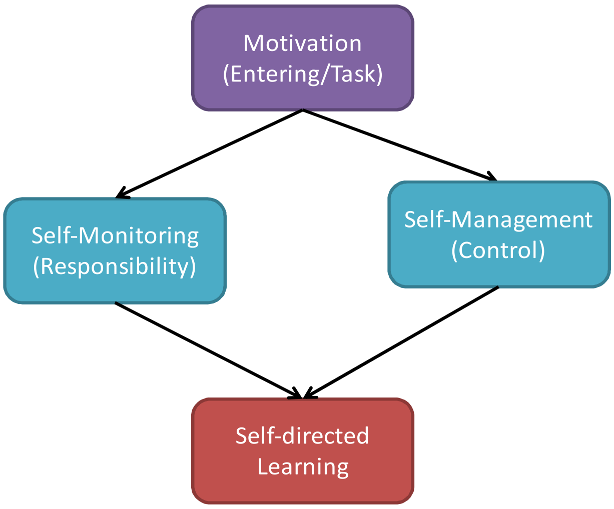


Figure 6: Garrisons' Dimensions of self-directed learning (Garrison, 1997)

2.6.1.1 The impact self-directedness has on learners

Students within a class can each have varying levels of self-directedness and therefore, be ready for different levels of learning which require them to be self directed. Student readiness for self-directed learning (SDL) can therefore be represented on a continuum, whereby students will be either more teacher-focused versus more self-directed. According to Guglielmino (Conole, et al., 2008; 1977) and other leading researchers in this area (Caffarella, 1993; Garrison, Cleveland-Innes, & Fung, 2010; Loyens, et al., 2008), teachers who match their teaching delivery with the SDL readiness of their students will offer the best learning opportunity for their students. Determining the readiness of learners for self-directedness will therefore, impact the type of learning activities that are employed. An individual that has a low level of readiness for SDL will need more teacher guidance to avoid feeling isolated and anxious when learning, whereas a student that is highly self-directed would feel unhappy with higher levels of teacher directed learning. It is therefore necessary to determine how self-directed a learner is so that that learner can be made comfortable in the learning processes. The following section explores how SDL is measured in education.

2.6.2 Measurement of self- directedness

Since the 1960s, when SDL became a major topic of interest, a number of instruments have been developed to assess the readiness of students for SDL (Conner, et al., 2009). One of the first instruments designed to measure readiness was Guglielmino's self-directed learning readiness scale (SDLRS) (Guglielmino, 1977). According to Conner et al. (2009) who carried out an extensive analysis of SDL research over the previous two decades, Guglielmino's SDLRS was one of the most highly cited measurement tool to assess SDL. The second most highly referenced measure was Oddis' Continuing Learning Inventory (OCLI) (Oddi, 1986). Oddis' measurement tool was however was only cited 10 times, which was considerably less than Guglielmino's dissertation (Conner, et al., 2009). These two measures have been adapted for use by a number of researchers. A newer measure that has been developed, based on these two scales is the self-directed learning readiness scale for nursing education (SDLRS) developed by Fisher, King and Tague (2001). These measures are discussed more fully below.

The Self Directed Learning Readiness Scale (SDLRS) developed by Guglielmino (1977) is a self-report questionnaire used to assess the attitudes, skills, and characteristics of the students that comprise an individual's current level of readiness to manage his or her own learning. It was built using a list of key characteristics that were considered important for self-directedness in learning and resulted in the identification of eight factors that related to SDL namely: (1) openness to learning opportunities; (2) self-concept as an effective learner; (3) initiative and independence in learning; (4) informed acceptance or responsibility for one's own learning; (5) love of learning; (6) creativity; (7) future orientation; and (8) ability to use basic study skills and problem solving skills (Hoban, Lawson, Mazmanian, Best, & Seibel, 2005). The internal reliability of this measure was good in this study and a number of other studies have also shown good reliability and validity (see Guglielmino & Hillard, 2007 for a detailed discussion of the reliability and validity of this measure). While the SDLRS has been widely used there some studies that have challenged the validity and reliability of the scale (see Field, 1989; Field, 1991; Hoban, et al., 2005 for more details). In particular Hoban et al. (2005) highlighted concerns about how readiness for SDL was measured and the meaning of the score. In addition, they offered criticism of the overall construction of the scale and the method that was used to develop it. Hoban et al. (2005) suggest an alternative approaches to studying self-directed learning should be explored.

The Oddi's Continuing Learning Inventory (OCLI) developed by Oddi (1986) was developed as an alternative to Guglielmino's SDLRS. Oddi (1986) took a different stance to measuring SDL and felt that SDL should be conceptualised as a personality characteristic, rather than a process (Harvey, Rothman, & Frecker, 2006). The OCLI was designed to assess three domains of self-directed learning: (a) proactive drive versus reactive drive, (b) cognitive openness versus defensiveness, and (c) commitment to learning versus apathy or aversion to learning (2010).

Later studies have recommended the OCLI be extended to four domains, namely: (a) learning with others, (b) learner motivation/self-efficacy/autonomy, (c) ability to be self-regulating, and (d) reading avidity (Harvey, Rothman, & Fredker, 2006). The reliability and validity of the OCLI has been found to be good by a number of studies (Harvey et al., 2006; Oddi, 1986; Oddi, Ellis, & Altman Roberson, 1990; Six, 1989a, 1989b; Straka, 1996). However, others have questioned the validity and reliability of the measures. Candy (1991, p.155) queries whether the OCLI can truly measure an attribute that is likely to be subject and context specific rather than "some abstract attribute". Brockett and Hiemstra (1991) also call into question the reliability of the OCLI as only a limited amount of research has been done, often with small samples.

One recent study that has received a lot of attention is Fisher, King and Tague's (2001) self-directed learning readiness scale (SDLRS). This scale was developed to assess nursing students' readiness for self-directedness, however the items used are generic and could be used for any discipline. The purpose of the SDLRS was to develop an alternative to Guglielmino's SDLRS to overcome criticism of reliability and validity (Fisher, King and Tague, 2001). The scale was based on key attitudes, abilities and personality characteristics of a self-directed learner. The result was the identification of three factors that were based on Garrison's self-directed learning principles: self-management, desire for learning, and self-control (Deyo, Huynh, Rochester, Sturpe, & Kiser, 2011). Even though the SDLRSNE measure is still fairly new a number of studies have reported good reliability and validity (Newman, 2004; Bridges et al., 2007; Smedley, 2007).

2.6.3 SDL and the adoption of technology

Technology used in the educational environment may impact students' level of self-directedness. While technology may enable the learner to access and engage with learning content it may require learners to have a degree of self-directedness (Teo, et al., 2010). Some have argued that technology can help support learners self-directedness, as it can provide access to a rich set of resources and tools that can be used to support learners (Usher & Pajares, 2008). It is clear that in an online learning environment, a learner who is more self-directed is more likely to be successful in their learning since they can match their learning activities to meet their learning goals (Straub, 2009). Hung, Chou, Chen, & Own (2010) conclude that self-directed students who take responsibility for their learning are also more likely to be more enthusiastic about their learning.

Students that are not ready for self-directed learning but are exposed to an environment requiring higher levels of self-directedness, will exhibit high levels of anxiety. Unprepared students thrust into this environment may disengage from their learning. Regan (2005) points out the need to match technology with students' level of self-directedness in a way that enables them to develop as a learner and become more self-managed and self-directed

Mobile learning is thought to be able to facilitate learner independence since it offers the possibility of greater autonomy of the learner, but can also helps build this autonomy (Liu & Li, 2009). Using mobile technology students have flexibility and control over time and access to learning content. To use the mobile technology they have to make a series of decisions about why, what and when to access learning content – decisions normally made by educators. Students may not even be aware of the process but by engaging in this activity they are self managing. The more they use their mobile, the greater the responsibility they are taking for their learning. Several studies have looked at mobile technology that supports self-directed learning. These mobile technologies include activities such as microblogging (Ebner, Lienhardt, Rohs, & Meyer, 2010), RSS (Lan & Sie, 2010), podcasting (Evans, 2008; Lawlor & Donnelly, 2010; Lazzari, 2009) and other mobile learning tools (Chen, 2010; Conole, et al., 2008; Liaw, et al., 2010; Ng & Nicholas, 2009; Puustinen & Rouet, 2009; Ruchter, Klar, & Geiger, 2010; Virvou & Alepis, 2005). Stone (2004b) argues that mobile technology can be used to help student to become more self-directed. Mobile tools can be utilised for planning, monitoring, and evaluating their own learning (Reio & Davis, 2005).

Developing a learner centred teaching environment is considered to be an important characteristic in enabling successful learning (Fulton, 2003). As described by Sharples, Taylor and Vavoula (2005) a learner centred approach “builds on the skills and knowledge of students, enabling them to reason from their own experience”. Mobile learning has been seen as a way to provide personalised and learner-centred activities to learners (Sharples, Taylor and Vavoula (2005), however it is important that the level of self-directedness required for this learner-centered approach match the readiness of students to avoid students disengaging. For mobile learning to be adopted students need to be willing and able to take advantage of this greater autonomy and take responsibility for their own learning (Ebner, et al., 2010).

Chan and Lee (2005) report that mobile technology can be used to minimise anxiety and create a productive and satisfying learning experience that involves actively engaging students and having them take responsibility for their own learning. Two studies found that it was possible to use mobile SMS messages to support learners and alleviate anxiety (Harley, Winn, Pemberton, & Wilcox, 2007; Stone, 2004a). The aim of the study was to use text messaging to support learners’ needs, and help students develop independent self-management (Stone, 2004a). SMS interaction was used between students and educators to keep the communication lines open and offer support. Similarly, Chan and Lee (2005) adopted podcasting to alleviate pre-class anxiety and address students’ preconceptions prior to attending lessons. Students were able to listen to content before class and this helped to reduce students’ preconceived ideas of the course content and helped prepare them for class. In another study by Goh, Seet and Rawhiti (2011) looking at the effectiveness of SMS messages found that SMS messages could be a persuasive and affective tool to support students’ learning. Their findings also found that the

SMS messages in the form of early intervention was able to provide stabilising and stimulating effects on students' self-regulated learning compared to a control group who received no SMS messages. Their study also shows that students who received SMS intervention performed better than students who did not receive SMS intervention.

2.7 Conclusion

Technology offers new possibilities to provide effective teaching and learning. Mobile technology is one of these technologies that have ignited considerable interest in terms of how it could be utilised to give students and educators more control over their learning. How technology has been harnessed in the educational arena has been of increasing interest, however, it is the factors that will impact adoption of users that still need to be clarified. Current studies into adoption of mobile learning tend to be small scale trials and pilots, with many focussing on a variety of different factors. In terms of the adoption by educators little empirical evidence could be found assessing the factors that impact their adoption.

This literature review has identified a number of gaps that exist in our understanding of the factors that will influence adoption. Current research has shown that some factors, such as ICT-self-efficacy and self-directedness have been shown to influence students' adoption of mobile learning, however, there is still some confusion as just how these factors influence adoption. Other factors such as the effect of student motivation needs considerably more research. As for the factors that influence educator's adoption considerably less is known. These gaps in the literature argue a need for further research into the factors that will influence the perception of mobile learning and adoption of mobile learning by students and educators. In addition further research is needed to determine if these factors will influence students and educator differently.

The research questions are:

- *To what extent do student and educator perceptions of ease of use and usefulness of mobile learning influence the adoption of mobile learning?*
- *What factors play an influencing role in the perceptions of the students' and educators' adoption of mobile learning?*
- *How do students and educators differ in their attitudes to, perceptions and adoption of mobile learning?*

CHAPTER 3: METHODOLOGY

3.1 Introduction

The purpose of this study is to identify and model the factors that influence student and educator perception of the usefulness and ease of use of mobile technology used for educational purposes and their adoption of mobile learning. There were two populations of interest in this thesis, namely tertiary students and tertiary educators. A multi-stage stratified convenience sampling method sampling was adopted for surveying three tertiary institutions in New Zealand. Students from these institutions, one polytechnic and two universities were sampled from four geographic locations in New Zealand using a combination of site-visits and electronic methods. Educators were surveyed via electronic means. Two slightly different versions of the same questionnaire were developed; one for students and one for teachers. The items in the questionnaire related to assessing respondents ICT self-efficacy, teaching ICT self-efficacy (in the educator's questionnaire), motivational orientations, learning orientations (in the students' questionnaire) and attitudes towards the integration of mobile technology into the learning and teaching environment.

In total, 446 students and 196 educators participated in the study. Following data screening, a final sample of N = 416 and N=175 were achieved respectively. The student and educator samples were analysed separately to determine the factors that influenced their adoption of mobile learning. For each sample group an exploratory factor analysis (EFA) was used to examine the data structure and guide the selection of indicator variables for the structural model (Blunch, 2008). The results from the analysis of the questionnaire are presented in Chapter 4 for the student sample and Chapter 5 for the educator sample.

This chapter includes the research design and methods that were used in this study. It begins with an explanation of the research design that was used. The second section outlines the sampling methods used with the populations of interest and the administration of the survey; the third section presents the measures used in the questionnaires; and the fourth section explains the methods used to screen and analyse the data.

3.2 Research Approach

A quantitative methodology was used in this study. The adoption of a quantitative framework enabled the development of a model that would identify those factors that influenced the adoption of mobile learning by students and educators. A combination of multi-stage stratified convenience sampling methods was used to sample students and educators at three different tertiary institutes in New Zealand. Two versions of the questionnaire were developed; the first questionnaire was targeted at students, the second educators. These questionnaires were fundamentally similar, however, some small differences were necessary to accommodate the two groups. In total 446 students from both the Polytechnic and University sector completed the survey along with 169 educators from the tertiary sector.

The aim of this research was to identify attitudes to and opinions of mobile learning by New Zealand tertiary students and educators. The two populations of interest are a quite large with approximately 469,107 students in tertiary education (Ministry of Education, 2010a) and 12,739 full time academic staff (Ministry of Education, 2010b). The following describes the student and educator populations and the justification for the selection of the sample group.

Ethical approval was also sought and granted by the Massey University Human Ethics Committee 8 December 2009. See Appendix K.

3.3 Sampling of Students

A multi-stage cluster convenience sampling method was used to sample students at three different tertiary institutions in New Zealand. In total 446 students from both the Polytechnic and University sector completed the survey.

According to the Ministry of Education (2010a), in 2009 there were 469,107 students in tertiary education (domestic n=425,650; international n=43,457). Of those who were domestic students, just over half are female (56%, n=237,789). The majority of domestic students (86.4%, n=367,815) were working towards their qualification at public providers with most attending institutes of technology and polytechnics (42.5%, n=180,709) and universities (36.4%; n=54,866). Students were undertaking a range of qualifications, with a large portion of them studying for a Bachelors degrees (29.2%, n=124,163) or diplomas at levels 5-7 (16.1%, 68,638). Students' ages ranged considerably however most students fell within the 20-39 age group

(53.8%, n=228,870). Ethnicities were mainly European (64.9%, 276,244), with Māori comprising of the second largest (19.7%, 83,785) and Asian were the third largest group (12.7%, 53,881).

An important part of the sampling procedure was to establish an appropriate sampling frame that would enable the collection of a representative sample of the population. According to Zikmund (2000), a number of factors need to taken into consideration when picking the best sampling frame, including; the characteristics of the target population, accessibility to the population, feasibility of the method of data collection, and the types of analysis to be conducted. The student population was diverse and therefore careful consideration was needed when sampling to ensure collection from a representative sample. A random sample of the entire population was difficult due to limitations of access, cost and time; therefore cluster sampling of business students from institutions in the North Island was used. The motivation for selecting business students to be the focus of this study, was that, compared to overall student distribution, in terms of all institutions, disciplines and qualifications, the business discipline distribution were the most similar in terms of age, gender and ethnicity, to the wider population of all students in tertiary education (Ministry of Education, 2010a).

Five different institutions were then selected from throughout the North Island of New Zealand, and permission was sort for them to participate in the study. Initially the University of Canterbury and WELTEC were planned to be included in this study, but had to be dropped. The University of Canterbury data collection period coincided with the first Canterbury earthquake in 2010. After originally agreeing to take part in the study, WELTEC embarked on a major re-structure that disrupted the collection process to a point where it was no longer viable. Consequently, only the Eastern Institute of Technology, Auckland University and Massey University were included in this study.

Questionnaires were administered to students from the Eastern Institute of Technology, Auckland University and Massey University. Both the Eastern Institute of Technology and Massey University have multiple campuses and all campuses were included in this study. As a result samples were drawn from five locations in New Zealand, namely; Hawkes Bay, Gisborne, Palmerston North, Wellington and Auckland. Classes were randomly selected from the business courses listed on the University/ Polytechnic course calendars. The section of this sampling technique enabled the most effective coverage of the population (Punch, 2009; Zikmund, 2000).

The researcher first approached the course coordinator seeking permission to speak to their students about the research. Of the 23 classes approached three classes were unable to participate as they were already participating in another study. Therefore an additional three classes were selected to replace the original three. Each class was addressed by the researcher and introduced to the study; students were given information sheets informing them of their rights in relation to this study, details of the study and an URL to the online questionnaire. Classes were given the option to complete the questionnaire online or using a hard copy. Approximately 30% of the questionnaires were completed in hard copy and the rest online. After the classes had been spoken to, an email was sent via the course website to all students registered on the course. This email once again briefly outlined the study and contained the link to the research questionnaire that was also included the information sheet.

Courses included in this study were from a range of academic levels. Of the approximate 1213 students invited to take part (based on numbers enrolled in each course supplied by the course coordinator of each course), 446 completed the questionnaire giving a response rate of 37%. Of the 446 students 298 were from the University sector and 148 were from the Polytechnic sector.

The resulting sample size of the student group was adequate for testing purposes (Chin & Todd, 1995; Ding, Velicer, & Harlow, 1995). There is little agreement on the number of responses appropriate for structural equation modelling (Sivo, Fan, Witta, & Willse, 2006) however Hoelter (1983) and Hoe (2008) recommend a sample size of 200 would be suitable for this type of statistical analysis. To eliminate bias it is recommended that studies with “three or more indicators per factor, a sample size of 100 will usually be sufficient for convergence, ”and a sample size of 150 “will usually be sufficient for a convergent and proper solution” (Anderson & Gerbing, 1984, pp. 171-170). While the sample size was suitable for most statistics, it was not large enough to allow for cross-validated of the structural equation model, since splitting the sample would have resulted in groups too small to reliably compare (Chin & Todd, 1995; MacCallum, 1986). Cross-validating is a relatively complex process of randomly splitting a sample into two or more groups to allow for comparison between the samples. This is used to confirm that the outcomes are consistent between the samples and have not occurred by chance (Schumacker & Lomax, 2010).

3.3.1 Student Characteristics.

The following section describes the sample of students. This section will describe the demographic makeup of the sample group and a general description of the sample. The first section will briefly explain the data screening process that was undertaken. Then details about the sample will be discussed.

3.3.1.1 Missing Data.

Of the original 446 completed surveys, 33 were removed because they were incomplete resulting in a response total of 413 students. All questionnaire results were screened to check for missing data and any datasets with missing data was either removed or substitute values were used where appropriate. There are two general approaches to handling missing data; either to remove the cases or variables or substitute values for the missing data. Mertler and Vannatta (2005) recommend that if the number of cases with missing data is small, then deleting those cases is generally appropriate. However, if the number missing is not small, then substitution should be considered. In this study, a combination of these two was used. Cases with a large amount of missing data (n=30, in student version) were removed.

Those cases with a small amount of missing data were inspected for patterns. Based on this it was established that the missing data was random and that the occurrence of missing data increased towards the later stages of the questionnaire or in the larger sections of the survey, indicating mild response fatigue (Brace, 2008). The small numbers of surveys that were found to have a small amount of missing data were not deleted as this helped to maintain the sample size needed for the selected statistical approach. Where appropriate, missing values were substituted. Person-mean substitution was undertaken where missing data was minimal and where missing data was random (Pallant, 2007; Tabachnick & Fidell, 2007). Person-mean substitution is appropriate for multi-item uni-dimensional scales and was adopted as it retains the integrity of the individual's responses by estimating a value based on their own responses rather than other respondents which may have greatly different opinions (Downey & King, 1998). For sections where this was inappropriate, such as for gender and age, statistics were conducted using a pairwise approach by which respondents are dropped only for those analyses involving variables that had missing values (Pallant, 2007).

The data was also inspected for univariate outliers, normality, homoscedasticity, and multicollinearity. The sample was within all the desired limits and therefore suitable for the planned analyses (Pallant, 2007). However four cases in the student data were identified as having significant outliers in relation to a number of the variables and were found to have an undue effect on the model, these were removed (Kline, 2005; Tabachnick & Fidell, 2007).

3.3.2 Sample Description.

Of the 413 responses there was a fairly even split between genders, with 227 females (55%). There seem to be an even split between males and females in the university sample (n=169 or 50.6% of total females) however the polytechnic sample had considerably more females (n=112 or 75.7% of total females). The mean students age was between the age of 20-29 years ($\bar{x}$ =2.21; s =.991). The age distribution of the two institutions was fairly similar with the biggest grouping falling in the 20-29 age group. However, the polytechnic sample had a higher representation from the 40-49 age group compared to the University sample (University: n=31, 10.4%; Polytechnic: n= 32, 21.5%). The ethnicity of participants in both sample groups seem to be relatively similar with the majority of participants classifying themselves as European or part European (University: n=226, 63.7%; Polytechnic: n=56, 65.9%), however the second largest group in the polytechnic sector were Maori (17, 20%; compared to 32, 9% in the University sector). In the university sector students of Asian descent were the second highest (64, 18%; compared to 7, 8.2% from the polytechnic sector). The sample was consistent with the population characteristics outlined in the previous section. Table 2 shows a summary of these demographics for the student sample.

Table 2: Demographic summary of student sample

Characteristics	**Number**	**Percentage (%)**
Gender		
Male	180	43.6
Female	227	55.0
Age		
Under 20	102	24.7
20-29	186	45.0
30-39	56	13.6
40-49	47	11.4
Over 50	18	4.4
Ethnicity/s		
European (incl NZ European)	282	68.3
Maori	49	11.9
Pacific Peoples	14	3.4
Asian	65	15.7
Other	3	0.7
Institute		
University	298	72.2
Polytechnic	149	36.1
How often do you carry your mobile phone with you?		
I do not own a mobile phone	8	1.9
Never	1	0.2
Seldom	8	1.9
Occasionally	30	7.3
Always	358	98.1
Type of mobile phone		
Low End: I can only make calls and text	42	10.2
2	59	14.3
3	116	28.1
4	85	20.6
High End: Fully functional smart device with latest features	78	18.9

The sample showed that the majority of the sample (n=397, 90%) always carried their mobile device with them. The type of mobile device that the students carried was classified as being mostly mid-range (n=392, 30%). When comparing the university sample and polytechnic sample, shown in Table 3, a slightly higher proportion of the university sample had high-end mobile phones (n=69, 20.7%), compared to the polytechnic sample (n=9, 12.9%). Table 3 shows a summary of phone type compared to the university and polytechnic student sample.

Table 3: Mobile phone type based on institution type

Characteristics	Number	Percentage (%)
Polytechnic Sample		
Low End: I can only make calls and text	6	8.6
2	10	14.3
Mid Range	21	30.0
4	15	21.4
High End: Fully functional smart device with latest features	9	12.9
University Sample		
Low End: I can only make calls and text	36	10.8
2	49	14.7
Mid Range	97	29.0
4	71	21.3
High End: Fully functional smart device with latest features	69	20.7

The data was assessed for normality and linearity. Normal probability plots were used to confirm the normality of data. Overall it showed acceptable levels of normality with skewness and kurtosis under -/+ 1.0 (Plallant, 2007). Scatter plots of paired variables did not show significant non-linearity.

3.4 Sampling of Educators

Convenience cluster sampling was used to sample educators in New Zealand. In total 196 educators from both the Polytechnic and University sector completed the survey.

Statistics published by the Ministry of Education (Ministry of Education, 2010b) found that teaching staff in tertiary education comprised approximately 12,739 full time staff. Of these, most were employed in universities (61%, n=7,830) and around a third employed at institutes of technology and polytechnics (34%, n=4,364), the rest were employed at Wānanga's (4%, n=545). In each of these sectors approximately half were female (universities: 43%; institutes of technology and polytechnics: 48%; Wānanga's: 55%). The age and ethnicity of this population was not available, however, based on data collected in 2005 from the Performance-Based Research Fund Census, a high portion of staff employed at universities (full-time equivalent

Performance-Based Research Fund-eligible university staff) were over the age of 50 years (45%, n=2959).

Two strategies were used to recruit tertiary staff: staff emails lists (from the three institutions participating in this study) and presentations at conferences where used to encourage eligible teaching staff to take part. The conferences included; Teaching and Learning Conference 2009, the Distance Educators of NZ conference 2010, and the Computing and Information Technology Research and Education New Zealand conference 2009 and 2010. Educators were also encouraged to distribute the invitation to participate to other tertiary educators in New Zealand.

Although the sampling method in this research is a form of convenience sampling, the representativeness of the sample was checked against population characteristics and found to be within acceptable limits. However the sampling approach used made it difficult to determine the response rate.

The final total of 175 suitable responses received was not a particularly large, but it is close to Hoelter's (1983) recommended 'critical sample size' of 200. Additionally, others have recommended that to eliminate bias, studies with "three or more indicators per factor, a sample size of 100 will usually be sufficient for convergence," and a sample size of 150 "will usually be sufficient for a convergent and proper solution" (Anderson & Gerbing, 1984, pp. 171-170). While this sample size is considered adequate, caution is still needed when interpreting the results.

3.4.1 Educator Characteristics.

The following section describes the educator sample. This section will describe the demographic makeup of the sample group and the general description of the sample. First the following section will briefly explain the initial data screening in relation to the way missing data was handled. Then details about the sample will be discussed.

3.4.1.1 Missing data.

The educator sample comprised 196 completed surveys, however 21 surveys were removed because they were incomplete or had significant outliers, giving a total of 175 eligible responses. The same approach used for the student sample for handling missing data was used here. A total of 21 cases were removed because of a large amount of missing data. A number of responses were substituted by using the Person-mean substitution technique and for the sections that were not suitable for this technique pairwise analysis was used (Pallant, 2007).

As with the student sample, the educator data was inspected for univariate outliers, normality, homoscedasticity, and multicollinearity. It was found that the sample was within the desired limits and therefore suitable for the planned analyses (Pallant, 2007). Only one case in the educator data was identified as having significant outliers in relation to a number of the variables and as this was found to have an undue effect on the model it was removed (Kline, 2005; Tabachnick & Fidell, 2007).

3.4.2 Sample Description.

Of the total responses 61% (n=107) were female. The average age fell within the 40-49 age group ($\bar{x}$=4.38, s =8.21). The vast majority of respondents were from NZ and of European decent (90%, n=157). The remainder of the respondents were of Maori, Asian, African descent. The demographic information of the respondents is provided in Table 4.

Table 4: Demographic summary of educator sample

Characteristics	**Number**	**Percentage (%)**
Gender		
Male	68	38.9
Female	107	61.1
Age		
Under 20	0	0
20-29	5	2.9
30-39	23	13.1
40-49	47	26.9
Over 50	100	57.1
Ethnicity/s		
European (incl NZ European)	157	
Maori	15	
Pacific Peoples	0	
Asian	2	
Other	1	
How often do you carry your mobile phone with you?		
I do not own a mobile phone	8	4.6
Never	2	1.1
Seldom	12	6.9
Occasionally	14	8.0
Always	136	77.7
Type of mobile phone		
Low End: I can only make calls and text	49	28.0
2	32	18.3
3	31	17.7
4	30	17.1
High End: Fully functional smart device with latest features	22	12.6

The sample showed that the majority of the sample (n=136, 78%) always carried their mobile device with them. The type of mobile device that the educators used varied greatly with slightly more owning low-end mobile devices (n=49, 28%).

The data was assessed for normality and linearity. Normal probability plots were used to confirm the normality of data. Overall it showed acceptable levels of normality with skewness and kurtosis under -/+ 1.0 (Plallant, 2007). Scatter plots of paired variables did not show significant non-linearity.

3.5 Instrument Description

The aim of this thesis was to examine two relationships. The first was the effect of the affective variables of ICT self-efficacy, ICT-teaching self-efficacy, learner self-directedness and motivation on perceptions of ease of use and usefulness of mobile learning, and the second was the relationship between perceptions of ease of use and usefulness, and intentions to use mobile learning. The relationships between these factors were also examined for moderation by demographic variables (see Figure 7). Figure 8 gives a description of these factors and their operationalised constructs.

The following section describes the development of the scales used to measure these variables.

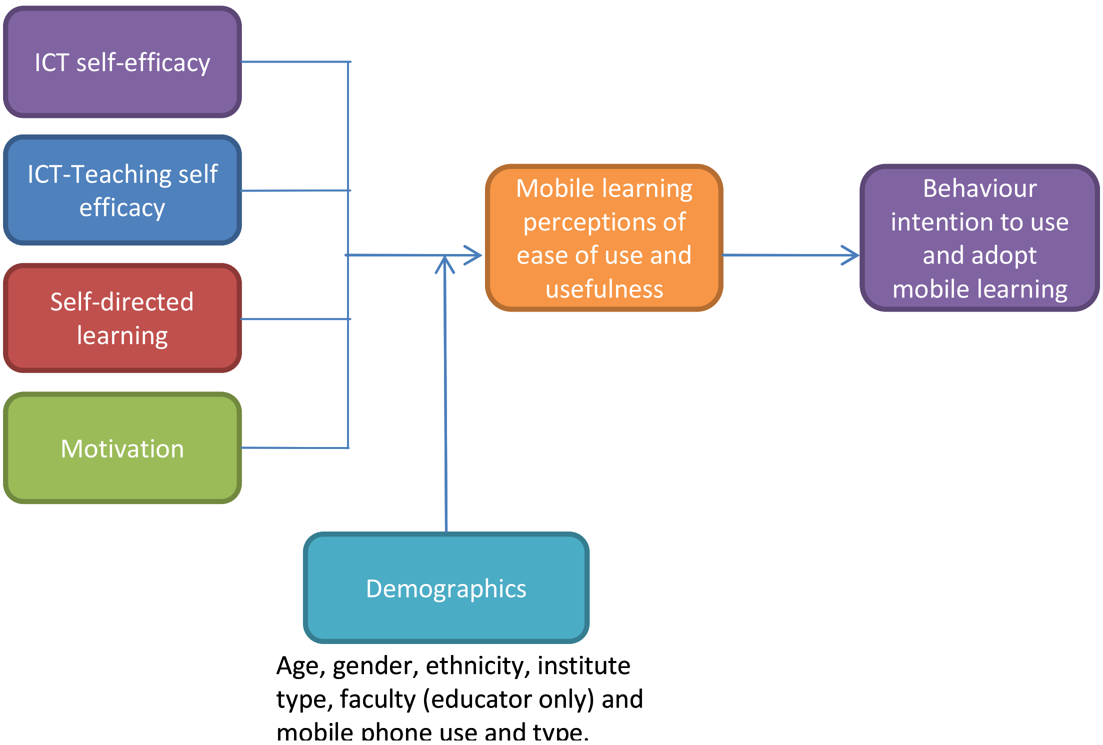


Figure 7: The structure of the model of this study.

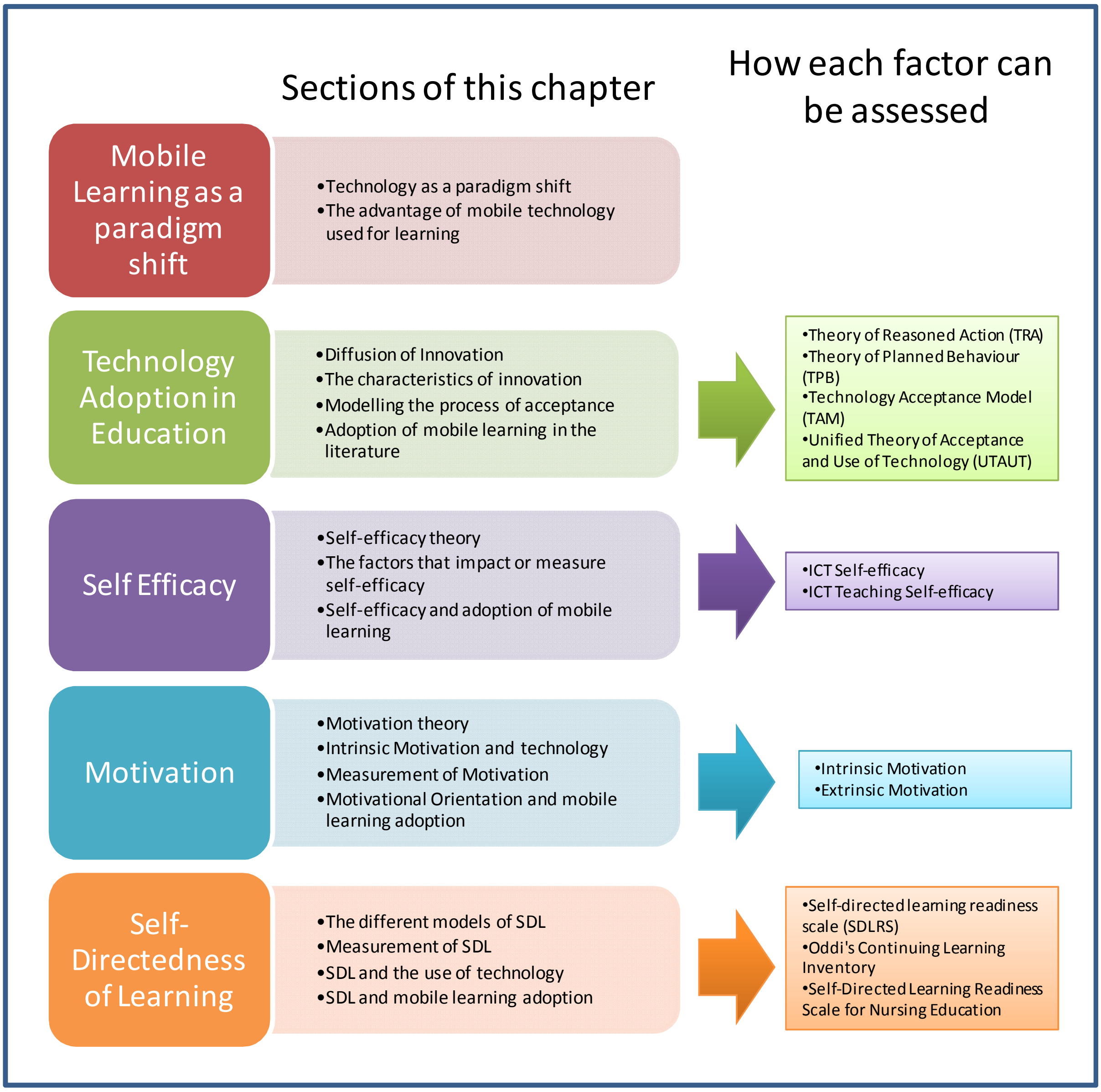


Figure 8: The main variables that were used in this study along with their operationalised constructs.

The questionnaire comprised a number of interval scales that measured the six major variables in this study. Each major variable was made up of two or more constructs that were measured by attitudinal statements. This approach of using a number of statements to reflect a particular characteristic can be unreliable if not handled correctly. Richardson (1999) states that unlike interview-based research, people who participate in questionnaire-based research may find it difficult to adjust their understanding of the individual statements, which comprise a particular scale/ construct, against the meanings which the author of the questionnaire originally intended. In an interview, respondents are able to develop a context based on cues, typically from previous questions, and infer the intended meaning of the question. Questionnaires often have very few cues, especially where statements are placed in random order in a questionnaire, which does not allow for cues to be drawn from neighbouring items. Therefore, special care was taken in the development of the questionnaire. This included using previously developed instruments that had already been subjected rigorous academic analysis. The questionnaire was also given to a small sample group who provide commentary on how understandable individual items were in relation to the questionnaire. This process was repeated a number of times and a number of small changes were made to the original survey. The results of the pilot tests are discussed in Section 3.6 of this chapter.

The survey used in this study primarily comprised self-report items to measure ability with a range of computing tasks, attitudes and opinions. The use of self-report items as measures provided a convenient and comprehensive indicator of student and educator attitudes, learning/teaching orientation and abilities. In the literature, there is some reservation about the use of self-report measures and how accurately participants are able to record their mental activities and ability (Richardson, 2004). However, the use of self-report scales have been consistently used as a key way to measure these constructs and have been found to have a high degree of validity and reliability (Beckers & Schmidt, 2003; Garland & Noyes, 2008; McIlroy, et al., 2007; Morris, Gullekson, Morse, & Popovich, 2009; Potosky & Bobko, 1998; Schulenberg & Melton, 2008; Smith, Caputi, & Rawstorne, 2007; Teo & Noyes, 2008; van Braak & Tearle, 2007; Wilkinson, Roberts, & While, 2010). Carini, Hayek, Kuh, Kennedy, and Ouimet (2003) describe five general conditions that should be adhered to when adopting self-reported measures. These conditions help insure the validity and reliability of the results: (a) respondents possess the information asked of them, (b) the items are phrased clearly to avoid confusion, (c) the questions ask about recent experiences, (d) the respondents believe the items warrant thoughtful answers, and (e) responding honestly does not threaten, embarrass, or compromise privacy. When assessing the suitability of the selected measures used in the survey, care was taken to insure that these conditions were met.

Two versions of the questionnaire were developed; the first questionnaire was targeted at students, the second at educators. These questionnaires were fundamentally similar, however some changes were made to reflect the different functions between the two groups. The six constructs were modified from six previously tested standardised measures (see Table 5). These constructs each measured characteristics of students and educators and are explained below.

Table 5: The original instruments used in this thesis.

Measure	Description	Source
ICT self-efficacy	Assessed attitude to computers are determined by four aspects, the individual's behaviour (actual skill), cognitive (belief), perceived control and affect (anxiety). Based on this concept four measures were developed each measuring the four different constructs, namely ICT skill, attitude, perceived control and anxiety.	Skill - Kennedy's et al (2008) Attitude – A combination of enjoyment, curiosity and perceived control Kay (1993) Perceived Anxiety - Kay (1993)
ICT-Teaching Self Efficacy (educator)	Assessed the beliefs and attitudes of educators in relation to their ability to integrate technology into their teaching.	Mueller et al. (2008)
Self-directed learning readiness (student)	Assessed the attitudes, abilities and personality characteristics necessary for self-directed learning. Assessed in relation to three factors; self-management, desire for learning and self-control.	Fisher, King & Tague (2001)
Motivation	Assessed the participants' motivation as being either as extrinsic or intrinsic.	Amabile et al. (1994)
Technology Acceptance Model	Three constructs were measured: Ease of use and perception of usefulness and behavioural intention	Venkatesh et al. (2000, 2003)

3.5.1 ICT self-efficacy items

The ICT self-efficacy measure comprised two scales that assessed the individuals' self-efficacy in relation to ICT. According to Kay (1993), attitudes to computers are determined by four aspects, the individuals' behaviour (actual skill), cognitive (belief), perceived control and affect (anxiety). Following Kay (1993) four measures were originally developed measuring these four constructs, namely ICT skill, attitude, perceived control and anxiety. However after the Exploratory Factor Analysis (EFA) only two constructs were retained; as ICT attitude strongly cross loaded with perceived control both these measures were removed (see section 3.7 of this chapter for more details regarding the EFA). Figure 9 briefly outlines the remaining two constructs. These two constructs (ICT skill and anxiety) will be discussed in the next two sections of this chapter.

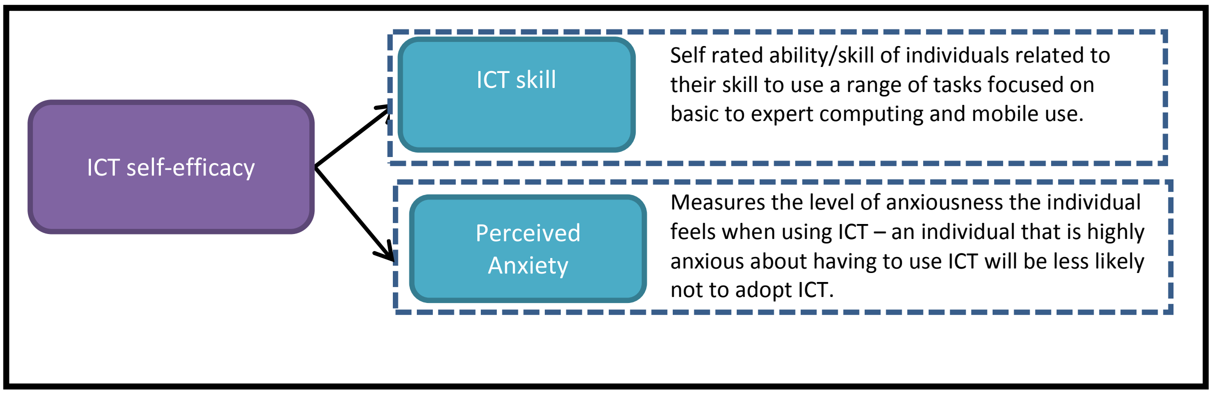


Figure 9: The two constructs that comprise ICT self-efficacy.

3.5.1.1 ICT Skill.

The general ICT skill scale was made up of several technology tasks. Participants were asked to rate their skill on each task. The tasks used in this study were taken from Kennedy, Dalgarno, Bennett, Judd, Gray and Chang (2008). The study conducted by Kennedy et al. (2008) included determining the most commonly used technology-based activities of student and staff. The original survey contained 38 tasks that were grouped into eight categories. The pilot test (see section 3.6) was used to reduce this number to 16 key activities that related to both computer and mobile usage. Computer based activities required a range of skills from using word processing software to searching and downloading files from the Internet. Mobile device usage included items relating to activities such as sending and receiving texts to uploading programs onto their phone. The skill was assessed based on a 7-point scale: 1= “Never used” to 7=” Extremely skilled”. Based on EFA (see section 3.7) these 16 tasks were grouped into three key groups, namely tasks associated with everyday ICT usage (referred to as general ICT skill), tasks associated with expert or specialised ICT usage (referred to advanced ICT skill) and tasks associated with mobile usage (referred to specific mobile skill). General ICT skill assessed the competency of users in relation to general computing tasks, such as using word processing software, searching and emailing on the Internet and doing basic mobile activities, such as texting and calling. Advanced ICT skill assessed the competency of users in relation to more advanced computing, such as modifying images and sounds and using advanced software (such as Skype). Specific mobile skill related to using mobile technology for more complex mobile learning activities, such as accessing the Internet, emailing and sending photos. In each category four items were retained to represent each construct (r = .80 for students, r = .84 for educators).

The motivation for determining participants’ skill using a range of technologies came from the assertion that students and educators skilled in wide range of technologies were more likely to adopt new technology (Hackbarth, et al., 2003). In their study they found that as people become more experienced with ICT tools, and learnt the necessary skills to use them, they were more likely to develop a favourable perception of the tool and feel at ease when using the tool. In addition, as discussed in Theng (2009), people tend to adopt information systems that are compatible to those previously adopted and used. In reference to mobile use, Theng (2009) found that student perceptions of ease of use about mobile devices as learning tool was significantly related to the students' prior experience of using mobile devices. This study attempted to determine the impact of a user's self-reported ICT skill and attitude on their intention to adopt mobile learning. In particular the following hypotheses were tested:

- H1-3 a and b: Students/educators with higher levels of general ICT skill (H1), advanced ICT skill (H2) and/or specific mobile skill (H3) will more likely to see mobile learning as easy to use and useful.
- H4-6: Students/educators with higher levels of general ICT skill (H4), advanced ICT skill (H5), and/or specific mobile skill (H6) will be more likely to adopt mobile learning.

In addition, the following relationships were tested.

- H7-9: As users become more skilled in one area of ICT usage they will be more likely to adopt a wider use of a range of ICT technologies.

Figure 10 illustrates these hypotheses.

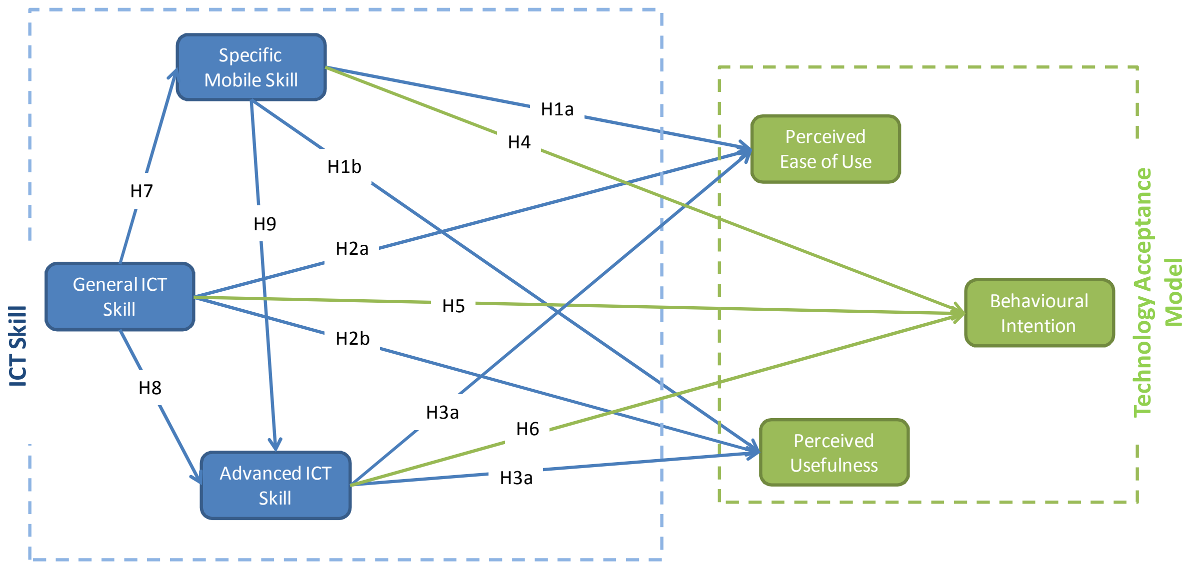


Figure 10: The hypothesis related to ICT skill.

3.5.1.2 ICT anxiety.

In addition, to the self-assessed skill used to measure ICT self-efficacy, eleven additional statements were used to assess the individual's attitude towards the use of ICT. The statements related to three general areas, general attitude to ICT, perceived control over ICT and anxiety. However, high levels of cross-loading in the EFA resulted in the retention of only anxiety for further analysis.

The anxiety measure was adapted from Wilfong (2006) and measured the level of anxiety felt when confronted with the issue of having to use ICT. Research has shown that an individual who is highly anxious about having to use ICT will be less likely to use ICT in their learning (Barbeite & Weiss, 2004; Beckers & Schmidt, 2003; Wilfong, 2006). This scale was measured using statements such as, "I feel apprehensive when using a computer" and "I have a lot of confidence when it comes to working with information and communication technology". These statements were all measured using a 7-point likert-type scale: 1 ="strongly disagree" to 7 = "strongly agree." Four items were retained to represent the ICT anxiety construct (r = .80 for students, r = .70 for educators).

ICT anxiety was used to determine the impact of anxiety on the intention to adopt, and attitude to, mobile learning. In particular two hypotheses were tested:

- H 10 a and b: Students/educators with lower ICT anxiety will be more likely to see mobile learning as easy to use and useful.
- H11: Students/educators with lower ICT anxiety will be more likely to adopt mobile learning.

In addition, the following relationships were tested.

- H12-14: As a user becomes more competent with one or more of the ICT skill areas they will experience less anxiety.

Figure 11 illustrates these hypotheses.

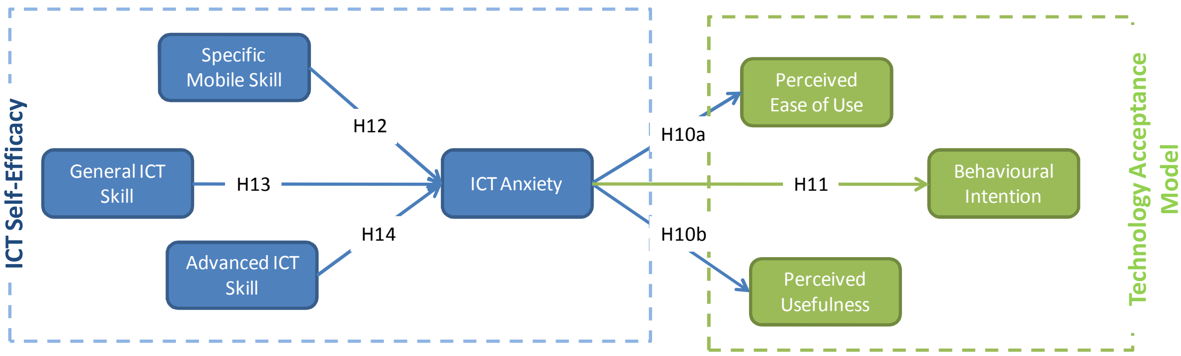


Figure 11: The hypothesis that relate to ICT anxiety.

3.5.2 ICT-Teaching self-efficacy.

In addition to assessing general ICT self-efficacy, the educators' survey included additional questions related to their use of ICT in their teaching. Teaching self-efficacy has been defined as educator belief that they can influence student performance (outcome) (Henson, 2001). A closely related concept is teaching self-efficacy. This is defined as the belief an educator holds regarding their ability to perform a variety of teaching tasks (Dellinger, et al., 2008). The difference between the two constructs is that teaching self-efficacy is related more to the theory of locus of control and teaching self-efficacy to the theory of self-efficacy (Dellinger, et al., 2008). In this study, these two constructs were combined in the context of integrating technology into their teaching to give a new construct, ICT-teaching self-efficacy. This is defined as the belief and ability an educator has in being able to successfully integrate technology into their learning.

The statements for this construct came from Mueller, et al. (2008). In their study they developed a comprehensive summary of teacher characteristics and variables that best discriminated between teachers who integrated computers into their teaching and those that did not. Mueller, et al. (2008) did not formally define these characteristics nor coin a label. This study has adopted the term ICT-teaching self-efficacy to represent these characteristics. This study found that ICT-teaching self-efficacy was an important determinant of high ICT integration into teaching. The scale used in this study assessed the attitudes of educators towards computers and their opinion of computers as an important instructional tool. The scale comprised 16 statements, and a 7-point likert-type scale, as with the anxiety scale. The EFA indicated this construct had two distinct sub-scales. The first sub-scale related to whether an educator saw ICT as giving them an advantage in their teaching over traditional methods (referred to as ICT perceived benefit) (r = .85). The second sub-scale related to the ability of the educator to use ICT in their teaching (referred to as ICT ability) (r = .70). Figure 12 briefly describes these two sub-scales. As with other sub-scales, these two constructs were represented by four items each.

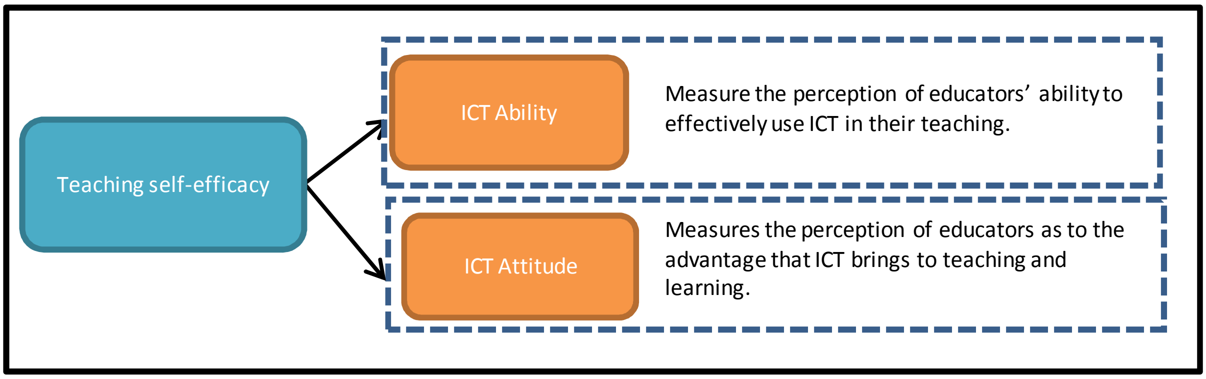


Figure 12: The two constructs that relate to teaching self-efficacy.

Two hypotheses tested the relationships between:

- H15-16 a and b: Educators with higher levels of ICT-teaching self-efficacy will be more likely to see mobile learning as easy to use and useful.
- H17 -18: Educators with higher levels of ICT-teaching self-efficacy will be more likely to adopt mobile learning.

In addition, the following relationships are tested:

- H33: Educators who are competent using ICT are more likely to have higher levels of ICT-teaching self-efficacy in relation to their ICT ability.

Figure 13 illustrates these hypotheses.

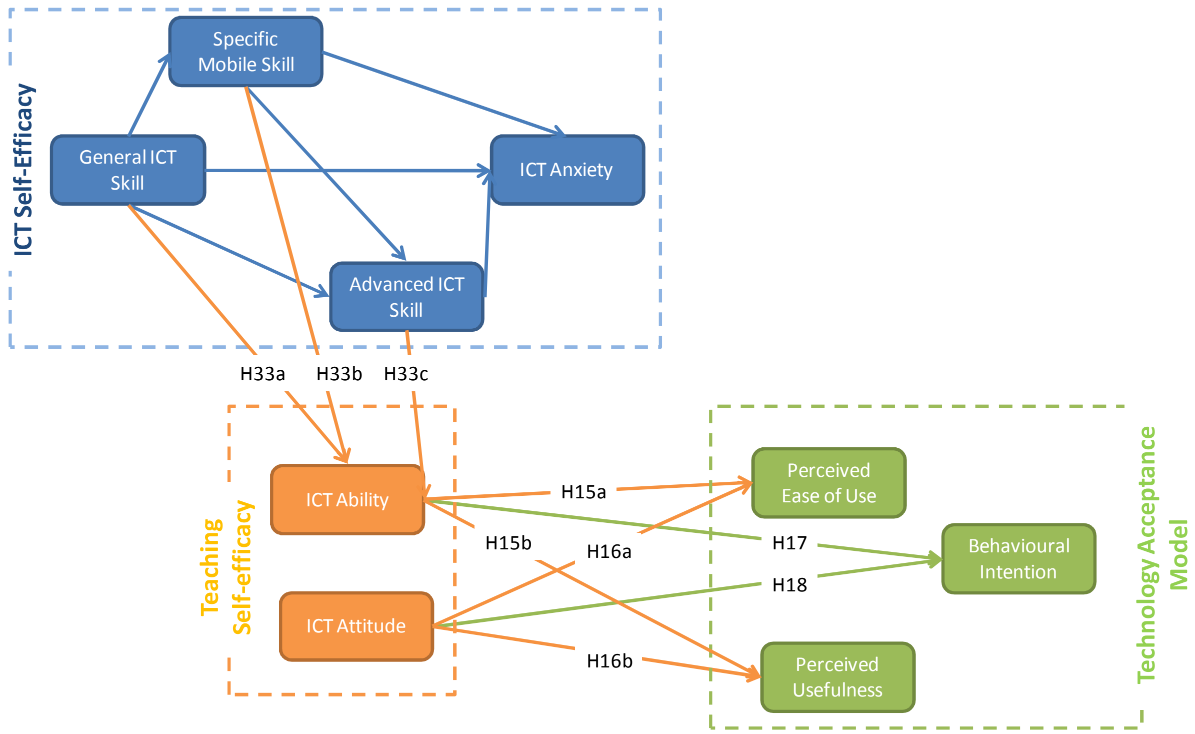


Figure 13: The hypothesis that relate to ICT-teaching self-efficacy.

3.5.3 Motivation.

The Work Preference Inventory scale (Amabile, et al., 1994) was used in this study to measure the level of intrinsic and extrinsic motivation that educators had towards their teaching and students to their learning. The WPI scale was used for both students and educators, with minor changes in the wording on six of the items on the scale. The WPI categorised ‘motivation’ as two primary scales: (1) Intrinsic motivation, which measures such elements as self-determination, competence, task involvement, curiosity, enjoyment, and interest, and (2) Extrinsic motivation which measures concerns with competition, evaluation, recognition, grades, and constraint by others (Mills & Blankstein, 2000). The scale is further divided into four secondary groups. Two subscales were used to assess intrinsic orientation; 1) challenge and 2) enjoyment; and two assessed extrinsic orientation; 1) outward and 2) compensation.

The original version of the questionnaire comprised 30 items, however, after the pilot test (see section 3.6 in this chapter for more details) this was shortened to 18 items. The items selected were those with the highest loading items on each of the four categories, on both versions of the original scale. Participants rated the items on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly disagree).

Based on the EFA carried out for both the student and educator survey there was only weak support for the four subscales of intrinsic and extrinsic motivation (see section 3.7 in this chapter for more details). It was therefore decided to use the two major scales; intrinsic and extrinsic motivation rather than the four sub-scales. For each scale four items were used (r = .71 for students, r = .70 for educators). Questions in the intrinsic scale included “I often will attempt the more complex problems in class to challenge myself”. The extrinsic scale included questions such as, “I believe that there is no point in doing a good job if nobody else knows about it”. Figure 14 describes these two constructs.

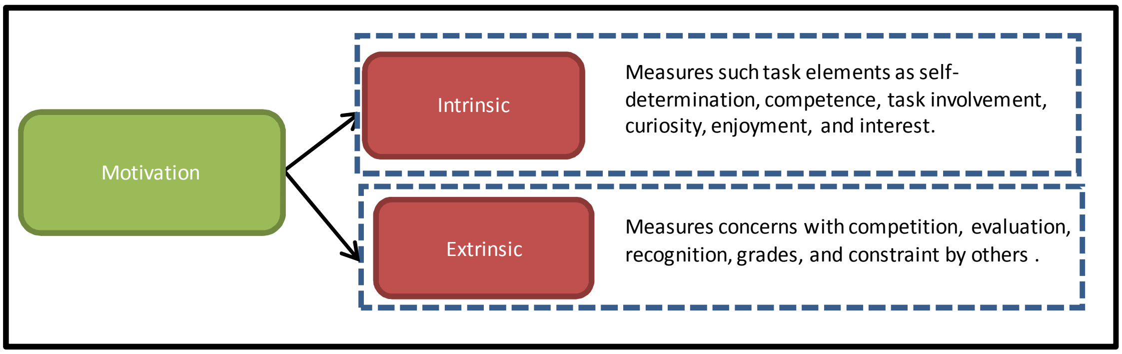


Figure 14: The two constructs that relate to motivation.

The WPI has been shown to have a meaningful factor structure, adequate internal consistency, good short-term test-retest reliability, and good longer-term stability (Amabile, et al., 1994). Further testing by Loo (2001) confirmed the strong construct validity of these scales.

Motivation theory and the adoption of technology has been addressed as a major force in adoption of, and attitude to, a range of technology in a broad range of contexts (Davis, et al., 1992; Gefen & Straub, 2000; Teo, et al., 2008; Yi & Hwang, 2003). Using the WPI scale it is possible to assess intrinsic and extrinsic orientation. Two hypotheses tested were:

- H19-20 a and b: Students/educators who have higher internal (H19) or external (H20) motivation will be more likely to see mobile learning as easy to use and useful.
- H21-22: Students/educators who have higher internal or external motivation will be more likely to adopt mobile learning.

Figure 15 illustrates these hypotheses.

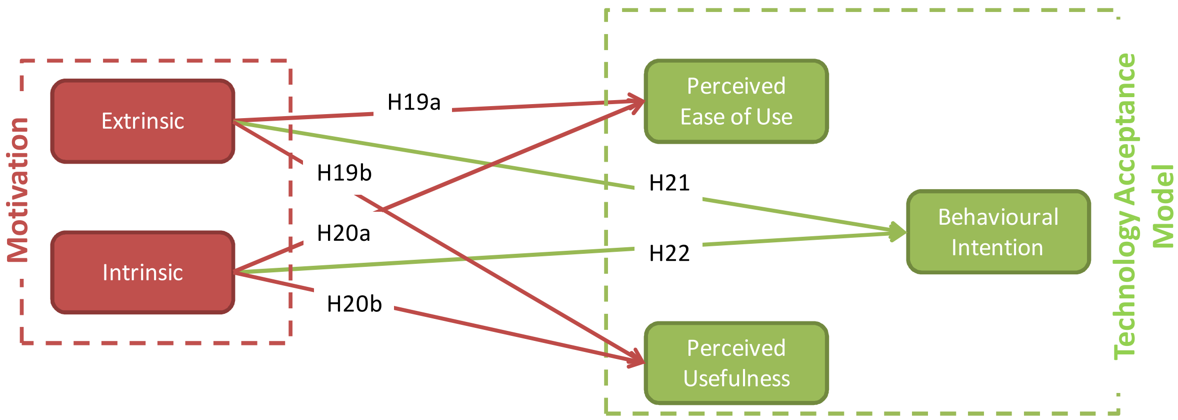


Figure 15: The hypothesis that relate to motivation orientation.

3.5.4 Self-directedness learning (in student version only).

Self-directed learning (SDL) can be defined in terms of the amount of responsibility the learner accepts for his or her own learning. A student that is more self-directed is more likely to take ownership of their learning and be more open to opportunities that may help or support their learning. The measure used in this section was developed by Fisher, King and Tague (2001) to determine the readiness of students for SDL. The scale referred to as SDLRSNE focused on nursing students and was based on Garrison's self-directed learning model (Garrison, 1997). Factors that would impact the ability of the students to be self-directed in their learning were: their self-management, their desire for learning and self-control. The self-management factor related to time management, information management and the development of a learning plan by the student. The self-control factor related to the ability of the student to set their own personal goals, evaluate their performance and be aware of their own limitations. The desire for learning factor measured intrinsic motivation for self-directed learning (Huynh et al., 2009). Though the scale was developed for nursing students, it has been suggested that it would be useful in a range of contexts, but particularly for students in distance or elearning contexts (Regan, 2005)

The SDLRSNE scale developed by Fisher, King and Tague (2001), was based on work by Chickering (1964), Gugliemino (1977), Knowles (1975, 1990) and Candy (1991) and comprised 40 items. The three constructs of self-management, self-control and desire for learning are shown in Figure 16. The SDLRSNE scale has shown good factorial validity in an exploratory factor analysis (Fisher & King, 2010), and the internal consistency of the SDLRSNE and its subscales has been reported in several studies (Bridges, Bierema, & Valentine, 2007; Newman, 2004; Smedley, 2007; Tarhan, 2010). These studies demonstrate that the SDLRSNE is reliable with good internal consistency across samples.

From the original SDLRSNE scale, 15 statements of the original 40 were selected to be included based on the pilot testing of the student survey (see section 3.7 in this chapter for more details). These items were measured using the same 7-point scale described earlier. Four items were selected to represent each construct (all scales had an *r* = 83 or higher). Questions in the self-management scale included "I manage my time well". The self-control scale included questions such as, "I like to make decisions for myself". Questions in the desire for learning scale included statement such as "I enjoy studying".

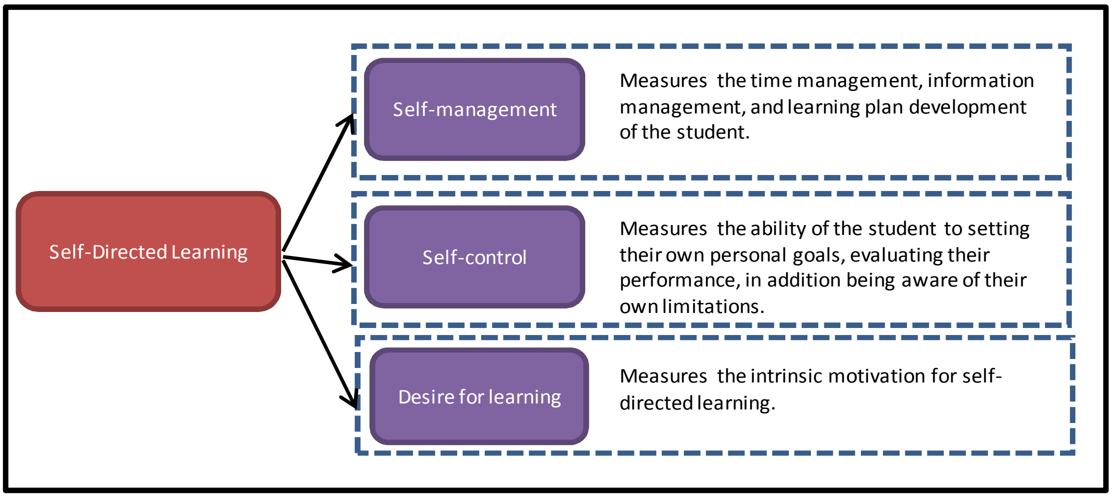


Figure 16: The three constructs that relate to self-directed learning.

The following hypotheses were tested in relation to the level of self- directedness of the students and mobile learning adoption:

- H 23-25a and b: Students with higher levels of self directed readiness will be more likely to see mobile learning as easy to use and useful.
- H26-28: Students with higher level of self directed readiness will be more likely to indicate that they would likely adopt mobile technology.

In addition, the following relationships were tested.

- H29: Students who are strongly intrinsically motivated will be more likely to be strongly self-directed.

Figure 17 shows an illustration of these hypotheses.

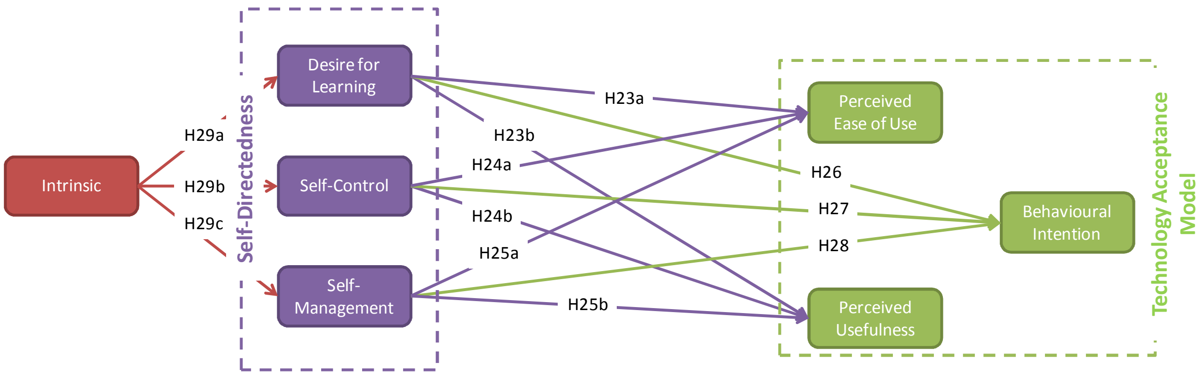


Figure 17: The hypothesis that relate to self-directed learning.

3.5.5 Mobile learning perceptions and behavioural intention to use and adopt.

Educator and student attitudes to mobile learning are thought to play an important role in the adoption of mobile learning. The Unified Theory of Acceptance and Usage Theory (UTAUT) was initially used in this study to measure the effect that performance expectancy, effort expectancy, social influence and facilitating conditions had on the intention to adopt mobile learning. Due to weak loadings however, the original four constructs could not be retained. Thus the original Technology Acceptance model (TAM), on which the UTAUT was based, was used. The TAM has only two constructs that determine intention to adopt, namely perceived usefulness and ease of use (Venkatesh, et al., 2003). The constructs of performance expectancy and effort expectancy are closely aligned to perceived usefulness and ease of use respectively. These two original constructs were therefore retained and renamed perceived usefulness and ease of use to maintain consistency.

The two constructs of perceived usefulness and ease of use had four items that were deemed to represent these two constructs (r = 71 for perception ease of use and r = 93 for usefulness by students, r = .70 for perceived ease of use and r =.86 for usefulness of educators). The ease of use construct measured whether mobile technology was seen to be free from effort. The perceived usefulness construct measured whether mobile learning was perceived as being beneficial to teaching and learning. Questions included “MT will enable me to access learning content more often” for perceived usefulness and “I think it might take me awhile to get comfortable with using a mobile device for learning” for ease of use. Figure 18 outlines the two constructs that measured these attitudes towards mobile learning.

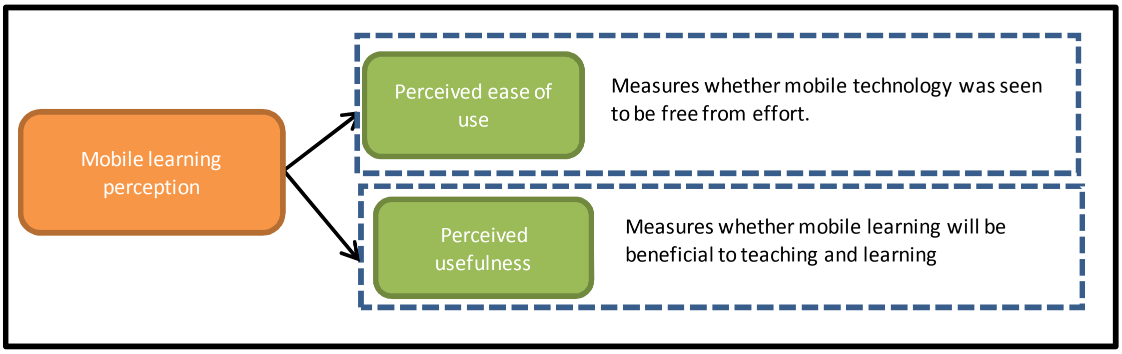


Figure 18: The two constructs that measure to mobile learning attitudes.

Using the TAM the following hypotheses were tested:

- H30: Students/educators who perceive mobile learning as easy to use will have a more positive perception of mobile learning usefulness.
- H31: Students/educators who perceive mobile learning as useful will be more likely to indicate that they intend to adopt mobile technology.
- H32: Students/educators who perceive mobile learning as easy to use will be more likely indicate that they intend to adopt mobile technology.

Figure 19 illustrates of these hypotheses.

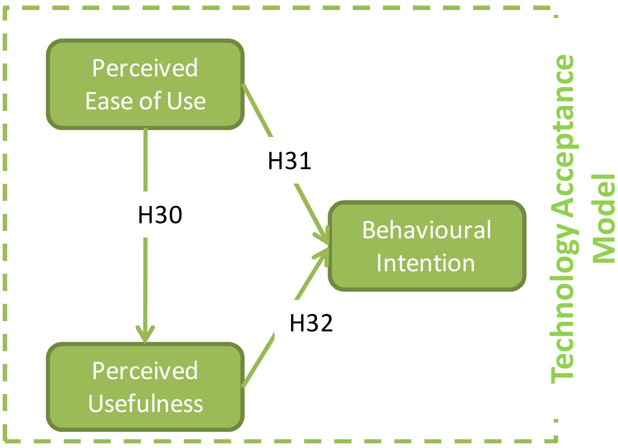


Figure 19: The hypothesis that relate to mobile learning adoption.

3.5.6 Demographic and organisational information.

The survey also collected demographic and organisational details for both staff and students. These variables were used to gain a richer picture of the respondents and check that the sample reflected to the population of interest. The variables also enabled analysis of group invariance so that the adoption models could be compared between groups (Schumacker & Lomax, 2010). The data collected included gender, age, ethnicity, department employed in (educator version), qualification being sought (student version) and whether the respondent owned a mobile device and type of mobile device they owned.

3.5.7 Open ended comments.

The survey had a section in which respondents were invited to add comments they wished to make regarding the survey or the use of mobile technology in education.

3.6 Pilot Study

The development of the questionnaire in this study took place over 2008-2009 and comprised two phases; the first phase involved working on the student survey, and the second, the educator survey. In each phase the questionnaire was developed, evaluated with a pilot group and changes made.

The student questionnaire was piloted with 30 students at one tertiary institution in Auckland, New Zealand. The participants were also asked to provide any feedback regarding to wording, layout and design of the questionnaire. From their feedback and reliability analysis, small wording changes were made and some measures were adjusted, as explained earlier. The first version of the student survey included a measure of student time poorness (Jeffrey, 2009), but this was dropped due to poor reliability. In addition, Button, Mathieu and Zajac's (1996) Performance and Learning Goal Orientation Scale was dropped because of its conceptual similarity with the intrinsic and extrinsic motivation and self-directness scales. The questionnaire was also shortened as the first version included the full scales for each construct. This was strongly recommended by the participants of the survey who felt that the initial version was far too long. Reducing the questionnaire length to reduce response fatigue is also recommended by Brace (2008). The ICT skill measure was shortened from 38 items to the 16 items that had highest factor loading (Kennedy, 2008). The section assessing motivational orientation was also shortened from 30 to 18 items. The retained 18 statements were selected based on factor loading.

The development of the teaching staff version of the questionnaire was undertaken after testing the student version. The changes recommended in the student version were implemented in the educator version where applicable. The survey was tested with 38 teaching staff at one tertiary institute in Hawkes Bay. The feedback was largely positive and most respondents felt the length of the survey was appropriate. Only small changes were made to the survey based on the feedback and included small wording changes and a few items being positively worded as the original negatively worded versions were found to be confusing to participants.

3.7 Exploratory Factor Analysis

Both data sets were analysed using exploratory factor analysis (EFA) to confirm the structure of the data and enable the selection of the strongest indicators of each construct (Plallant, 2007). Four indicators were selected to represent the latent constructs in the structural model (Little, Cunningham, Shahar, & Widaman, 2002). By using only four items to represent each construct the complexity of the structure model was reduced and a reasonable degree of freedom maintained (Schumacker & Lomax, 2010). This also improved parameter estimates and the reliability, validity and stability of the latent variables (Floyd & Widaman, 1995; Mulaik & Millsap, 2000; Schumacker & Lomax, 2010). When determining which items to select to represent each latent construct, the factor loading was taken into account along with how well the items related to the overall construct of the latent factor (Schumacker & Lomax, 2004). The reliability of the items was also taken into account ($\alpha \geq .7$) (Mulaik & Millsap, 2000; Schumacker & Lomax, 2010).

Initial exploratory factor analysis was conducted using principal factor analysis (also known as principal axis factoring, 'PAF'). The reason for using an exploratory approach was to determine the underlying structure of each latent construct without imposing a preconceived structure on the outcome (Suhr, 2006). PAF was adopted as it was robust enough to deal with a small amount of skewness (<1) (Costello & Osborne, 2005; Tabachnick & Fidell, 2007). Due to the complexity of the model tested the items were analysed in groups to test the suitability and uniqueness of the identified constructs (Tabachnick & Fidell, 2007). Post-hoc indicators of data and sampling adequacy (Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity) were used to determine the appropriateness of the identified latent constructs (Pallant, 2007). The results of these analyses are presented in Table 6 for student results and Table 7 for educator. Table 8 and 9 identify the adopted items for each construct. Appendix I and J shows the results of the factor analysis and shows retained factors and items.

Table 6: EFA results for students (by measurement cluster).

Measurement Cluster	**# Items**	**# Factors Retained**	**% Variance Explained**	**KMO**	**Bartlett's Test of Sphericity *p*<**
ICT skill	16	3	57.9	.891	.000
Anxiety	11	1	47.5	.871	.000
Motivation	18	2	41.2	.793	.000
Self-directed Learner	15	2	52.7	.901	.000
TAM	17	2	60.0	.921	.000

Table 7: EFA results for educators (by measurement cluster).

Measurement Cluster	**# Items**	**# Factors Retained**	**% Variance Explained**	**KMO**	**Bartlett's Test of Sphericity *p*<**
ICT skill	16	3	94.8	.901	.000
Anxiety	11	1	57.0	.701	.000
ICT-teaching self-efficacy	16	2	56.4	.691	.000
Motivation	18	2	42.3	.600	.002
TAM	24	2	57.1	.733	.000

3.8 Instrument Validity and Reliability

The following section outlines the validity and reliability of the questionnaire used in this study.

The individual scales used to measure each construct in this study were drawn directly from previous studies for which the validity and reliability had already been determined. The validity and reliability of each scale has each been discussed in the Instrument Development section (section 3.5) of this chapter. Each scale comprised a number of items that were used to measure a single construct. Multi-item measures ensure lower measurement error, provide a finer measure of each construct and better reflect complex theoretical concepts compared to single item measures (McIver & Carmines, 1981; Nunnally & Bernstein, 1994; Spector, 1992).

In addition to ensuring the validity of the instrument each scale was assessed for its reliability. The reliability of the data from each scale measures the consistency of each measurement both over time (test-retest reliability) and with the consistency within each indicator (internal consistency reliability) (Punch, 2009). The internal consistency reliability of each scale was tested throughout the development the instrument and changes made to the instrument based on these results. In addition, the internal consistency reliability score, measured by Cronbach's alphas, has been reported. Composite reliability is analogous to the Cronbach's coefficient alpha for measuring the reliability of a multiple-item scale (Helms, Henze, Sass & Mifsud, 2006). In this study the alpha coefficient value was set at a minimum of 0.70 (Punch, 2009). All the constructs used in this study met this target level. Table 8 and 9 reports the Cronbach's alpha of the constructs along with the adopted items.

Construct validity is referred to the degree to which the constructs adopted represents the theoretical concepts (Colliver, Conlee, & Verhulst, 2012). Convergent and discriminant validity are both subcategories of construct validity (Colliver, Conlee, & Verhulst, 2012). According to Straub, Gefen and Boudreau (2005), when conducting structure equation modelling (SEM), construct validity of the measures are inherent in the model. This means that a model that illustrates good fit would in essence have construct validity. In particular the fit statistic root mean square residual (RMSR) which indicates how much variance is not explained by the data also indicates construct validity (Gefen, Straub, & Boudreau, 2000).

Table 8: Cronbach's alphas for the constructs used in this study (Student Version)

	Abbreviation	Retained Items	Cronbach's alphas	Items Adopted
ICT self-efficacy				
General ICT skill	GICTS	4	0. 81	Use the web to send or receive email Use a mobile phone to text/ SMS people Use a mobile phone to call people Use the web to look up reference information for study purposes
Specific mobile ICT skill	SMS	4	0. 93	Use a mobile phone to access information/services on the web Use a mobile phone to play, and upload music (such as MP3 or the radio Use a mobile phone to send pictures or movies to others Use a mobile phone to download and play games or applications from the Internet
Advanced ICT skill	ExICTS	4	0. 85	Use a computer to create/edit audio and video Use a computer to manage/manipulate digital photos Using a computer to play digital music files (e.g. iTunes) without accessing the Internet Use the Internet to make phone calls (e.g. Skype)
Perceived anxiety	Anx	4	0.84	ICT is difficult to use (R) ICT frustrates me (R) I feel insecure about my ability to use ICT (R) I need someone to tell me the best way to use a computer

	Abbreviation	Retained Items	Cronbach's alphas	Items Adopted
Self-directedness				
Self-Management	SM	4	0.84	I manage my time well
				I am organized
				I set strict time frames
				I am self disciplined
Desire for Learning	DfL	4	0.83	I enjoy studying
				I have a need to learn
				I enjoy learning new information
				I want to learn new information
Self-control	SC	4	0.83	I like to make decisions for myself
				I am in control of my life
				I am responsible for my own decisions/actions
				I prefer to set my own goals
Motivation				
Intrinsic orientation	IM	4	0.76	I enjoy tackling problems that are completely new to me
				The more difficult the problem, the more I enjoy trying to solve it
				I often will attempt the more complex problems in class to challenge myself
				I prefer to figure things out for myself
Extrinsic orientation	EM	4	0.71	I am strongly motivated by the recognition I can earn from other people
				I have to feel that I'm getting something in return for everything I do
				I want other people to see and appreciate how good I really can be in my study
				I believe that there is no point in doing a good job if nobody else knows about it

	Abbreviation	Retained Items	Cronbach's alphas	Items Adopted
Mobile learning perceptions				
Perceived usefulness	PU	4	0.93	MT will enable me to access learning content more often MT would enable me to access learning content more quickly I would find mobile technology (MT) useful in my learning Taking a mobile-supported course would provide me with an efficient way to utilise my time
Perceived Ease of use	PEOU	4	0.71	I would be anxious about having to use my mobile device to help support my learning (R) I think it might take me awhile to get comfortable with using a mobile device for learning (R) I would be concerned if ML was a required component of my study (R) I believe that it would take me longer to accomplish learning tasks using a mobile device (R)

Table 9: Cronbach's alphas for the constructs used in this study (Educator Version)

	Abbreviation	Retained Items	Cronbach's alphas	Items Adopted
ICT self-efficacy				
General ICT skill	GICTS	4	0. 80	Use the web to send or receive email Use the web to buy or sell things (e.g. Trade Me) Use a mobile phone to call people Use the web to look up reference information for study purposes
Specific mobile ICT skill	SMS	4	0. 93	Use a mobile phone to access information/services on the web Use a mobile phone to take digital photos or movies Use a mobile phone to send pictures or movies to others Use a mobile phone to send or receive email
Advanced ICT skill	ExICTS	4	0. 70	Use a computer to create/edit audio and video Use a computer to manage/manipulate digital photos Using a computer to play digital music files (e.g. iTunes) without accessing the Internet Use a mobile phone to download and play games or applications from the Internet
Perceived anxiety	Anx	4	0.85	ICT is difficult to use (R) ICT frustrates me (R) I feel insecure about my ability to use ICT (R) I need someone to tell me the best way to use a computer

	Abbreviation	Retained Items	Cronbach's alphas	Items Adopted
ICT-teaching self-efficacy				
ICT ability	SEabl	4	.78	I see ICT as tools that can complement my teaching. ICT provide variety in instruction and in content for my students. ICT allows me to bring current information to the class ICT provides opportunities for individualized instruction.
ICT attitude	SEAtt	4	.82	I feel frustrated more often when I use ICT in my classes than when I don't use them (R) I have positive ICT experiences at my teaching institute. I had positive experiences with computers when I was younger I feel I am trained well enough to use a variety of ICT tools when teaching
Motivation				
Intrinsic orientation	IM	4	0.70	The more difficult the problem, the more I enjoy trying to solve it I often will look for work that challenges me I prefer to figure things out for myself It is important for me to have an outlet for self-expression
Extrinsic orientation	EM	4	0.70	To me, success means doing better than other people I am strongly motivated by the money I can earn I believe that there is no point in doing a good job if nobody else knows about it I want other people to see and appreciate how good I really can be in my work study
Mobile learning perceptions				
Perceived usefulness	PU	4	.86	MT will make learning and teaching more interesting I see ML as a way of encouraging more interaction by students and educators I see ML as a way to improve student learning as it allows students to access learning content anywhere and anytime I see ML as a way to enhance/encourage my students self-directed learning
Ease of use	PEOU	4	.70	I would be anxious about having to use my mobile device to help support my learning (R) I think it might take me a while to get comfortable with using a mobile device for teaching (R) I believe I would find it easy to use a mobile device to support my teaching I feel that I would have the knowledge necessary to implement and use MT in my teaching

3.9 Data Analysis

Statistical analysis was conducted on the data to test the null alternatives to the hypotheses presented in this chapter. These results are presented in the next chapter. Two major statistical tests were used in this study, the first was structural equation modelling and the second was ANOVA (Analysis of Variance) used to further refine the usefulness variable.

The structural model was tested using structural equation modelling (SEM) techniques. The SEM analysis tested how well the path models fitted the overall hypothesised structural model (Byrne, 2010; Kline, 2005; Schermelleh-Engel, Moosbrugger, & Müller, 2003; Schumacker & Lomax, 2010). The measurement model and path models were tested as a two-step approach as this enabled the accuracy of the measurement components to be verified before proceeding to the testing of the paths (Byrne, 2010; Schumacker & Lomax, 2010). The path model was tested in three phases; the first analysed the fully mediated structural model where the characteristics of ICT self-efficacy, self-directedness and motivation were mediated through ease of use and perception of usefulness. The second phase determined whether each factor had a direct influence on behavioural intention, by removing the mediation between ease of use and perception of usefulness. The final model took the significant paths from the two phases and combined them into one final model. Testing in this way it allowed the best model to be developed and helped to clarify the complex relationships being tested. According to MacCallum and Austin (2000) this approach is both recommended and a popular way to approach structural testing compared to a purely exploratory model evaluation that can be otherwise quite restrictive and isolated (MacCallum & Austin, 2000). Each alternative model was tested by examining the fit statistics with the model, with the best fit being selected for the final model (Byrne, 2010; Kline, 2005; Schermelleh-Engel, et al., 2003; Schumacker & Lomax, 2010). The last step in the analysis of the student sample (the educator sample was not large enough to allow for this) involved testing for the moderating effects of gender, age and institution attendance.

The analysis of variance (ANOVA) is used when two or more means are compared to see if there are any significant differences among them. The analysis of variance was conducted to compare how differences in the demographics of students and educators may play a role in attitudes of the respondents' to specific mobile learning initiatives. The analysis of variance was used as a way to further unpack the influences on mobile learning adoption. Factors such as gender and age have been described as possibly playing a key role in adoption of mobile learning (Wang, et al., 2009b), however other demographics variables such as type of institution the student is enrolled in were also considered to be possible influences on adoption. The analysis of variance testing enabled the testing of these relationships.

ANOVA was conducted using Statistical Package for the Social Sciences (SPSS) v19.0 (Pallant, 2007), and the exploratory factor analysis, maximum likelihood estimation and structural analysis were performed using the SEM programme Analysis of Moment Structures (AMOS) v18.0 with SPSS and (Arbuckle, 2007; Byrne, 2010). The results for the student sample are reported in chapter 3, the educator sample results are reported in chapter 4.

The comments in the survey were coded then content analysed for emerging themes. These themes were used to provide a more detailed explanation for the variables used in this study. Content analysis was used as it allows for a systematic and reliable procedure that can be used to reduce a large amount of comments to a smaller number of categories (Krippendorff, 2003).

The data collected from the comments section of the survey yielded 87 comments in the student survey and 62 comments in the educator survey. The content analysis was analysed used the following procedure: 1) All comments were read through; 2) They were then coded identifying recurring topics; 3) These topics were then grouped into complementary headings and topics placed under relevant headings. Based on the content analysis 3 categories were identified in each group, these categories were order in terms of how frequent they were discussed in the comments.

CHAPTER 4: STUDENT RESULTS

4.1 Overview

This chapter presents the results of the student questionnaires. The results are divided into two sections. The first section (Section 4.2) presents the structural relationship modelling that was used to test the proposed model of influences on the adoption of mobile learning by the students. This section has been broken down into three parts.

The first part (section 4.2.1) describes the results of the correlation analysis used to determine the relationships between the factors and assess for multicollinearity. The second part (section 4.2.2) describes the measurement model of the study along with the reported goodness-of-fit statistics. The third part (section 4.2.3) describes the results of the testing the hypothesised structural model (the 'structural model'). The last part (section 4.2.4) describes the results of the multi-group analysis examining the effect of student characteristics on adoption of mobile learning. Additional analysis was carried out in the form of an ANOVA which was used to further unpack the perceived usability of mobile learning and compare this perception between students of different ages, genders and backgrounds.

The last section (Section 4.3) of this chapter describes the qualitative results of the survey. With the use of content analyses it identifies three themes that influenced the attitude of the students towards mobile learning and its adoption.

Chapter 5 presents the results of the educator survey.

4.2 Structural Equation Modelling

Structured Equation Modelling (SEM) was used to test two relationships. The first was the effect of the learner characteristics, ICT self-efficacy, ICT-teaching self-efficacy, self-directedness and motivation on perceptions of ease of use and usefulness of mobile learning, and the second is the relationship between perceptions of ease of use and usefulness, and intentions to use mobile learning. The indicators for each variable used in the model were previously selected from an exploratory factor analysis. SEM analysis was then used to find how well the path models fitted the overall hypothesised structural model. This followed a two-step process in which the accuracy of the measurement components was verified (measurement model) before testing the paths (structural model).

These results are presented below.

4.2.1 Correlation analysis of the two primary relationships

The two main relationships that are the focus of this study are examined here in relation to students. Structural equation modelling was used to test these relationships in an integrated model that contained all the major variables. The first relationship measured the effect of the affective variables of ICT self-efficacy, learner self-directedness and motivation on perceptions of ease of use and usefulness of mobile learning. The influence of student perceptions of ease of use and usefulness on intentions to use mobile learning was then tested. The correlations between the relationships were first assessed to determine the level of multicollinearity between relationships. Multicollinearity exists when relationships between two factors are highly correlated (Gefen, Straub, & Boudreau, 2000). High correlation can pose a risk of Type II errors in statistical modelling (Grewal, Cote, & Baumgartner, 2004).

The correlations were determined using a bivariate Pearson product-moment coefficient (r). Based on the results of the correlation it was possible to determine that there were a number of significant relationships between the two important relationships in the study. However, these correlations were not sufficiently high for multicollinearity to be a concern. Table 10 presents the correlation matrix.

As expected, the three dimensions of the TAM model showed a positive correlation with each other. Perceived usefulness and perceived ease of use were moderately correlated ($r=0.39$, $p < .000$), and perceived usefulness and perceived ease of use were correlated with behavioural intention to use and adopt mobile learning ($r=0.33$ and $r=0.46$, $p < .000$, respectively). Most other constructs in the model showed some correlation with perceived usefulness and perceived ease of use. Perceived usefulness is associated with all constructs except anxiety. On the other hand, perceived ease of use had a significant relationship only with ICT self-efficacy (General ICT self-efficacy $r=.099$, $p=.044$; Specific mobile self-efficacy $r=.162$, $p=.001$; Expert ICT self-efficacy $r=.130$, $p=.008$; and anxiety $r=-.252$, $p<.000$).

With the exception of anxiety, most constructs exhibited moderate to high means, and had modest but acceptable levels of negative skew (< 1).

Table 10: Means, standard deviations, and inter-correlations between latent constructs in the structural mode.

	Mean	SD	GICTS	SMS	ExICTS	Anx	IM	EM	SM	DfL	SC	PU	PEOU
General ICT Skill (GICTS)	5.99	.972											
Specific Mobile Skill (SMS)	4.80	1.82	.579** .000										
Expert/ Specialised ICT Skill (ExICTS)	4.30	1.390	.454** .000	.517** .000									
ICT Anxiety (Anx)	2.90	1.260	-.337** .000	-.195** .000	-.379** .000								
Intrinsic Motivation (IM)	4.91	1.010	.147** .003	.116* .019	.181** .000	-.227** .000							
Extrinsic Motivation (EM)	3.98	1.207	.045 .366	.176** .000	.220** .000	.142** .004	.114* .020						
Self-Management (SM)	4.89	1.256	.144** .003	.024 .633	.022 .650	-.064 .192	.332** .000	.084 .087					
Desire for Learning (DfL)	6.07	.689	.318** .000	.083 .093	.183** .000	-.263** .000	.458** .000	.027 .588	.367** .000				
Self control (SC)	5.86	.039	.271** .000	.150** .002	.129** .009	.249** .000	.217** .000	.126** .000	.515** .000	.558** .000			
Perceived Usefulness (PU)	4.94	1.477	.198** .000	.337** .000	.183** .000	.032 .519	.156** .001	.233** .000	.126* .010	.167** .000	.227** .000		
Perceived ease of use (PEOU)	3.68	1.175	.099* .044	.162** .001	.130** .008	-.252** .000	.004 .942	.061 .079	-.018 .711	.061 .219	.093 .059	.386** .000	
Behaviour Intention (BI)	4.93	1.613	.244** .000	.328** .000	.234** .000	-.060 .227	.156** .001	.233** .000	.037 .455	.204** .000	.187** .000	.734** .000	.397** .000

Note: ** $p < 0.001$, *$p < 0.05$ level, highlighted cells refer to non-significant results, $p > .05$. Means for all scales: 1=minimum (low), 7=maximum (high). $n = 446$.

4.2.2 Structural Equation: Measurement Model

Structural equation modelling (SEM) was used in this study to test the hypothesised model of factors expected to impact on mobile learning adoption. SEM enables simultaneous analysis of different factors that may influence mobile learning adoption whereas regression models such as linear regression, ANOVA, and MANOVA can only analyse one layer of linkages between independent and dependent variables at a time (Gefen, et al., 2000). SEM enables the testing of the whole model rather than just testing one relationship between constructs at a time and enables complex relationships between variables to be analysed (Schumacker & Lomax, 2010).Twenty eight hypotheses were tested using SEM to determine how the three primary constructs of ICT self-efficacy, motivation, and self- directedness influenced the technology acceptance of mobile learning.

The SEM model produces two inter-related models: the measurement and the structural model. The measurement model defines the latent variables that are part of the model and the items that are used to assess these variables (Gefen, et al., 2000). The structural model then defines the relationship between the latent variables (Gefen, et al., 2000). The measurement model and the structural model were assessed separately.

The measurement model uses factor analysis to assess the degree to which the observed variables load on their latent constructs (Gefen, et al., 2000). Chapter 3 presented the results of the EFA for the constructs used in this model. The item loading for each latent variable based on the final version of the model are shown in Appendix E. All but one of the constructs in this model used four items to estimate the variable. Behavioural intention, had only one item – "Overall, I think mobile learning would be beneficial to my learning and I would be willing to adopt it, if I had the opportunity, in the future". SEM does allow for constructs to be represented by a single item as long as the item is from an established scale with its own reliability and the item is able to reference the whole scale as is the case with the Behavioural intention construct (Gefen, et al., 2000).

The suitability of the measurement model was assessed using the fit statistics. Fit statistics are used to confirm whether the data collected supports the theoretical model under scrutiny (Byrne, 2010; MacCallum & Austin, 2000; Schumacker & Lomax, 2010).

4.2.3 Goodness-of-Fit Statistics.

Finding a statistically significant theoretical model that makes sense in terms of the theory is the primary goal of SEM (Schumacker & Lomax, 2010). A number of fit statistics have therefore been developed to assess the suitability of the model under different model-building assumptions. When reporting goodness of fit it is acceptable to report a range of fit statistics. The fit statistics used are described and the results reported below.

AMOS computes a wide range of goodness-of-fit statistics which, can be categorised into three key groups, namely absolute, relative and parsimony fit measures (Blunch, 2008; Meyers, Gamst, & Guarino, 2006). It is recommended that at least one statistic from each group be reported (Blunch, 2008; Schumacker & Lomax, 2010). The six most common fit statistics were selected to assess the model's overall goodness of fit: the Chi-square (χ^2), the root mean square residual (RMR), the Normed Fit Index (NFI) and the associated parsimony adjusted NFI index (PNFI), and the Akaike Information Criterion (AIC) (Gefen, et al., 2000; Wang, et al., 2009).Table 11 presents the accepted range for each of these fit statistics.

Table 11: Fit measures in AMOS

Test	Accepted Values
χ^2	$\geq .05$
SRMR	$\leq .10$
RMSEA	$\leq .05$
NFI	$\geq .90$
PNFI	$\geq .50$
AIC	The model with the lowest value

Note: χ^2 = Chi-squared Test, RMSEA = Root Mean Square Error of Approximation, SRMR = Standardised Root Mean Square Residual, NFI = Normed Fit Index, PNFI = Parsimony Adjusted NFI Index, AIC = Akaike Information Criterion

Chi-square (χ^2) is used for testing the theoretical model (Schumacker & Lomax, 2010). X^2 measures the entire model fit. To have a good fit the statistic should be insignificant (*$p > 0.05$)* (Gefen, et al., 2000). The chi-square statistic has been criticised in the past as it is sensitive to larger sample sizes and reliance on this value has resulted in the rejection of models that would otherwise have been accepted (Schumacker & Lomax, 2010). To help strengthen the χ^2 statistic, a ratio of χ^2 to degrees of freedom is sometimes examined. Usually a ratio near 1.00 is considered a sign of good fit (Blunch, 2008). Research within the Information Systems arena has tended to be slightly more lenient and a model would still be acceptable as long the χ^2 statistic was small as possible (Segars & Grover, 1993) and the ratio of χ^2 to degrees of freedom no more than 3:1 (Chin & Todd, 1995).

Other widely reported measures of fit are those relating to the size of the residuals. The root mean square residual (RMR), is the amount the observed variances and covariances differ from the estimated model (Ingram, Cope, Hatrju, & Wuensch, 2000). Since RMR measure is difficult to interpret as the residuals are relative to the size of the observed variances and covariances the standardised RMR (SRMR) is often adopted (Byrne, 2010). The SRMR represents the average value across all the standardised residuals, and ranges from zero to 1.00 (Byrne, 2010). A good fitting model would result in a low value; anything below .05 is considered to be a good fit (Byrne, 2010; Schumacker & Lomax, 2010), however values of <.08 (Hu & Bentler, 1999) or even <.10 (Kline, 2005) have also found acceptance. Associated with the SRMR is the root mean square error of approximation (RMSEA). The RMSEA estimates lack of fit compared to the saturated model (Ingram, et al., 2000). Good fit is typically indicated with values less than .05, however values under .08 or .10 are still considered to have adequate fit (Blunch, 2008; Ingram, et al., 2000; Meyers, et al., 2006).

In addition to the above measures (considered as absolute fit measures), relative fit measures compare the fit between the saturated and independence model (Blunch, 2008). Often used measures based on model comparisons are the Normed Fit Index (NFI), the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) (Schermelleh-Engel, et al., 2003). The NFI measures the normed difference in χ^2 between the independence model and the default model (Gefen, et al., 2000). Similar to the SRMR measure, the value of the NFI is bounded with the interval of 0 to 1.00, where a high value close to .90 or .95 reflects a good model fit (Schumacker & Lomax, 2010).

Adding more parameters to a model often increases the fit of the model, however adding parameters to simply aid in fit makes the resulting model hard to justify in relation to the theory and other comparable samples. A simple model, with few parameters is considered to be generalisable and more theoretically sound (Blunch, 2008). The parsimony fit statistics penalise models that have too many parameters (Meyers, et al., 2006). The parsimony adjusted NFI index (PNFI) is the product of NFI and PRATIO. The PRATIO is the ratio of how many paths that are dropped compared to how many paths could have dropped i.e. all of them (Ingram, et al., 2000). Typically, parsimony fit indices are much lower than other normed fit statistics therefore values greater than .60 and .50 are acceptable (Blunch, 2008; Ingram, et al., 2000).

There are other fit statistics that do not fall with the three main grouping discussed above, such as information-theoretic fit measure. These measures are based on the notion of trying to show how well a model will cross validate in future samples of the same size from the same population (Blunch, 2008). The Akaike information criterion (AIC) index is used as an aid to choosing between competing models (Everitt, 2006). There are no clear guidelines are given on how to interpret this index however lower values are considered best (Raykov & Marcoulides, 2006).

4.2.4. Results.

The measurement component of the model was tested to ensure adequacy and suitability of the items used as indicators of the latent constructs (Byrne, 2010). EFA was used to assess the suitability of each cluster of latent constructs and the items loading on each latent variable. These constructs were inspected and goodness of fit measurements gathered. The results presented in Table 12, show the fit statistics for the latent clusters. Not all the latent constructs meet each criteria of goodness of fit, however they were sufficiently close to the desired value to justify retaining the constructs.

Table 12: Fit statistics for measurement models.

Model Description	**# Latent Variables**	**# Observed Variables**	χ^2	**df**	***p*** **<**	**SRMR**	**NFI**	**PNFI**	**RMSEA**	**90% CI**	**AIC**
ICT Self-efficacy	4	20	648.0	156	.000	.13	.85	.70	.09	.08-.10	756.02
Motivation	2	8	42.334	18	.001	.04	.95	.61	.06	.04-.08	78.33
SDL	2	8	119.34	11	.000	.07	.92	.36	.16	.13-.18	169.34
TAM	3	9	138.58	26	.000	.16	.93	.68	.10	.09-.12	176.58

4.2.5 Structural Equation: Structural Model

The structural model was analysed in three stages, the fully mediated model was examined first. This model measured the effect of the three latent variables, namely; ICT self-efficacy, motivation, and self- directedness, and its influence on behavioural intention to use and adopt mobile learning when mediated through the variables ease of use and usefulness. The second model assesses the effect of these three latent variables on behavioural intention to use and adopt mobile learning. The results of the first two models are used to build a final model that should result in the best fit.

4.2.5.1 Fully-Mediated Model.

The first phase of analysis assesses the fully-mediated structural model with all hypothesised paths (H1- H19) mediated by the two TAM variables of ease of use and usefulness. Figure 20 outlines the proposed model.

From an analysis of all the paths in this model a number of paths were removed as they were found to be non-significant ($p \geq .5$). Overall the model was supported and demonstrated a reasonable fit to the data (χ^2 = 1567.5, df = 66, $p < .039$, SRMR= .04, NFI = .97, PNFI = .48, RMSEA = .03 (90% CI =.01 - .05), AIC = 138.6) (n =446). Most of the fit statistics, other than the χ^2 and PNFI, showed evidence of good fit. The reason for the low PNFI value may be the large number of paths in the model. The supported paths and their standardised regression weights for the observed structural model are shown in Figure 21. For clarity, the measurement components of the model are excluded from the diagram. A complete list of parameter estimates and their standard errors is available in Appendix E.

Causal and covariance linear relationships were found between the primary exogenous variables; namely ICT self-efficacy, motivation and self- directedness; and endogenous (h) latent constructs; namely variables ease of use, usefulness and behaviour intention. The following relationships were supported in the model;

- Specific mobile skill and perceived ease of use (hypothesis #1a, β = .09);
- Specific mobile skill and perceived usefulness (hypothesis #1a, β = .20);
- ICT anxiety and perceived ease of use (hypothesis #10a, β = -.20);
- ICT anxiety and perceived usefulness (hypothesis #10b, β = -.23);
- General ICT skill and specific mobile skill (hypothesis #7, β = .89);
- General ICT skill and to expert/specialised ICT skill (hypothesis #8, β = .32);

- Specific mobile skill and expert/specialised ICT skill (hypothesis #9, β = .29);
- Specific mobile skill and ICT anxiety (hypothesis #12, β = -.08);
- General ICT skill and ICT anxiety (hypothesis #13, β =-.34);
- Expert/specialised ICT skill and ICT anxiety (hypothesis #14, β = -.29);
- Extrinsic motivation and perceived ease of use (hypothesis #19a, β = .08);
- Extrinsic motivation and perceived usefulness (hypothesis #19b, β = .31);
- Intrinsic motivation and self-management (hypothesis #29c, β = .13);
- Desire for learning and perceived usefulness (hypothesis #23b, β = .19);
- Self-control and perceived usefulness (hypothesis #24b, β = .22);

The results show that ICT anxiety had the highest (negative) impact on the perceived ease of use with extrinsic motivation the lowest. However extrinsic motivation had the second highest influence on the perceived usefulness of mobile learning, with the highest impact on perceived usefulness being student perception of the ease of use of mobile learning.

In addition, the results provide support for the Technology Acceptance Model, with perceived ease of use (Hypothesis #31, β = .18) and perceived usefulness (Hypothesis #32, β = .75) both associated with student intention to adopt mobile learning. However perceived usefulness was shown to have the highest impact on students' behavioural intention to adopt mobile learning. Perceived ease of use was found to be significantly associated to perceived usefulness. Figure 21 shows the significant relationships in the fully mediated model.

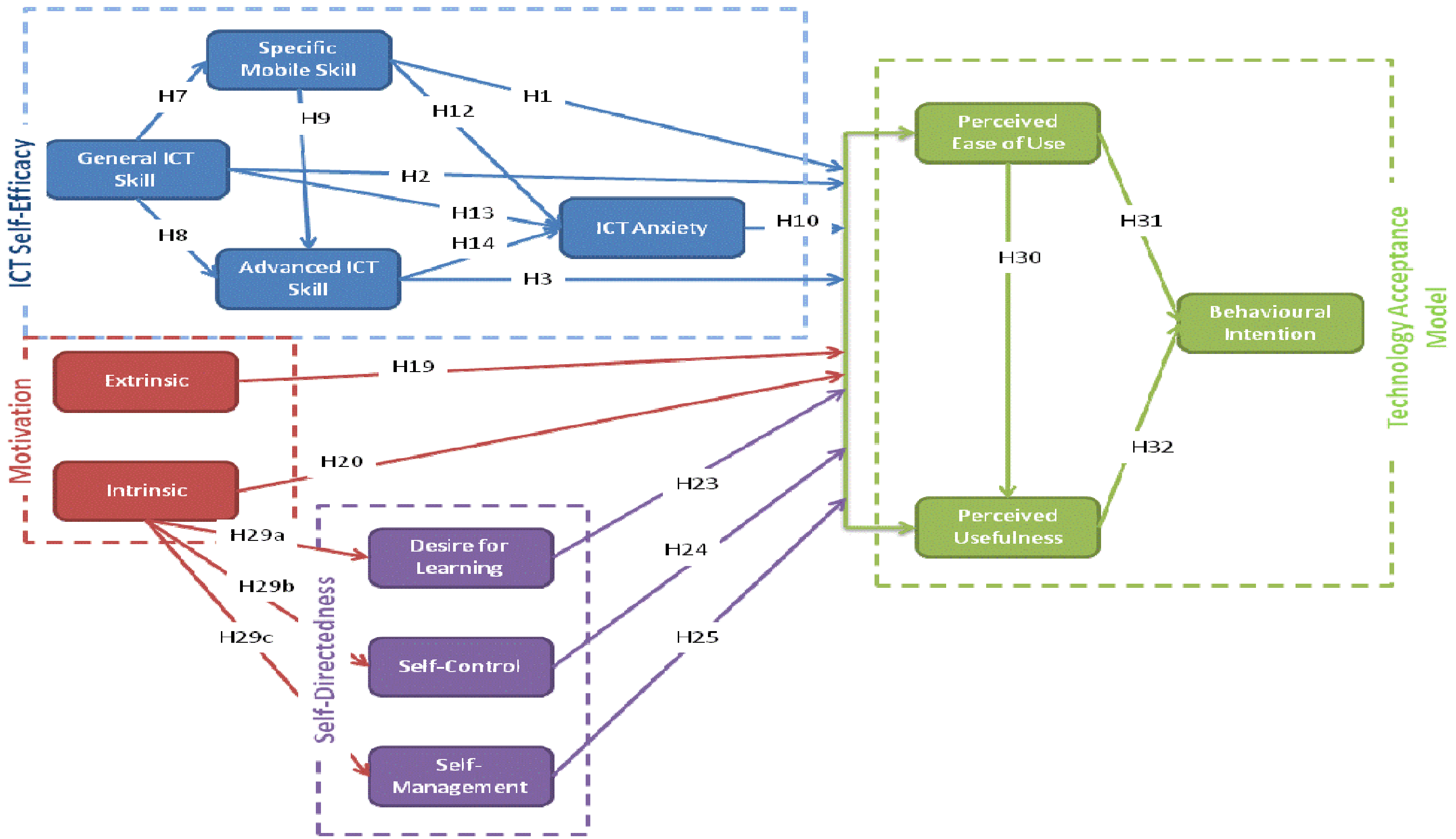
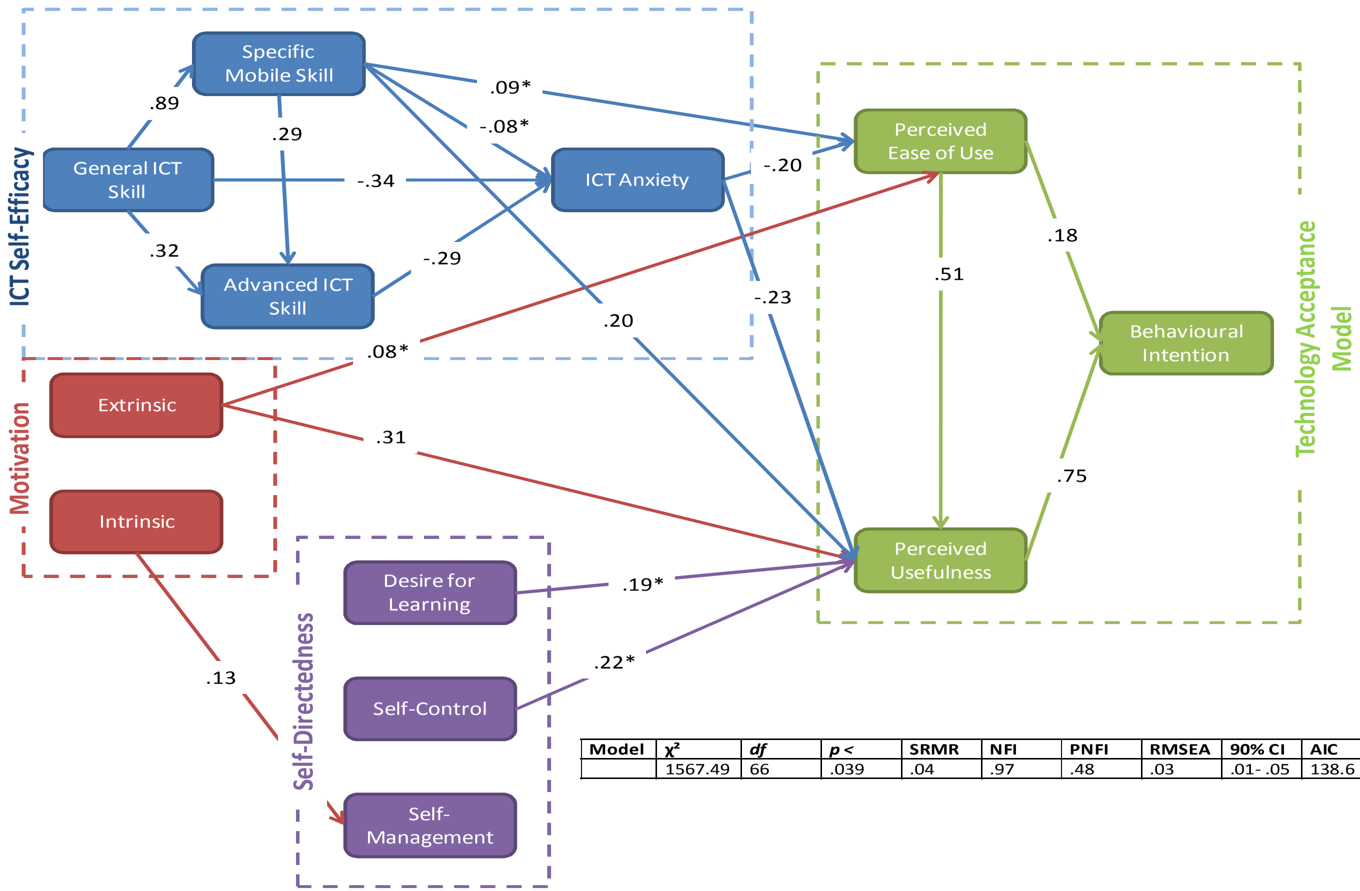


Figure 20: Hypothesised structural model (fully-mediated). Note: All hypothesised paths are positive (+), except for H10, H12, H13, H14 (anxiety self-efficacy) which is negative (–).



Model	χ^2	*df*	*p* <	SRMR	NFI	PNFI	RMSEA	90% CI	AIC
	1567.49	66	.039	.04	.97	.48	.03	.01- .05	138.6

*Figure 21: Observed structural model (fully-mediated). Note: All standardised path coefficients (β) shown are significant at p <.000 except: * which was significant at p ≤ .05. Other paths were non-significant (p >.05) and are not shown.*

As well as assessing the significance of each relationship the squared multiple correlations (SMC) (r-square values) were assessed. The SMC enabled the interpretation of the proportion of variance accounted for by each endogenous variable (Schreiber, Stage, King, Nora, & Barlow, 2006). The SMC shows how each latent construct accounts for any variation in the related latent. The latent variables ease of use and usefulness account for 55% of the variance in behavioural intention. Together ICT anxiety, specific mobile skill, extrinsic motivation, desire for learning and self-control accounted for 34% variance in perception of usefulness of mobile learning, however specific mobile skill, ICT anxiety and extrinsic motivation accounted for only 8% variance in ease of use. Table 13 outlines the SMC scores for all eight constructs in this study.

Table 13: Squared correlations of the eight constructs in the fully mediated model.

Constructs	Squared multiple correlations
Behavioural intention	.553
Perception of Usefulness	.362
Ease of Use	.084
Specific Mobile Skill	.330
Expert ICT Skill	.299
Anxiety	.189
Self-Management	.181

4.2.5.2 Alternative Model (Partially Mediated Model).

Although the fully mediated model showed an acceptable fit it was decided to assess whether each latent variable related directly to behavioural intention rather being mediated through the two TAM variables perceived ease of use and perception of usefulness. This was to verify whether the factors identified in the literature impacted intention to adopt mobile learning directly or whether the effect was partially mediated through perceived usefulness and ease of use. By assessing two models it was hoped that the most plausible explanation of the data could be developed (Cole & Maxwell, 2003). The following alternative model, the partially mediated model, was developed to assess the same latent variables as the fully mediated model however it assessed the relationship of the three primary constructs (ICT self-efficacy, motivation and self-directness) directly to their intention to adopt mobile learning.

The partially-mediated model replaced all paths to ease of use and perception of usefulness with a direct path from the latent variables (ICT self-efficacy, motivation and self-directness) to the behavioural intention construct. Figure 22 illustrates the hypothesised paths along with the relevant hypothesis referred to in the model. The fit statistics however are weaker compared to the first model (χ^2 = 1567.5, df = 66, p < .000, SRMR= .10, NFI = .88, PNFI = .51, RMSEA = .10 (90% CI =.08 - .11), AIC = 268.58) (n =446).

As with the first model causal and covariance linear relationships were found. The following relationships were supported in the model (Figure 23 shows the significant relationships in the fully mediated model);

- General ICT skill and behavioural intention to adopt (hypothesis #2, β = .15);
- General ICT skill and specific mobile skill (hypothesis #7, β = .89);
- General ICT skill and expert/specialised ICT skill (hypothesis #8, β = .32);
- Specific mobile skill and expert/specialised ICT skill (hypothesis #9, β = .29);
- Specific mobile skill and ICT anxiety (hypothesis #12, β = -.08);
- General ICT skill and ICT anxiety (hypothesis #13, β =-.34);
- Expert/specialised ICT skill and ICT anxiety (hypothesis #14, β = -.29);
- Intrinsic motivation and self-management (hypothesis #29c, β = .13);
- Desire for learning and behavioural intention to adopt (hypothesis #26, β = .25);
- Self-management and behavioural intention to adopt (hypothesis #28, β = .14);
- Perceived ease of use and behavioural intention to adopt (hypothesis #31, β = .18);
- Perceived usefulness and behavioural intention to adopt (hypothesis #32, β = .72);

The results show that perceived usefulness had the highest impact on student intention to adopt mobile learning with desire for learning the second highest. With general ICT skill, self-management and perceived ease of use making a smaller impact on behaviour intention.

Based on the squared multiple correlations (R^2), we can see that addition of the three latent variables (general ICT skill, desire for learning and self-management) to the original ease of use and perception of usefulness has increased the explanation of variance in behavioural intention to 57%.

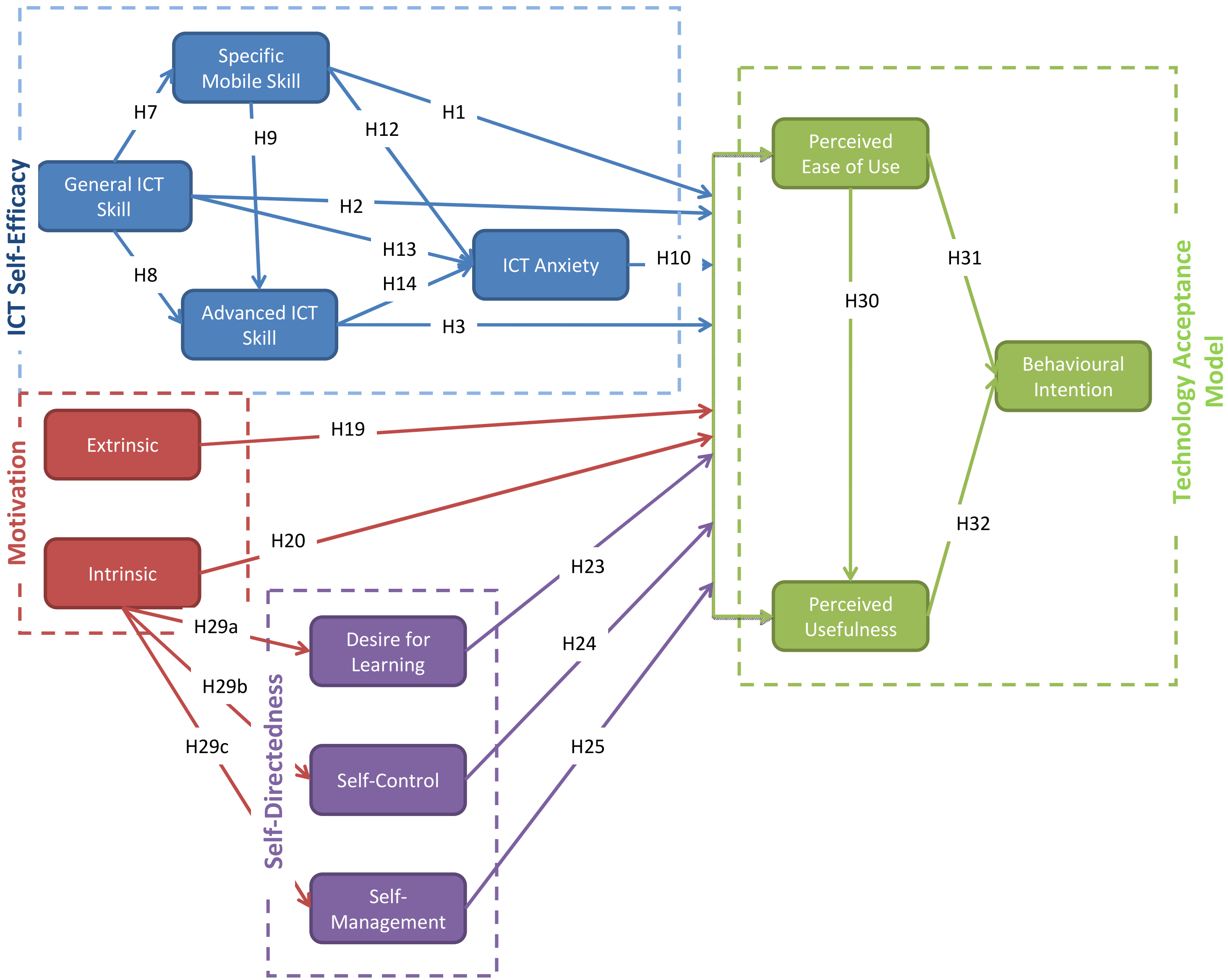
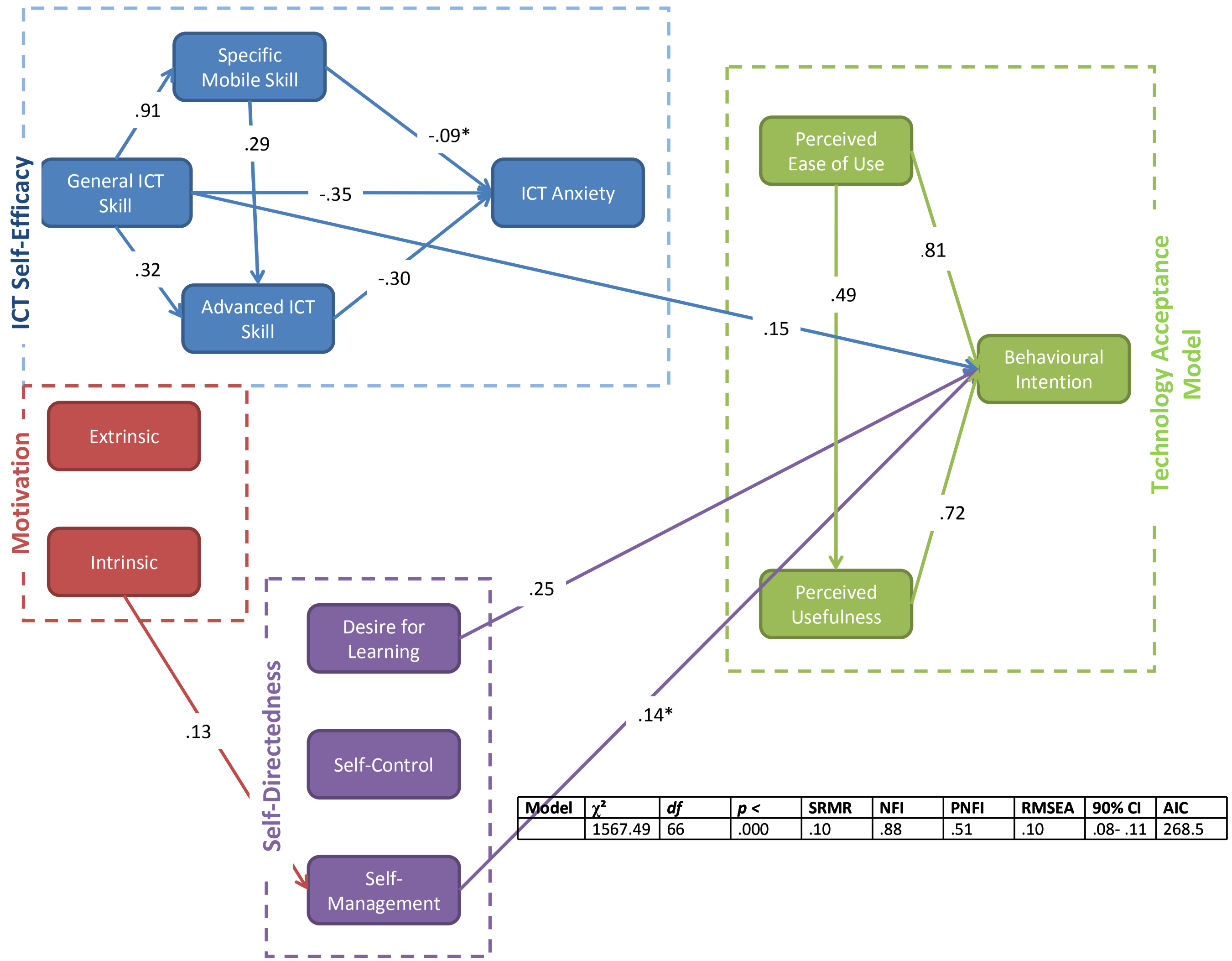


Figure 22: Hypothesised Structural Model (Partially-Mediated). Note: All hypothesised paths are positive (+), except for H11, H12, H13 and H14 which is negative (–).



Model	χ^2	*df*	*p* <	SRMR	NFI	PNFI	RMSEA	90% CI	AIC
	1567.49	66	.000	.10	.88	.51	.10	.08- .11	268.5

*Figure 23: Observed Structural Model (Partially-Mediated). Note: All standardised path coefficients (β) shown are significant at p <.000 except: * which was significant at p ≤ .05. All other paths were non-significant (p >.05) and are not shown.*

4.2.5.3 Final Model.

The final model comprised all significant relationships identified in the fully mediated model and the partially mediated model. Figure 24 shows all the significant standardised path coefficients for the final model. The goodness of fit statistics showed a better fit than the two previous models (χ^2 = 1567.49, df = 66, p < .004, SRMR= .04, NFI = .96, PNFI = .40, RMSEA = .04 (90% CI =.02 - .06), AIC = 149.04) (n =446). The difference between the first model and the final model is not too dissimilar with most fit statistics within .03 of each other. The χ^2 p value is lower in the final model however, since χ^2 statistic is seldom used to determine suitability of the model, this is not of great concern (Blunch, 2008). The AIC for the first model was lower than for the final model indicating that that model may be a better fit, however since the two values are relatively close it was still considered that the final model is a better model for explaining student adoption (see Table 14 for the fit statistics for all three models).

Table 14: Fit Statistics for the three models

Model	χ^2	*df*	*p* <	SRMR	NFI	PNFI	RMSEA	90% CI	AIC
Fully Mediated Model	1567.49	66	.039	.04	.97	.48	.03	.01-.05	138.6
Partially Mediated	1567.49	66	.000	.10	.88	.51	.10	.08-.11	268.5
Final Model	1567.49	66	.004	.04	.96	.51	.04	.02-.06	149.0

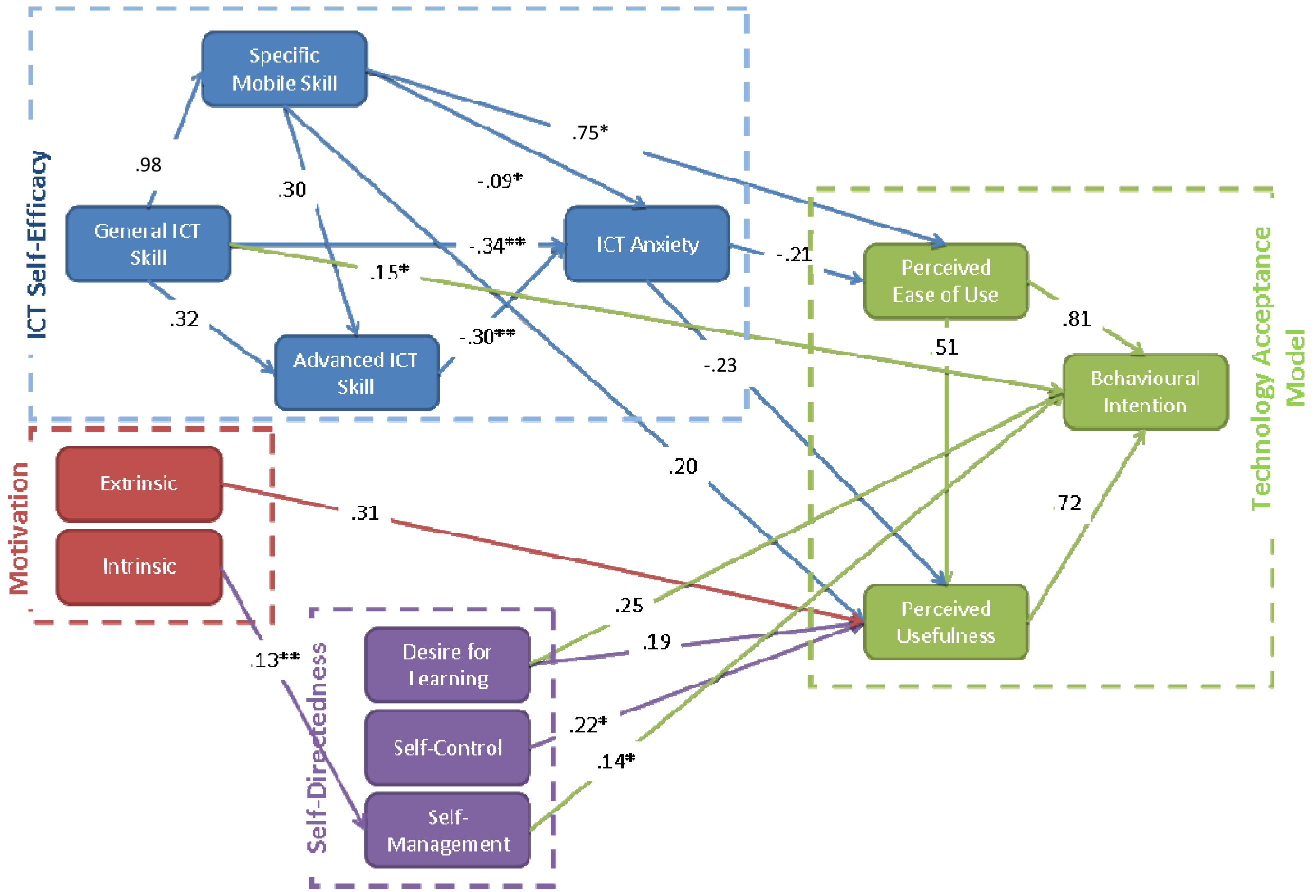
The significant relationships between the paths were unchanged from both previous models.

- Specific mobile skill and perceived ease of use (hypothesis #1a, β = .75);
- Specific mobile skill and perceived usefulness (hypothesis #1a, β = .20);
- General ICT skill and behavioural intention to adopt (hypothesis #2, β = .15);
- General ICT skill and specific mobile skill (hypothesis #7, β = .89);
- General ICT skill and to expert/specialised ICT skill (hypothesis #8, β = .32);
- Specific mobile skill and expert/specialised ICT skill (hypothesis #9, β = .29);
- ICT anxiety and perceived ease of use (hypothesis #10a, β = -.21);
- ICT anxiety and perceived usefulness (hypothesis #10b, β = -.23);
- Specific mobile skill and ICT anxiety (hypothesis #12, β = -.09);
- General ICT skill and ICT anxiety (hypothesis #13, β =-.34);
- Expert/specialised ICT skill and ICT anxiety (hypothesis #14, β = -.30);
- Extrinsic motivation and perceived usefulness (hypothesis #19b, β = .31);
- Desire for learning and perceived usefulness (hypothesis #23b, β = .19);
- Self-control and perceived usefulness (hypothesis #24, β = .22);
- Desire for learning and behavioural intention to adopt (hypothesis #27, β = .25);
- Self-management and behavioural intention to adopt (hypothesis #28, β = .14);
- Intrinsic motivation and self-management (hypothesis #29c, β = .13);
- Perceived ease of use and usefulness (hypothesis #30, β = .51);
- Perceived ease of use and behavioural intention to adopt (hypothesis #31, β = .81);
- Perceived usefulness and behavioural intention to adopt (hypothesis #32, β = .72);

The squared multiple correlations (r-square values) are the same as for the fully mediated model but the extra relationships added based on the partially mediated model increased the explanation of variance for behavioural intention up to 58% (see Table 15).

Table 15: Squared Multiple Correlations for final student adoption model

Constructs	**Squared multiple correlations**
Behavioural Intention	.583
Perception of Usefulness	.368
Ease of Use	.076
Specific Mobile Skill	.327
Expert ICT Skill	.299
Anxiety	.186
Self-Management	.181



Model	χ^2	*df*	*p* <	SRMR	NFI	PNFI	RMSEA	90% CI	AIC
Final Model	1567.49	66	.001	.04	.96	.51	.04	.02-.06	149.0

*Figure 24: Final Model. Note: All standardised path coefficients (β) are significant at p <.000 except: * which was significant at p ≤ .05. All other paths were non-significant (p >.05) and not shown.*

The final model had the best fit and was accepted as the final solution. In total, 18 of the original 28 hypothesised relationships were supported. Tables 16 list the original 28 hypothesised relationships and their support in the final model.

Table 16: Hypothesis description for students' adoption model.

Summary of hypothesis	Hypothesised Path	Supported?
H1-3 a and b: A student with higher levels of skill with general ICT skill (H1), advanced ICT skill (H2), specific mobile skill (H3) will more likely to see mobile learning as easy to use and useful.	**H1a**: GICTS → PEOU **H1b**: GICTS → PU **H2a**: SMS → PEOU **H2b**: SMS → PU **H3a**: ExICTS → PEOU **H3b**: ExICTS → PU	No No Yes Yes No No
H4-6: A student with higher levels of skill with general ICT skill (H4), advanced ICT skill (H5), specific mobile skill (H6) will more likely to adopt mobile learning.	**H4**: GICTS → BI **H5**: SMS → BI **H6**: ExICTS → BI	Yes No No
H7-9: As a student becomes more skilled in one area of ICT usage the more likely they will adopt a wider use of a range of ICT technologies.	**H7**: GICTS → SMS **H8**: GICTS → ExICTS **H9**: SMS → ExICTS	Yes Yes Yes
H 10 a and b: A student with low ICT anxiety will more likely to see mobile learning as easy to use and useful.	**H10a**: Anx→ PEOU **H10b**: Anx→ PU	Yes Yes
H11: A student with a low ICT anxiety will more likely to adopt mobile learning.	**H11**: Anx → BI	No
H12-14: As a student becomes more competent with ICT they more likely that they will have less anxiety.	**H12:** SMS → Anx **H13**: GICTS → Anx **H14**: ExICTS → Anx	Yes Yes Yes
H19-20 a and b: A student who is highly internally (H19) or externally (H20) motivated will more likely to see mobile learning as easy to use and useful.	**H19a**: IM → PEOU **H19b**: IM → PU **H20a**: EM → PEOU **H20b**: EM → PU	No No No Yes
H21-22: A student who is highly internally or externally motivated will more likely to adopt mobile learning.	**H21**: IM → BI **H22**: EM → BI	No No

Note: General ICT Skill (GICTS), Specific Mobile Skill (SMS), Expert/ Specialised ICT Skill (ExICTS), Anxiety (Anx), Self-Management (SM), Desire for Learning (DfL), Self control (SC), Intrinsic Motivation (IM), Extrinsic Motivation (EM), Perceived Usefulness (PU), Perceived ease of use (PEOU), Behaviour Intention (BI)

Table 16: Hypothesis description for students' adoption model. (continued).

Summary of hypothesis	Hypothesised Path	Supported?
H 23-25a and b: A student with higher levels of self directed readiness will more likely to see mobile learning as easy to use and useful.	**H23a:** DfL → PEOU	No
	H23b: DfL → PU	Yes
	H24a: SC → PEOU	No
	H24b: SC → PU	Yes
	H25a: SM → PEOU	No
	H25b: SM → PU	No
H26-28: A student with higher levels of self directed readiness will more likely indicate their intention to adopt mobile technology.	**H26:** DfL → BI	Yes
	H27: SC → BI	No
	H28: SM → BI	Yes
H29: Students who are strongly intrinsically motivated would more likely be strongly self-directed.	**H29a:** IM → DfL	No
	H29b: IM → SC	No
	H29c: IM → SM	Yes
H30: A student who perceives mobile learning as ease to use will have positive perception of mobile leaning usefulness.	**H30**: PEOU → PU	Yes
H31: A student who perceives mobile learning as useful will more likely indicate that they would likely adopt mobile technology in the future.	**H31**: PEOU → BI	Yes
H32: A student who perceives mobile learning as easy to use will more likely indicate that they would likely adopt mobile technology in the future.	**H32**: PU → BI	Yes

Note: General ICT Skill (GICTS), Specific Mobile Skill (SMS), Expert/ Specialised ICT Skill (ExICTS), Anxiety (Anx), ICT-teaching Self-efficacy Attitude (SEAtt), ICT-teaching Self-efficacy ability (SEabl), Intrinsic Motivation (IM), Extrinsic Motivation (EM), Perceived Usefulness (PU), Perceived ease of use (PEOU), Behaviour Intention (BI)

4.2.6 Structural Equation: Multi-Group Analyses

This section presents the results of the influence of gender, age and attendance of a particular tertiary institute on mobile learning adoption. The following describes the results of each analysis.

The final model was analysed separately for both gender groups. By evaluating the path coefficients for the significant paths the Female Adoption Model had two paths that were found to be no longer significant namely; mobile ICT skill to anxiety (H12) and desire for learning to usefulness (H23b).

After examining the Modification Indices two additional paths were added to the overall Male Adoption Model that had been originally dropped from the final model, they were; general ICT skill to ease of use (H1a); and expert/specialised ICT skill to ease of use (H3a). No additional paths were added to the Female Model.

Lastly, to identify whether the remaining paths were significantly different between genders, the pairwise parameter comparisons (critical ratios) were inspected. Critical Ratios are the estimate divided by its standard error. Twelve paths were found to exhibit statistically significant differences with a critical ratio (cr) value > 1.96. See Figure 25 which compares the male and female adoption models.

The squared multiple correlations (SMC) (r-square values) were similar between the male and female model, however, the male variance was slightly more than the female model. See Table 17 for the SMC for these two groups.

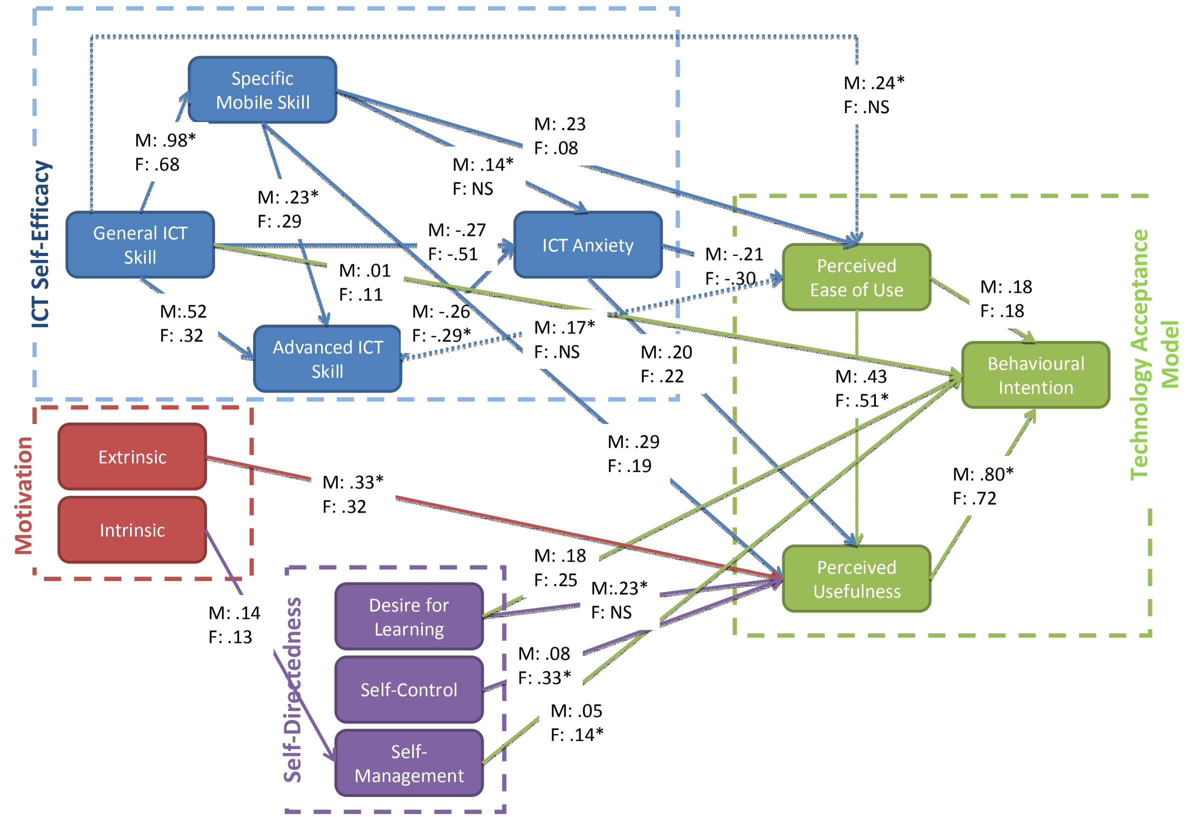
Table 17: Squared Multiple Correlations for male and females

Constructs	**Squared multiple correlations**	
	Male	**Female**
Behavioural intention	.662	.582
Perception of Usefulness	.373	.363
Ease of Use	.143	.080

The fit statistics of the model was analysed to determine whether the groups were invariant. The results of the nested comparisons are presented in Table 18. A complete list of parameter estimates and standard errors are presented in Appendix F. Analysis of the configural model statistics supported invariance at the measurement level ('measurement weights', $\Delta\chi^2$ p > .01) as previously found. The results indicated a marginally significant difference at the structural level ('structural weights', $\Delta\chi^2$ p = . 580) (Byrne, 2010; Cheung & Rensvold, 2002).

Table 18: Fit statistics for nested model comparisons for gender.

Model Description	χ^2	Df	$p <$	$\Delta\chi^2, p =$	SRMR	NFI	CFI	RMSEA	90% CI
Configural Model (unconstrained)	69.375	56	.108	-	.0417	.960	.992	.024	.000-.041
Measurement Weights	138.280	76	.000	.580	.0603	.920	.961	.045	.033-.057
Structural Weights	206.765	106	.000	.132	.0741	.880	.936	.048	.039-058



Male and Female Model

Model	χ²	*df*	*p* <	SRMR	NFI	PNFI	RMSEA	90% CI	AIC
Final Model	1567.49	66	.004	.04	.96	.51	.04	.02-.06	149.0

*Figure 25: A comparison between male and female adoption. Note: M: Male and F: Female, * significant difference between groups (CR>1.96)*

The results of this comparison found that additional factors such as ICT self-efficacy may have a more significant impact on male adoption than female adoption in terms of the perceived ease of use of mobile technology. However self-directness in the form of self-control and self-management has a stronger influence on female perception than male perception of usefulness. Desire for learning plays a stronger role in perception of usefulness for males.

The same process was used to determine whether there was a difference between age groups. Due to the sample size the ages of the respondents were classified into two groups, those 29 years and below and those 30 years and above.

The same procedure as described for gender differences was used to determine differences in age groups. First the path coefficients were assessed to determine if any paths in each model were no longer significant. In the Under 29 Years Adoption Model two paths were no longer significant however they were still significant in the Above 30 Years group Adoption Model namely; general ICT skill to behaviour intention (H4) and self-management to behaviour Intention (H28). Two additional paths were no longer significant in the Above 30 Years group Adoption Model, namely, self-control to usefulness (H24b) and specific mobile skill to ICT anxiety (H12). Next, the hypothesised relationships of the two age groups were analysed to determine whether they were significantly different. Nine paths were found to be significantly different between the two groups (CR>1.96). Figure 26 shows the changes to the adoption model when students are grouped by age. A complete list of parameter estimates and standard errors are presented in Appendix G.

The squared multiple correlations (SMC) (r-square values) are similar between the two age groups however the Above 30 age group variance was slightly higher for behavioural intention and Perception of Usefulness larger compared to the under 29 group. See Table 19 for the SMC for these two groups.

Table 19: Squared Multiple Correlations for respondent under 29 years and above 30 YEARS

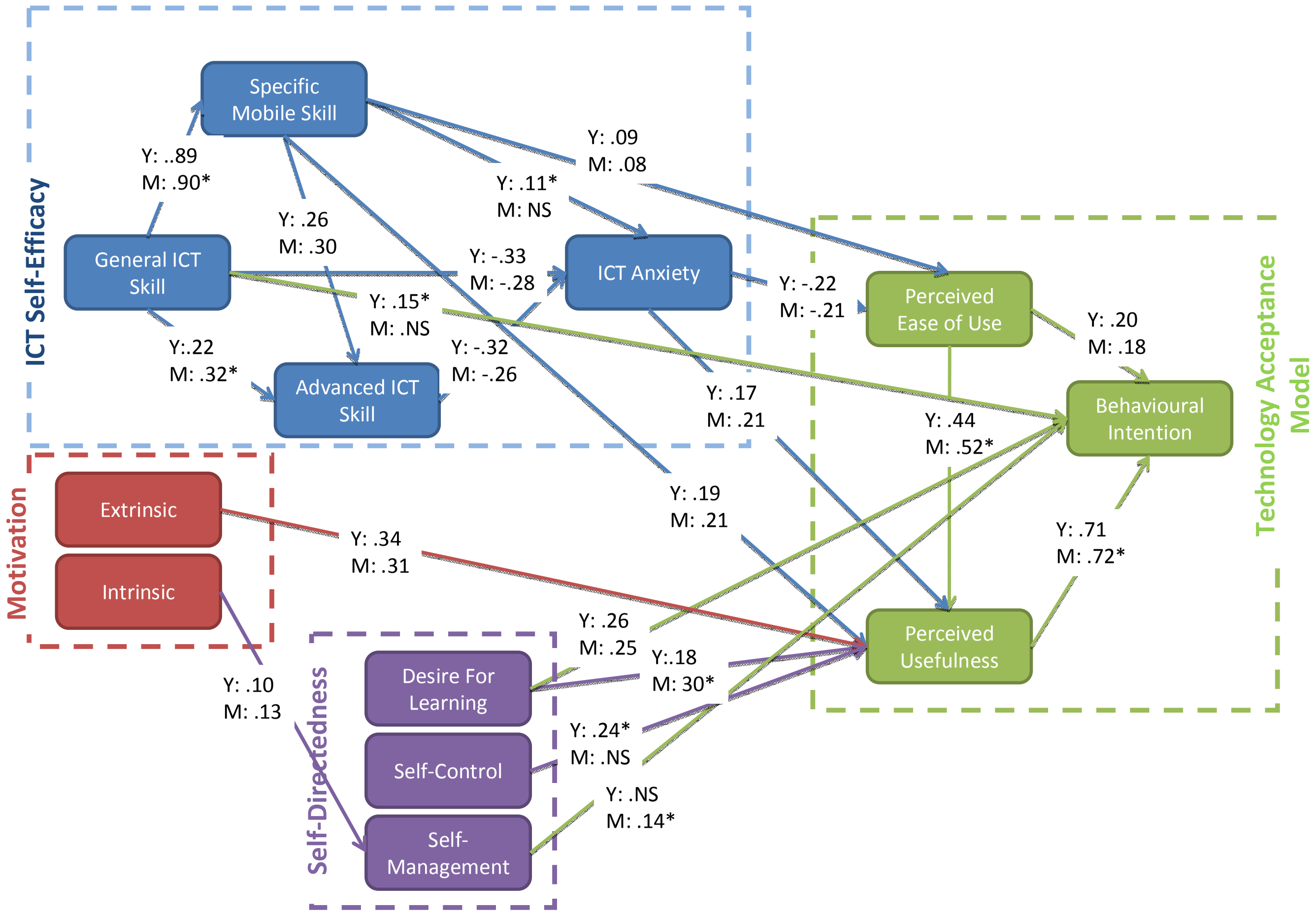
Constructs	**Squared multiple correlations**	
	Under 29 years	**Above 30 years**
Behavioural intention	. 567	. 587
Perception of Usefulness	. 332	. 362
Ease of Use	. 082	. 080

The results of the nested comparisons are presented in Table 20. The results indicated a marginally significant difference at the structural level (‘structural weights’, $\Delta\chi^2$ p = . 180) (Byrne, 2010; Cheung & Rensvold, 2002).

Table 20: Fit statistics for nested model comparisons for ages

Model Description	χ^2	Df	*p* <	$\Delta\chi^2$, *p* =	SRMR	NFI	CFI	RMSEA	90% CI
Configural Model (unconstrained)	117.802	62	.000	-	0423	.923	.960	.047	.034-.060
Measurement Weights	137.707	80	.000	.180	.0453	.910	.959	.042	.030-.054
Structural Weights	137.707	109	.000	.086	.0530	.872	.937	.045	.034-.054

Overall the results show that there are some differences between students adoption based on age. In particular their general ICT skill has a stronger influence on the more mature students' adoption of mobile learning and self- directness of more mature students will also play a stronger role in their perception of how useful they see mobile learning.



Model	χ²	*df*	*p* <	SRYR	NMI	PNMI	RYSEA	90% CI	AIC
Final Model	1567.49	66	.004	.04	.96	.51	.04	.02-.06	149.0

*Figure 26: A comparison between age group adoption models. Note: Y: 29 years and under and M: 30 years and above, * significant difference between groups (CR>1.96)*

When comparing polytechnic students to university students small differences between the two groups were found. The main differences related to two paths that were no longer found to be significant in the Polytechnic group; these were general ICT skill to advanced ICT skill (H8) and advanced ICT skill to anxiety (H14). Two paths were also found to be non-significant in the University Model, specific mobile skill to perceived ease of use (H2a) and general ICT skill to behaviour intention (H4). One additional path was also found to be significantly different between the two models, namely general ICT skill to anxiety (H12). Figure 27 shows the changes to the adoption model when grouped by the different types of institutes. As can be seen in Table 21 the squared multiple correlations (SMC) are similar between the two groups. A complete list of parameter estimates and standard errors are presented in Appendix H.

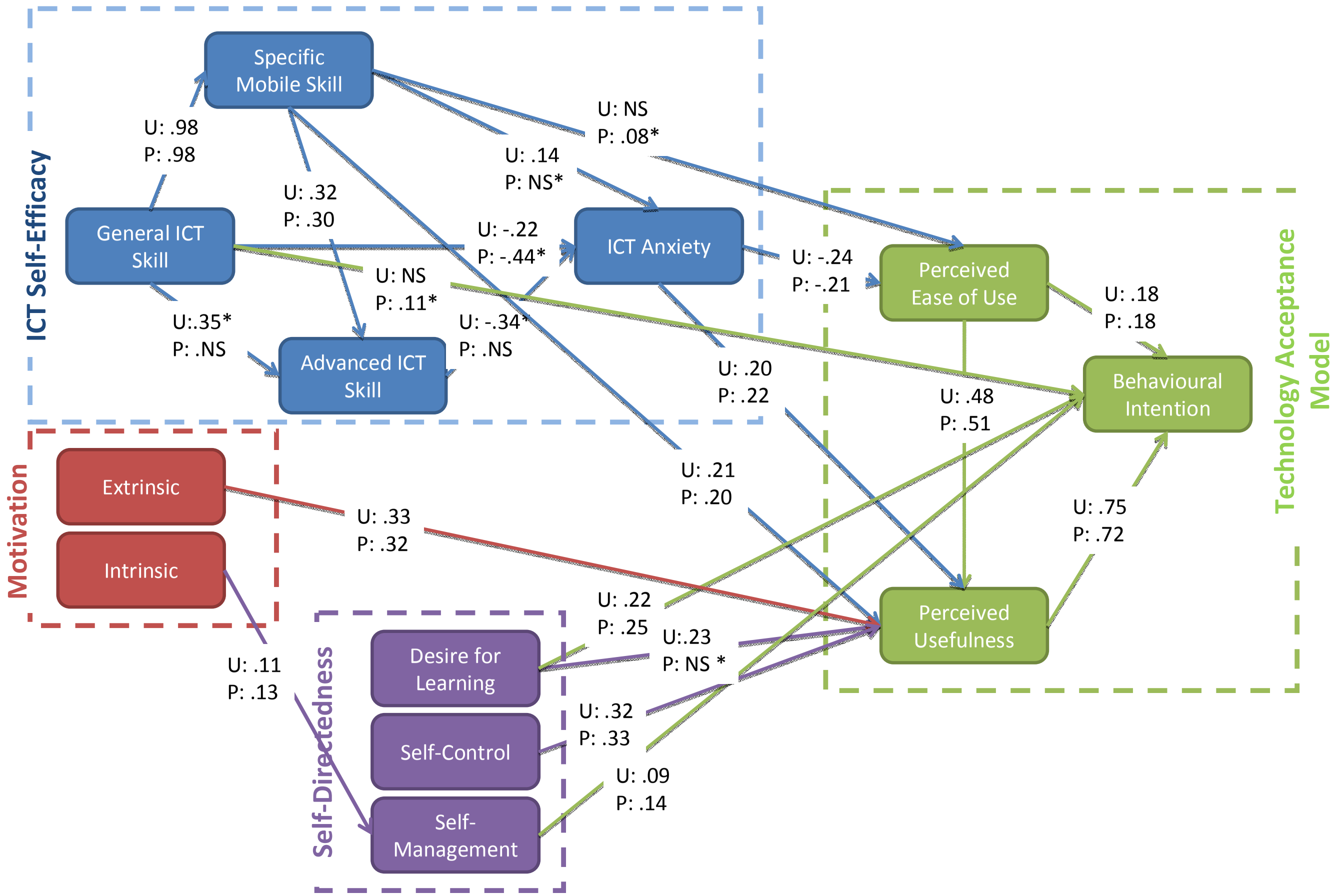
Table 21: Squared Multiple Correlations for university and polytechnic students

Constructs	**Squared multiple correlations**	
	University	**Polytechnic**
Behavioural intention	.594	.582
Perception of Usefulness	.342	.363
Ease of Use	.063	.076

The results of the nested comparisons are presented in Table 22. They indicate a marginally significant difference at the structural level ('structural weights', $\Delta\chi^2$ *p* = . 427) (Byrne, 2010; Cheung & Rensvold, 2002).

Table 22: Fit statistics for nested model comparisons for two institute types

Model Description	**χ^2**	**Df**	***p* <**	**$\Delta\chi^2$, *p* =**	**SRMR**	**NFI**	**CFI**	**RMSEA**	**90% CI**
Configural Model (unconstrained)	51.508	48	.338	-	.0261	.969	.998	.013	.000-.036
Measurement Weights	101.997	68	.005	.427	.0325	.938	.978	.035	.020-.048
Structural Weights	169.186	102	.000	.159	.0349	.897	.956	.040	.029-.051



Model	χ²	*df*	*p* <	SRUR	NPI	PNPI	RUSEA	90% CI	AIC
Final Model	1567.49	66	.004	.04	.96	.51	.04	.02-.06	149.0

*Figure 27: A comparison between institution type adoption models. Note: U: University and P: Polytechnic, * significant difference between groups (CR>1.96)*

The results of this comparison have shown that polytechnic and university student differ in their perceptions and intentions to adopt mobile learning. In particular self-efficacy plays a stronger role in student adoption when attending polytechnics than it does for university students. It also shows that university student desire for learning had an impact on how they perceived the usefulness of mobile learning.

4.2.7 Analysis of variance between student characteristics and mobile learning strategies

In order to unpack and further analyse the usefulness of mobile learning, students were asked to indicate their interest in six mobile learning strategies. Students were asked to rate their interest in using the six mobile learning strategies as part of their learning on a 1-6 Likert scale, where 1 represented 'no interest at all', and 6 'extremely interested'. The aim was to determine which strategies would be potentially more acceptable to students and therefore might be given priority by educators in a mobile learning context.

The results confirmed there was a moderate level of interest in these mobile learning strategies. As shown in Table 23, the most popular mobile learning strategy was 'To download and view lecture recordings as audio or video (podcasting)' ($\bar{x}$=4.28; s=.124); the second was 'SMS notifications or study notes' ($\bar{x}$=4.11; s =.112); and third 'To view lecture slides or readings' ($\bar{x}$ =3.79; s=.113). These six mobile learning strategies were common strategies adopted by educationalists when developing mobile learning activities.

Table 23: Descriptives Results for Mobile Learning Strategies.

Mobile Learning Strategy	**Mean** $\bar{x}$	**Standard deviation** *s*	**Confidence Index (95%)**
To download and view lecture recordings as audio or video (podcasting)	4.28	.124	4.04 -4.53
SMS notifications or study notes	4.11	.112	3.89 - 4.33
Access the internet for educational content via your mobile phone	3.79	.113	3.57 – 4.01
Mobile quizzes	3.73	.113	3.51 - 3.95
Mobile educational games	3.63	.122	3.39 – 3.87
Mobile blogging	3.08	.113	2.86 - 3.30

To determine whether demographic variables influenced attitudes to mobile learning strategies a one-way ANOVA was carried out. ANOVA is a statistical test that enables the testing of the statistical difference between two or more means (George, 2003; Pallant, 2007). ANOVA was appropriate for testing whether there was a significant difference between students of different gender, age, type of institute, and types of mobile devices in terms of their attitude toward using the six mobile learning strategies. Since multiple ANOVA's were conducted, it was important to avoid a type 1 error (a false-positive). Therefore an alpha level of 0.008 was used as recommended by Gordi and Khamis (2004).

The results of the ANOVA show that university students were significantly more interested in using all mobile learning strategies than their polytechnic counterparts. The results suggest that university students may be more favourably disposed to using mobile technology in their learning (Table 24).

Table 24: Analysis of variance between tertiary institution and attitude to mobile learning.

	University (n=334) Mean and Standard Deviation	**Polytechnic (n=70) Mean and Standard Deviation**	**F value**
Access the internet for educational content via your mobile phone	4.01 (1.964)	3.11 (1.900)	F=12.303* df=403
SMS notifications or study notes	4.28 (1.952)	3.51 (2.013)	F=8.706* df=403
Mobile quizzes	3.88 (1.983)	3.01 (1.892)	F=11.210* df=403
Mobile blogging	3.35 (2.030)	2.43 (1.758)	F=12.548* df=403
To view lecture slides or readings	4.28 (2.086)	3.53 (2.152)	F=7.408* df=402
To download and view lecture recordings as audio or video (podcasting)	4.51 (2.086)	3.43 (2.157)	F=15.508* df=403
Mobile educational games	3.85 (2.181)	2.84 (2.026)	F=11.924* df=309

Note: Standard Deviation is shown in brackets, * $p < 0.008$

Further ANOVA tests were run to test whether age and gender were factors in the attitude towards one or more of the mobile learning strategies. As shown in Table 25, younger students seemed to be more enthusiastic about using mobile learning, with interest waning in older the respondents. No relationship could be demonstrated between gender and interest in mobile learning.

Table 25: Analysis of variance between age and attitude to mobile learning.

	Under 20 (n=103) Mean and Standard Deviation	**20-29 (n=188) Mean and Standard Deviation**	**30-39 (n=56) Mean and Standard Deviation**	**40 and over (n=65) Mean and Standard Deviation**	**F value**
Access the internet for educational content via your mobile phone	4.22 (1.878)	4.05 (1.987)	3.80 (1.882)	2.60 (1.826)	F=6.376* df=411
SMS notifications or study notes	4.66 (1.871)	4.32 (1.947)	3.95 (1967)	2.81 (1.765)	F=8.135* df=411
Mobile quizzes	4.04 (1.889)	3.98 (2.042)	3.48 (1.878)	2.55 (1.572)	F=5.911* df=411
Mobile blogging	3.51 (2.024)	3.38 (2.079)	2.79 (1.734)	2.06 (1.580)	F=5.708* df=411
To view lecture slides or readings	4.82 (1.949)	4.43 (1.997)	3.75 (2.151)	2.49 (1.898)	F=12.705* df=410
To download and view lecture recordings as audio or video (podcasting)	4.82 (1.949)	4.69 (2.005)	4.18 (2.167)	2.49 (2.052)	F=12.880* df=411
Mobile educational games	4.11 (2.137)	4.05 (2.165)	2.94 (1.884)	2.03 (1.748)	F=9.145* df=318

Note: Standard Deviation is shown in brackets, $*p < .000$

The type of mobile phone the respondents owned also seemed to be related to their interest in mobile learning (Table 26). Owners of higher end the mobile device were more likely to express a higher level of interest in most of the mobile learning strategies. Interest in mobile quizzes and education games, however, was not related to phone types.

Table 26: Analysis of variance between students' type of mobile device and attitude to mobile learning

	Low-end (n=42) Mean and Standard Deviation	2 (n=59) Mean and Standard Deviation	Mid-end (n=118) Mean and Standard Deviation	4 (n=86) Mean and Standard Deviation	High-end (n=78) Mean and Standard Deviation	Significance
Access the internet for educational content via your mobile phone	3.52 (2.003)	3.19 1.969	3.76 (1.838)	3.98 (1.934)	4.72 (1.913)	F=6.202** df=382
SMS notifications or study notes	3.40 (1.901)	3.61 (1.930)	4.25 (1.940)	4.45 (1.895)	4.58 (2.048)	F=4.204* df=382
Mobile quizzes	3.43 (1.640)	3.07 (1.920)	3.89 (1.921)	4.00 (2.047)	4.08 (2.131)	F=3.077 df=382
Mobile blogging	3.19 (1.991)	2.39 (3.66)	3.31 (1.964)	3.10 (1.959)	3.94 (2.091)	F=5.295** df=382
To view lecture slides or readings	3.60 (2.037)	3.66 (2.081)	3.99 (2.044)	4.52 (2.079)	4.90 (2.086)	F=4.930* df=381
To download and view lecture recordings as audio or video (podcasting)	3.76 (1.923)	3.95 (2.185)	4.34 (2.052)	4.45 (2.140)	5.05 (2.095)	F=3.601* df=382
Mobile educational games	2.55 (2.197)	3.52 (2.276)	2.117 (3.34)	3.75 (2.161)	4.17 (2.206)	F=1.401 df=291

Note: Standard Deviation is shown in brackets, * $p< 0.008$, ** $p<.000$

4.3 Qualitative Analysis

Content analysis was undertaken to interpret the comments made by students in the open-ended questions in the questionnaire. Content analysis has been defined as "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (Hsieh & Shannon, 2005, p. 1278). Four major themes emerged from the analysis. They are 1) The barrier caused by the cost of devices and services; 2) The suitability of mobile learning compared to traditional methods; 3) The technology constraints of mobile technology; and 4) The convenience of mobile learning. Each of the themes identified are described below. Individual student voices have identifier codes that start with S.

4.3.1 The barrier caused by the cost of devices and services

A number of students expressed concern about the cost of the devices that would be needed to support mobile learning and the cost of the services to support these learning activities such as mobile data services. For example:

> *…phones that have the capacity to do these things are too expensive… (S122)*
>
> *…The cost of [communication] is simply too [high]! For example, it costs around $10 just to view the front page of the NZ Herald. So for most students, the communications cost will be prohibitive…. (S51)*
>
> *…I think it is a great idea, the difference would be if there is a cost for this service… (S502)*

Students felt that mobile learning was a good idea, however cost would be a major inhibiting factor for them. As this limitation may act as a barrier to participation by less wealthy students, the price factor may contribute to the digital divide. For example, one student wrote:

> *There is not only a digital divide between countries but also between houses. I am struggling this year with technology issues; i.e. no internet access at home for 3mths for personal reasons, and now with the only access at home now dial up-which won't load up very quickly, gets bumped off easily and I seem to spend all my time just trying to get online. As a mature student with children (youngest 16 weeks) I cannot easily use technology that is free at the University or at my local library; people don't take kindly to screaming babies! So as great as technology is, and even though NZ is not classed as third world, there are still those of us out there in NZ who are dealing with 'digital divide'. This makes ML/ MT a great thought but for some just too hard! (S95)*

4.3.2 The suitability of mobile learning compared to traditional methods

Students were keenly aware of the benefits of mobile learning, however, some cautioned against the unthinking adoption of mobile learning; they did not want mobile learning to replace more efficient traditional ways of learning, for example:

> *Mobile learning would be hard to adopt in the beginning for new users but it is likely that if it becomes everyday method it would make study more [convenient] and easier to approach. (S179)*

> *I work full time as well as study, so it would be invaluable to be able to access study material using my mobile device to help juggle my time. Listening to podcast lectures, reviewing notes and readings and reviewing forum posts while I'm in transit to/from work, during breaks etc would assist me hugely in keeping on top of my [university] stuff. (S134)*

> *It would be fun to have, but I wouldn't want to have it as the main method, as I prefer to print off lecture notes… (S11)*

> *I like to have time and space for learning. The environment I am in affects how I think. I have a structured timetable and have a set area (nice) for working in. I learn by writing notes and thoughts down, by the act of writing I can easily commit theories to memory. (S562)*

> *[Mobile technology is too] small for some notes and slides… (S23)*

> *[I] prefer to use books, just personal preference although the use of mobile technology and computers can make things far more efficient as well as giving you quick and most importantly, easy [access] to relevant information… (S113)*

> *I believe that Mobile Learning would be beneficial if it were used as a source of administration information (exam dates, times, upcoming dates, reminders etc). However, to be able to [receive] short sharp and concise lecture information would be highly beneficial (e.g.: highlighted points that were in the lecture, or [information] regarding the key points to [concentrate] study on etc.) (S49)*

…mobile learning depends on the context in which it is used, and the quality of the resources provided. For example, I have a laptop with wireless capability so prefer to do reading and viewing [videos] on a larger screen. However, listening to audio is [okay] on a mobile device because you can do it while driving, riding, walking, running etc. It is much more flexible - can't do all that with video material, and the screen is too small… (S12)

Also a number of students stated that they were already using mobile technology in their study in some way and were very keen to be able to extend the use of mobile technology if had the opportunity. Comments included:

[An] excellent idea. Coincidentally I sent an e-mail a few days asking about how [I] could I have access to stream with my PDA/phone, as I tried and it doesn't work. Unfortunately, I didn't receive an adequate answer, I believe I was misunderstood. I work full time in rural areas, and to be able to access stream on my phone would be wonderful and very convenient. I do carry with me (PDA SD card) the readings and study guide etc, but that is just not enough. (S56)

I already listen to mp3s of lecture notes on my mobile! (S118)

Hurrah. Can't wait to access my learning content on my iPad & iPhone. I can already in a way, but it would be even better if there was a specific application, or if it was taken into consideration in the structure of the course, and also the structure/layout of stream. (S56)

I already use my Smartphone for reading lecture notes during lectures, it is very handy as it is a small device but easily allows me to follow the notes whilst taking my own on pad and pen - and I avoid printing out countless amounts of paper… Hopefully one day I can get [access to the wireless network on my phone] as it will further open opportunities [which] mobile technology provides. (S83)

4.3.3 Technology constraints and limitations

A number of students commented that mobile technology has its limitations, such as small screens and that it can be difficult to read or type. For example:

....time consuming using a mobile so audio would be more useful than anything that required typing... (S328)

… I still don't like [to] write or type words on my mobile. Also the screen size is one of priority as well. Some people hate looking at PC screen and mobile screen… (S642)

... mobile phones are too small and cumbersome to use [extensively]. (S511)

The hardware of a mobile itself can be quite frustrating depending on the size and sensitivity. If the mobile was small and if one had big fingers it would make the texting or typing annoying as it would cause one to make mistakes quite easily. Similarly, downloading certain information on a mobile may be difficult as the document may sometimes not be compatible… (S21)

Also there were a number of comments relating to mobile learning not being suitable to all students. Two comments that related to this include:

I think that older students that aren't as technological orientated as younger students would find it hard to get their head around the use of mobile learning and there would be harder adjusted to this new way of learning. Younger students however would enjoy the [convenience] of this and would (I feel) rise to the challenge of using mobile learning to enhance their University experience. (S2)

… I have osteoarthritis in my hands, fingers and wrist. Using a mobile can be frustrating and time consuming. (S80)

4.3.4 Convenience of mobile learning

The perception of usefulness was determined by whether the individual found technology a helpful support for their teaching or learning. For students this meant that they believed it assisted them to learn more effectively or efficiently. Collectively, these qualities equate to the convenience of mobile learning as seen by students. The convenience of mobile learning was shown to be related to three dimensions; the speed of access, immediacy of interaction and the ability to efficiently utilise small chunks of time. These three dimensions can be seen in the following student comments:

The speed of access:

I have an iPhone and I believe I would use it to learn things whenever I'm away from my computer. (S41)

I think having a phone for learning use will be very handy, because nowadays most people have mobile with them all the time. (S455)

I completely agree about mobile learning [being convenient and beneficial] because I own an iPhone and I take it to class every time to access the quizzes provided and also lecture notes and it makes everything easier for me. I do not have to waste money to print out every lecture notes I can just look it up on my iPhone. (S224)

I already use my Smartphone for reading lecture notes during lectures, it is very handy as it is a small device but easily allows me to follow the notes whilst taking my own on pad and pen - and I avoid printing out countless amounts of paper. (S83)

Immediacy of mobile learning:

I often use my phone when I am watching TV. I often use it to look up things that intrigue or spark my interest while watching a programme. I often use it to look up things which me and my partner disagree on. The ease of quickly looking up something is really great. (S346)

I do think that will help with learning as it could be more interactive, if the lecturers did podcasts as well it would be fantastic for revision, especially if you could save them for use in study later on. In the quiz mobile games for study etc was mentioned, I think this would be a really good idea as I think the majority of students find it hard to learn just by sitting and listening, if they could play a game about it or something like that I think they would retain a lot more information. I also think it will make uni a lot more accessible for those people who often can't make lectures etc because of work/family, the podcasts they could pretty much do the lectures when they had time. (S731)

I believe that Mobile Learning would be beneficial if it were used as a source of administration information (exam dates, times, upcoming dates, reminders etc). However, to be able to receive short sharp and concise lecture information would be highly beneficial (e.g.: highlighted points that were in the lecture, or information regarding the key points to concentrate study on etc.) (S49)

> *I completely agree about mobile learning because I own an iPhone and I take it to class every time to access the quizzes provided and also lecture notes and it makes everything easier for me. I do not have to waste money to print out every lecture notes I can just look it up on my iPhone. (S224)*

Efficient use of small chunks of time:

> *I work full time as well as study, so it would be invaluable to be able to access study material using my mobile device to help juggle my time. Listening to podcast lectures, reviewing notes and readings and reviewing forum posts while I'm in transit to/from work, during breaks etc would assist me hugely in keeping on top of my [university] stuff. (S134)*

> *I believe [mobile technology] should really help in our learning, especially if it could include audio files as a support. You can take it anywhere and encourage people to learn as they have more tools they can access. (S612)*

> *I think that it would be good to market this more towards people who regularly take public transport to work and study part-time. (S331)*

CHAPTER 5: EDUCATORS RESULTS

5.1 Overview

This chapter presents the results of the educator questionnaires. The structure of this chapter follows that of the students'. The results are divided into two sections. The first section (Section 5.2) presents the structural relationship modelling used to test the proposed model of influences on educator adoption of mobile learning. This section is further broken down into two parts. The first part (section 5.4) describes the measurement model along with the reported goodness-of-fit statistics. The second part (section 5.5) describes the results of the testing of the hypothesised structural model.

The second section presents the results of the analysis of variance (ANOVA) between educator characteristics and interest in six mobile learning strategies.

5.2 Structural Equation Modelling for Educator Sample

Structural equation modelling (SEM) was used in this study to test a hypothesised model of factors impacting on mobile learning adoption for educators. As described earlier in the student results, SEM enables the simultaneous analysis of all the different factors that may influence mobile learning adoption (Gefen, et al., 2000). Twenty nine hypotheses were tested using SEM to assess the influence of three primary constructs namely; ICT self-efficacy, ICT-teaching self-efficacy and motivation on technology acceptance of mobile learning of educators.

5.2.1 Correlation Results of the Factors Included In This Study

The two main relationships that are the focus of this study are examined here in relation to educators. Structural equation modelling was used to test these relationships in an integrated model that contained all the major variables. The first relationship measured the effect of the affective variables of ICT self-efficacy, teaching self-efficacy and motivation on perceptions of ease of use and usefulness of mobile learning. The influence of the perceptions of ease of use and usefulness by educators on intentions to use mobile learning was then tested. As with the student sample, correlations between the relationships were first assessed to determine the level of multicollinearity between relationships as well as measure the strength and direction of the relationships between the constructs identified in the literature review. The results provide insight into the factors that may impact adoption of mobile learning (George, 2003; Pallant, 2007). The results demonstrated that multicollinearity was not an issue in this part of the study and that the majority of the correlations showed moderate correlations. Table 27 presents the results of the bivariate Pearson product-moment coefficient (*r*).

All factors showed low to modest levels of negative skew (< 1).

Table 27: Means, standard deviations, and inter-correlations amongst latent constructs in the structural model

	Mean	SD	GICTS	SMS	ExICTS	Anx	SEAtt	SEabl	IM	EM	PU	PEOU
General ICT Skill (GICTS)	3.92	1.702										
Specific Mobile Skill (SMS)	5.63	1.120	.793** .000									
Expert/ Specialised ICT Skill (ExICTS)	3.45	2.112	.651** .000	.627** .000								
Anxiety (Anx)	3.61	1.505	-.589** .000	-.545** .000	-.377** .000							
ICT-Teaching Self-efficacy Attitude (SEAtt)	5.55	.639	.300** .000	.281** .000	.179* .018	-.180* .017						
ICT-Teaching Self-efficacy Ability (SEabl)	4.47	1.352	.565** .000	.579** .000	.444** .000	-.393** .000	.334** .000					
Intrinsic Motivation (IM)	5.09	1.060	.392** .003	.459** .000	.467** .000	-.234** .002	.126 .096	.261** .000				
Extrinsic Motivation (EM)	3.95	1.149	.061 .422	.092 .227	.073 .337	-.163* .031	.189* .012	.026 .733	.025 .740			
Perceived Usefulness (PU)	5.32	.969	.199** .008	.206** .006	.101 .183	-.068 .374	.207** .006	.230** .002	.086 .256	.122 .108		
Perceived ease of use (PEOU)	3.51	1.190	.459** .000	.527** .000	.283** .000	-.498** .000	.426** .000	.383** .000	.196** .009	.074 .329	.067 .380	
Behaviour Intention (BI)	5.46	1.159	.157* .038	.093 .221	.156* .039	-.001 .989	-.006 .935	.142 .062	.012 .878	.068 .371	.168* .026	.076 .318

Note: ** $p < 0.001$, *$p < 0.05$ level, highlighted cells refer to non-significant results, $p > .05$. Means for all scales: 1=minimum (low), 7=maximum (high). $n = 446$

5.2.2 Structural Equation: Measurement Model

Structural equation modelling (SEM) was used in this study to test a hypothesised model of factors impacting on mobile learning adoption for educators. As described earlier in the student results, SEM enables the simultaneous analysis of all the different factors that may influence mobile learning adoption (Gefen, et al., 2000). Twenty nine hypotheses were tested using SEM to assess the influence of three primary constructs namely; ICT self-efficacy, ICT-teaching self-efficacy and motivation on technology acceptance of mobile learning of educators.

The processes used to assess the model were the same as those described in the student results, where the measurement model and the structural model were assessed separately. The measurement model was assessed using factor analysis to determine the degree to which the observed variables loaded on their latent constructs (Gefen, et al., 2000). Chapter 3 reported the results of the EFA for the constructs used in this model. The item loadings for each latent variable based on the final version of the model are shown in Appendix E. As with the student model, all but one of the constructs used four items to measure the variable. Behavioural intention, had only item – “Overall, I think mobile learning would be beneficial and would be interested in including mobile learning in my teaching if I had the opportunity in the future”. The measurement model suitability was assessed using the same fit statistics as used in the student model.

5.2.3 Fit statistics and results

The measurement component of the model was tested to ensure the adequacy and suitability of the items as indicators of the latent constructs (Byrne, 2010). EFA was used to assess the suitability of each cluster of latent constructs and the item loading on each latent variable. These constructs were inspected and goodness of fit measurements gathered. The results, presented in Table 28, show an adequate goodness of fit for each of the latent clusters. All latent constructs, except the ICT Self-Efficacy, meet each criteria of goodness of fit. However, the ICT self-efficacy latent fit statistics were sufficiently close to the desired value to justify retaining it.

Table 28: Fit statistics for measurement models

Model Description	**# Latent Variables**	**# Observed Variables**	**χ^2**	***df***	***p* <**	**SRMR**	**NFI**	**PNFI**	**RMSEA**	**90% CI**
ICT Self-efficacy	4	16	584.935	63	.000	.08	.84	.61	.13	.12-.14
ICT-Teaching Self-efficacy	2	8	10.619	12	.562	.03	.98	.62	.00	.00-.07
Motivation	2	8	25.372	12	.013	.07	.93	.66	.05	.03-.12
TAM	3	9	39.303	18	.059	06	.89	.72	.05	.00-.08

5.2.4 Structural Equation: Structural Model

The same processes were used to assess the educator model as the student model. The fully mediated model was examined first, and the three primary latent variables were assessed in terms of their impact on behavioural intention when mediated through the variables ease of use and usefulness (Section 5.5.1). The second model assessed the direct effect the three primary latent variables had on behavioural intention (Section 5.5.2). The final model used the results of the first two models to find the best fit (Section 5.5.3).

5.2.4.1 Fully-Mediated Model.

The first phase of analysis assessed the fully-mediated structural model with all hypothesised paths mediated by the two TAM variables of ease of use and usefulness. Figures 28 outline the proposed model.

After an analysis of all the paths, a number of them were removed as they were non-significant. Overall the model was supported and demonstrated a reasonable fit with the data (χ^2 = 670.7, df = 55, p < .002, SRMR= .09, NFI = .92, PNFI = .57, RMSEA = .05 (90% CI =.02 - .08), AIC = 117.0) (n =175). The fit statistics showed a good fit, meeting the minimum criteria. The supported paths and their standardised regression weights for the observed structural model are shown in Figure 28. For clarity, the measurement components of the model were excluded from the diagram. A complete list of parameter estimates and their standard errors is available in Appendix E.

The motivational orientation relationship to perceived ease of use and usefulness was found to be not significant in the educator model; however the other two primary constructs were significant in some form. After an examination of the Modification Indices an additional path was added to the overall model. ICT anxiety was found to have a negative impact on the ICT-teaching self-efficacy of educators in regards to their attitude towards using ICT in their teaching (β = -.07, p<.05). Figure 29 outlines all the relationships that were found to be significant in the educator model.

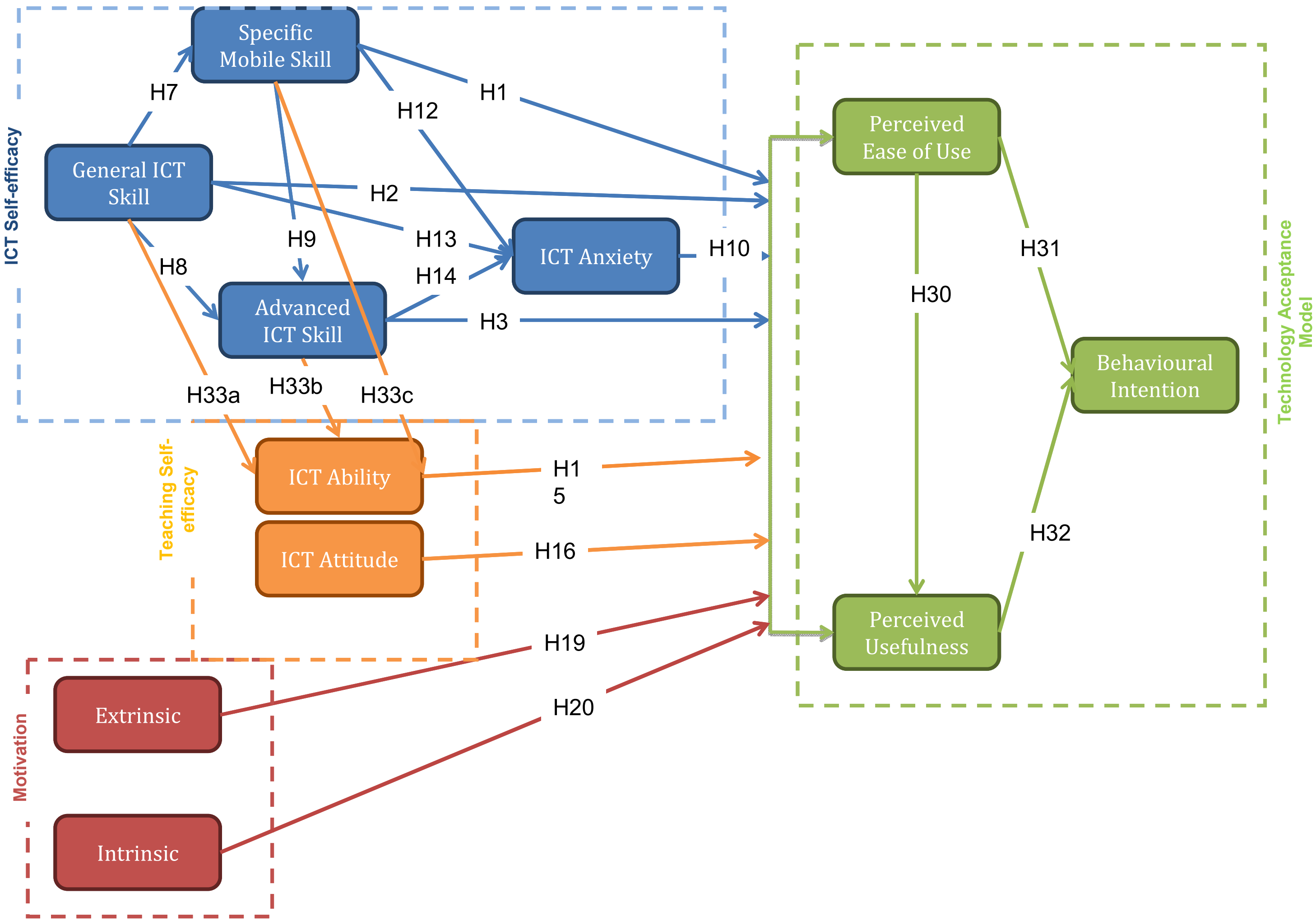
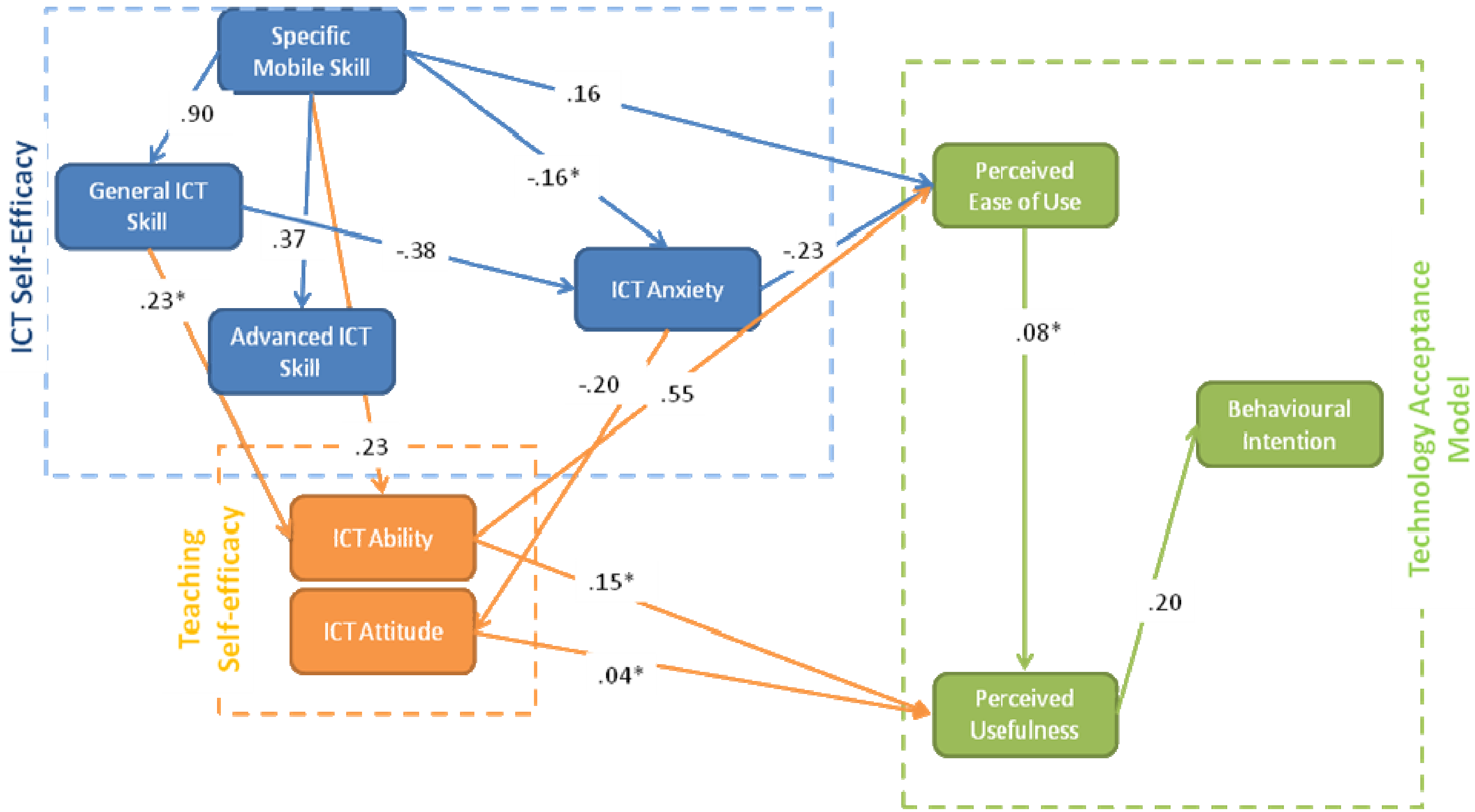


Figure 28: Hypothesised structural model (fully-mediated) Note: All hypothesised paths are positive (+), except for H12, H13, H14 and H10 which is negative (–)



Model	χ^2	*df*	*p* <	SRMR	NFI	PNFI	RMSEA	90% CI	AIC
	670.7	55	0.02	.09	.92	.57	.05	.02-.08	117.0

*Figure 29: Observed Structural Model (fully-mediated). Note: All standardised path coefficients (β) shown are significant at p <.000 except: * which was significant at p ≤ .05. All other paths were non-significant (p >.05) and are not shown.*

The squared multiple correlations (r-square values or SMC) for the educator model was also assessed. Overall the perceived ease of use and perceived usefulness accounted for only 5% of the variance of behavioural intention. Specific mobile skill, ICT anxiety and ICT-teaching self-efficacy of their ICT ability accounted for 8% variance in perceived ease of use, which is relatively low. However ICT-teaching self-efficacy and specific mobile self-efficacy accounted for 48% variation in perceived usefulness. Table 29, outlines the SMC for all the constructs in this model.

Table 29: Squared correlations of the eight constructs in the fully mediated model

Constructs	**Squared multiple correlations (SMC)**
Behavioural intention	.048
Perception of Usefulness	.077
Ease of Use	.447
Specific Mobile Skill	.618
Expert/Specialised ICT Skill	.342
Anxiety	.364
ICT-teaching self-efficacy- ability	.349

5.2.4.2 Alternative Model (Partially Mediated Model).

Although the fully mediated model showed an acceptable fit, additional paths were assessed. The reason for this was to determine if the identified factors had a direct influence on behavioural intention of educators rather than being simply mediated by perceived ease of use and perceived usefulness. The additional model was assessed to ensure that the best explanation of the data was developed (Cole & Maxwell, 2003). The partially mediated model, assessed the same latent variables as the fully mediated model however it assessed the relationship directly to behavioural intention (Figure 30).

The first alternative model replaced all paths to ease of use and perception of usefulness with a direct path from the three primary latent variables; ICT self-efficacy, motivation and ICT-teaching self-efficacy to the behavioural intention construct. The results indicated that all four secondary variables of ICT self-efficacy (specific mobile skill, general ICT skill, advanced/specialised ICT skill and ICT anxiety) had a direct relationship to the intention of educators to adopt and use mobile learning. ICT-teaching self-efficacy attitude was also shown to have a significant relationship to behaviour intention. Figure 31 presents the results of the tested model. Based on the squared multiple correlations (r-square values), we can see with the addition of these relationships along with ease of use and perception of usefulness has increased the explanation of variance in behavioural intention to 12%. The fit statistics show good fit (χ^2 = 670.7, df = 55, p < .000, SRMR= .09, NFI = .80, PNFI = .51, RMSEA = .13 (90% CI =.11

- .15), AIC = 195.8) (n =175) for most of the statistics. Although the NFI is slightly lower than the .90 cut off, it is nevertheless not so far as to be of concern. The RMSEA is also slightly larger than .05 cut off but this is still acceptable since the other values fit within accepted levels.

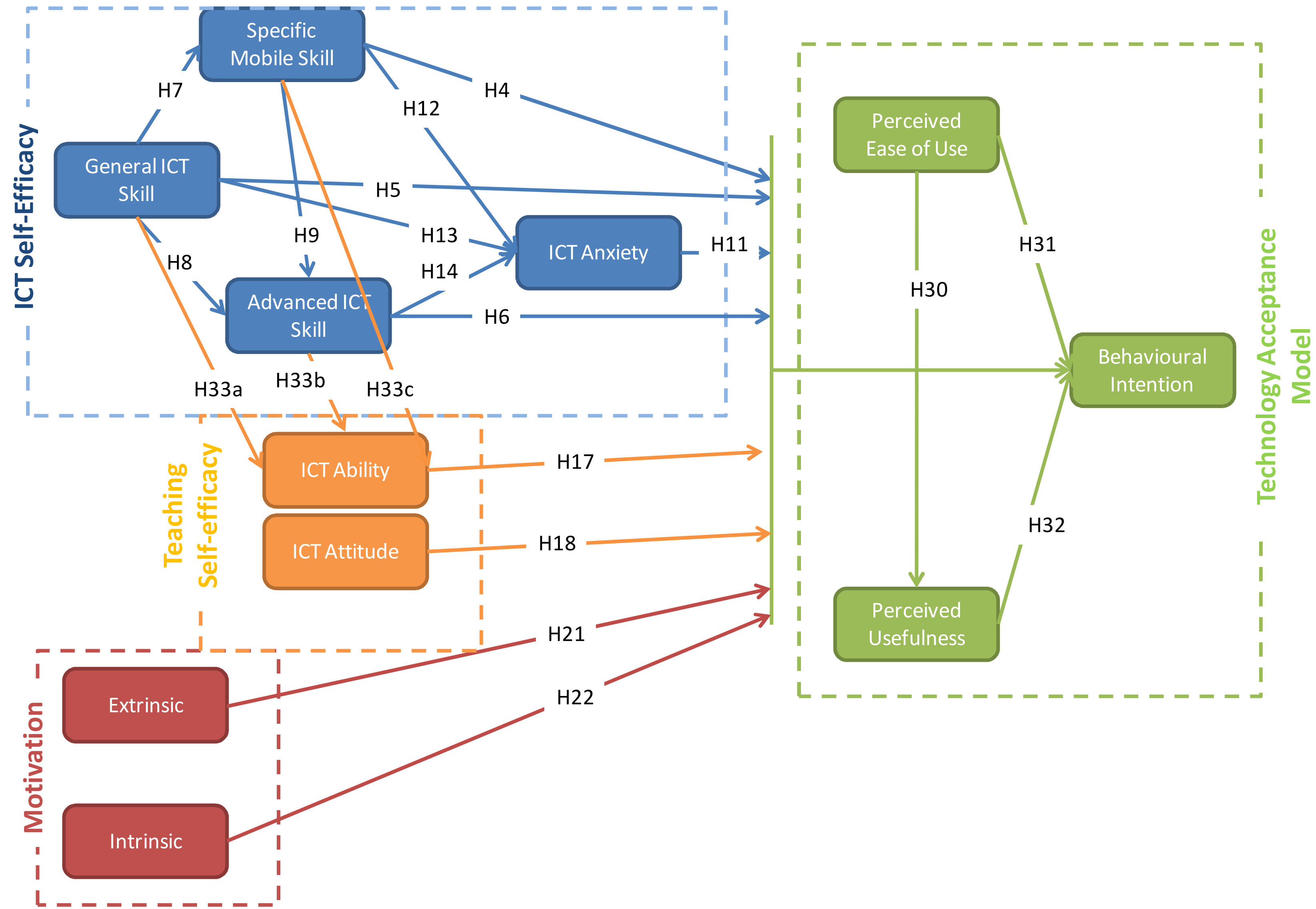
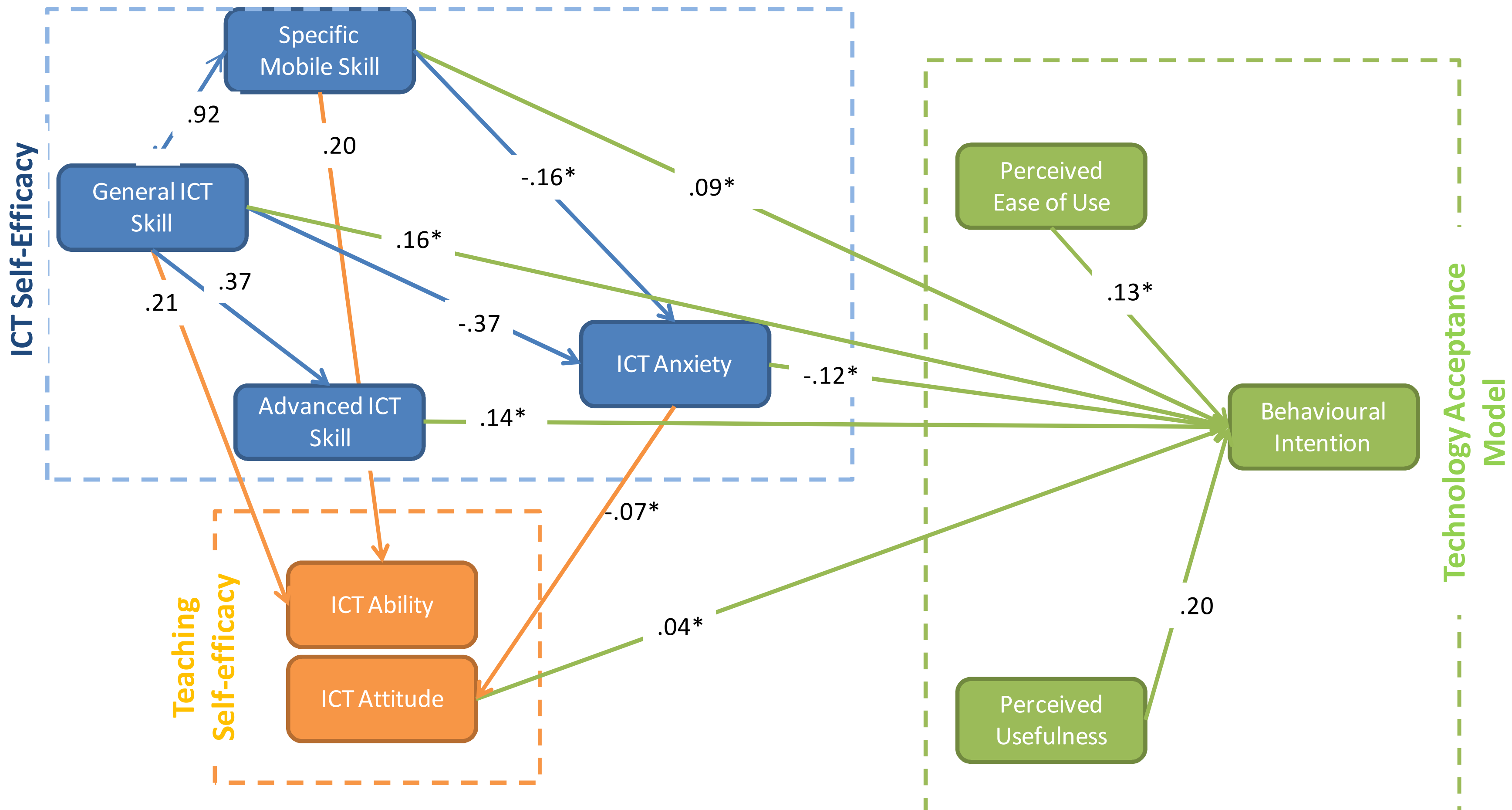


Figure 30: Hypothesised Structural Model (Partially-Mediated). Note: All hypothesised paths are positive (+), except for H12, H13, H14 and H11 are negative (–)



Model	χ^2	*df*	*p* <	SRMR	NFI	PNFI	RMSEA	90% CI	AIC
	670.7	55	0.02	.09	.92	.57	.05	.02-.08	117.0

*Figure 31: Observed Structural Model (Partially-Mediated). Note: All standardised path coefficients (β) shown are significant at p <.000 except: * which was significant at p ≤ .05. All other paths were non-significant (p >.05) and are not shown.*

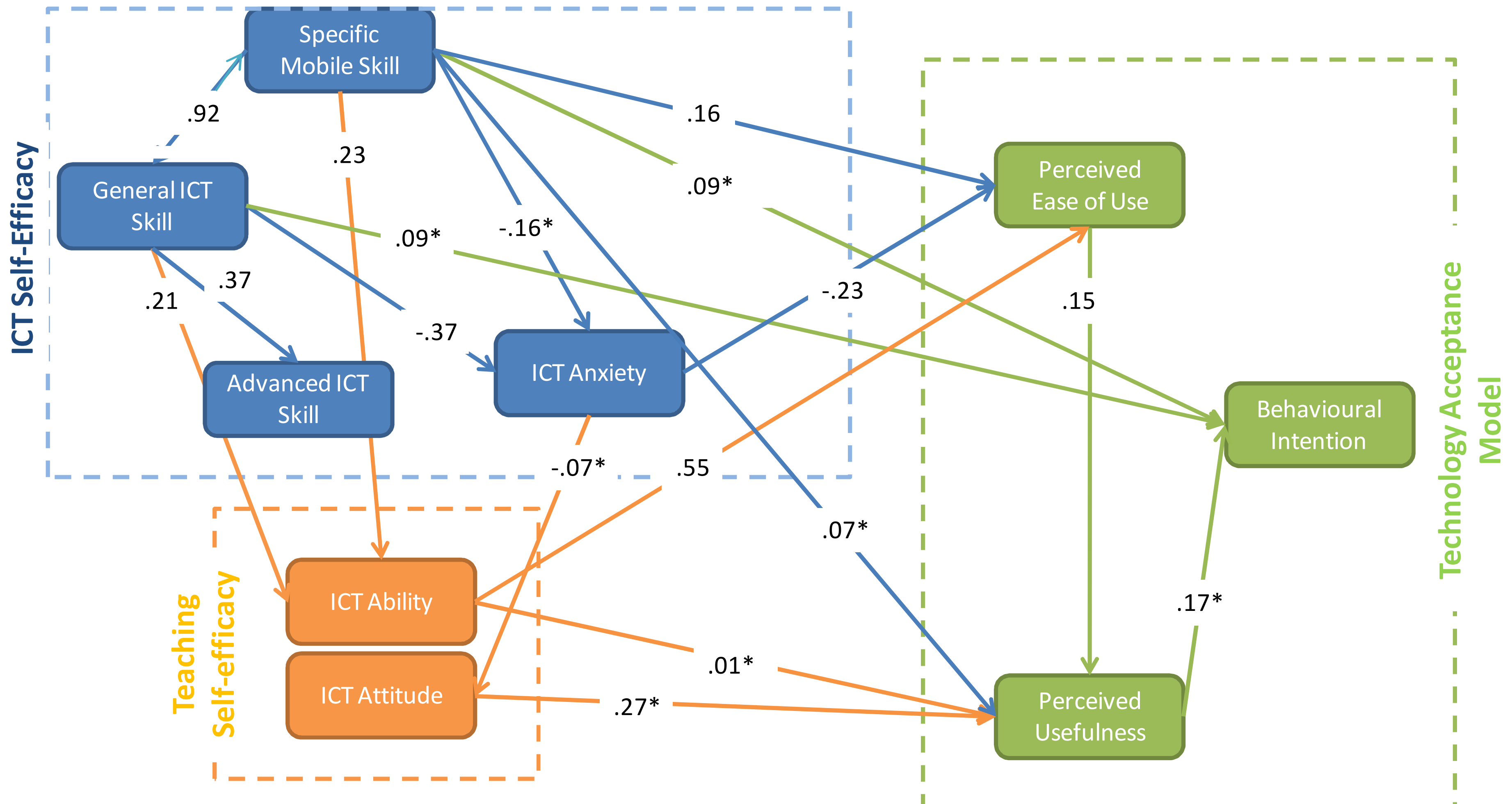
5.2.4.3 Final Model.

The final model comprised all significant relationships identified in the fully mediated model and the partially mediated model. Figure 32 shows all the significant standardised path coefficients for the final model. As with all the other models motivation is not significant and therefore does not impact the adoption of mobile learning. The other two primary constructs, ICT self-efficacy and ICT-teaching self-efficacy, do have an impact on mobile adoption (see Figure 32 for the particular relationships). One major difference between the educator and student model is that perceived ease of use is no longer related to behavioural Intention in the educator model as it was in the student model.

The goodness of fit statistics had a better fit than the two previous models (χ^2 = 670.7, df = 55, p < .947, SRMR= .09, NFI = .97, PNFI = .53, RMSEA = .00 (90% CI =.00 - .01), AIC = 90.674) (n =175). The χ^2 p value is now above .05% cut off. And by assessing the AIC statistic for all models we can see that the final model has the lowest value therefore has the better fit (see Table 30). The other fit statistics are all within suitable ranges.

Table 30: Fit Statistics for the three models

Model	**χ^2**	**df**	***p* <**	**SRMR**	**NFI**	**PNFI**	**RMSEA**	**90% CI**	**AIC**
Fully Mediated	670.7	55	0.02	.09	.92	.57	.05	.02-.08	117.0
Partially Mediated	670.7	55	0.00	.09	.80	.51	.127	.10-.15	195.8
Final Model	670.7	55	0.947	.09	.97	.53	.00	.00-.01	90.7



Model	χ²	*df*	*p* <	SRMR	NFI	PNFI	RMSEA	90% CI	AIC
	670.7	55	0.947	.09	.97	.53	.00	.00-.01	90.7

Figure 32: The final model for educator mobile learning adoption.

The variances between the paths were relatively unchanged from the first two models. Table 31 shows the SMC for all constructs.

Table 31: Squared correlations of the eight constructs in the final model

Constructs	**Squared multiple correlations (SMC)**
Behavioural intention	.122
Perception of Usefulness	.077
Ease of Use	.447
Specific Mobile Skill	.629
Expert/Specialised ICT Skill	.423
Anxiety	.364
ICT-teaching self-efficacy- ability	.366

The final model showed the best fit and was accepted as the final solution. In total 18 of the original 26 hypothesised relationships were found to be significant. Table 32 outlines the original 26 hypothesised relationships and whether or not they were supported in the final model.

Table 32: Hypothesis description for the adoption model of educators

Summary of hypothesis	Hypothesised Path	Supported?
H1-3 a and b: An educator with higher levels of skill with general ICT skill (H1), advanced ICT skill (H2), specific mobile skill (H3) will more likely to see mobile learning as easy to use and useful.	**H1a**: GICTS → PEOU	Yes
	H1b: GICTS → PU	No
	H2a: SMS → PEOU	No
	H2b: SMS → PU	No
	H3a: ExICTS → PEOU	No
	H3b: ExICTS → PU	No
H4-6: An educator with higher levels of skill with general ICT skill (H4), advanced ICT skill (H5), specific mobile skill (H6) will more likely to adopt mobile learning.	**H4**: GICTS → BI	Yes
	H5: SMS → BI	Yes
	H6: ExICTS → BI	No
H7-9: As an educator becomes more skilled in one area of ICT usage the more likely they will adopt a wider use of a range of ICT technologies.	**H7**: GICTS → SMS	Yes
	H8: GICTS → ExICTS	Yes
	H9: SMS → ExICTS	No
H 10 a and b: An educator with low ICT anxiety will more likely to see mobile learning as easy to use and useful.	**H10a**: Anx→ PEOU	Yes
	H10b: Anx→ PU	No
H11: An educator with a low ICT anxiety will more likely to adopt mobile learning.	**H11**: Anx → BI	No
H12-14: As an educator becomes more competent with ICT they more likely that they will have less anxiety.	**H12:** SMS → Anx	Yes
	H13: GICTS → Anx	Yes
	H14: ExICTS → Anx	No
H15-16 a and b: An educator with higher levels of ICT-teaching self-efficacy will more likely to see mobile learning as easy to use and useful.	**H15a:** SEabl → PEOU	Yes
	H15b: SEabl → PU	Yes
	H16a: SEAtt → PEOU	No
	H16b: SEAtt → PU	Yes
H17 -18: An educator with higher levels of ICT-teaching self-efficacy will more likely to adopt mobile learning.	**H17:** SEabl → BI	No
	H18: SEAtt → BI	No

Note: General ICT Skill (GICTS), Specific Mobile Skill (SMS), Expert/ Specialised ICT Skill (ExICTS), Anxiety (Anx), ICT-teaching Self-efficacy Attitude (SEAtt), ICT-teaching Self-efficacy ability (SEabl), Intrinsic Motivation (IM), Extrinsic Motivation (EM), Perceived Usefulness (PU), Perceived ease of use (PEOU), Behaviour Intention (BI)

Table 32: Hypothesis description for the adoption model of educators (continued)

Summary of hypothesis	Hypothesised Path	Supported?
H19-20 a and b: An educator who is highly internally (H19) or externally (H20) motivated will more likely to see mobile learning as easy to use and useful.	**H19a**: IM → PEOU **H19b**: IM → PU **H20a**: EM → PEOU **H20b**: EM → PU	No No No No
H21-22: An educator who is highly internally or externally motivated will more likely to adopt mobile learning.	**H21**: IM → BI **H22**: EM → BI	No No
H30: An educator who perceives mobile learning as ease to use will have positive perception of mobile leaning usefulness.	**H30**: PEOU → PU	Yes
H31: An educator who perceives mobile learning as useful will more likely indicate that they would likely adopt mobile technology in the future.	**H31**: PEOU → BI	No
H32: An educator who perceives mobile learning as easy to use will more likely indicate that they would likely adopt mobile technology in the future.	**H32**: PU → BI	Yes
H33: An educator who is competent using ICT is more likely to have higher levels of ICT-teaching self-efficacy.	**H33a:** SMS → SEabl **H33b:** GICTS → SEabl **H33c:** ExICTS → SEabl	Yes Yes No

Note: General ICT Skill (GICTS), Specific Mobile Skill (SMS), Expert/ Specialised ICT Skill (ExICTS), Anxiety (Anx), ICT-teaching Self-efficacy Attitude (SEAtt), ICT-teaching Self-efficacy ability (SEabl), Intrinsic Motivation (IM), Extrinsic Motivation (EM), Perceived Usefulness (PU), Perceived ease of use (PEOU), Behaviour Intention (BI)

5.2.5 Analysis of the Variance between Educator Characteristics and Mobile Learning Strategies

As with the student sample, educators were asked indicate their interest in six mobile learning strategies and whether they would be interested in implementing them in their class in the future. This section was used to help further pin point how mobile learning might be useful.

The six strategies were; Access the internet for educational content via a mobile phone; SMS notifications or study notes; Mobile quizzes; Mobile blogging; A fully integrated mobile application; and uploading lecture recordings as audio or video (podcasting). The educators were asked to rate their interest, using a 1-6 Likert scale, where 1 represented ‘no interest at all’, and 6 ‘extreme interest’. As shown in Table 23, the most popular mobile learning initiative were ‘To upload lecture recordings as audio or video (podcasting)’ ($\bar{x}$=4.05; s =2.14), this was also the highest rated mobile learning initiative by students. The second highest rated initiative was ‘SMS notifications or study notes’ ($\bar{x}$=3.95; s =1.919). This initiative was rated third highest by the students. The third highest rated initiative rated by educators was ‘Mobile quizzes’ ($\bar{x}$=3.77; s =1.926), this was rated as only fifth highest by students.

Table 33: Mobile learning strategies and means ratings.

Mobile Learning Stategies	**Mean ($\bar{x}$)**	**Standard deviation (α)**	**Confidence Interval (95%)**
To download and view lecture recordings as audio or video (podcasting)	4.05	.162	3.73 – 4.37
SMS notifications or study notes	3.95	.137	3.68 – 4.23
Mobile quizzes	3.77	.146	3.48 - 4.05
Access the internet for educational content via your mobile phone	3.71	.142	3.43 – 3.99
A fully integrated mobile application	3.66	.137	3.39 – 3.93
Mobile blogging	3.41	.151	3.11 -3.70

Based on a t-test comparing the scores between students and educators, there was no significant difference in interest between these two groups. This suggests a strong similarity between educators and students in their perceptions of the usefulness of these six mobile learning strategies.

As in the student analysis, a one-way ANOVA was carried out to determine whether gender and device type ownership influenced attitudes to mobile learning activities of the educators. As with the student analysis, to avoid type 1 error, otherwise known as a false-positive result, which can occur with multiple ANOVAs (or t-tests), a significance level of 0.008 was used (Gordi & Khamis, 2004).

Overall there were few differences between men and women; though in the main women were more open to using new initiatives (see Table 34). The biggest difference was in relation to mobile quizzes where females were much more likely to favour using it (males; $\bar{x}$ =3.21, s =.226; females; $\bar{x}$=4.21, s =.196). No other significant differences were found.

Table 34: Analysis of variance between tertiary institutes and their attitude towards a range of mobile learning initiatives

	Male (n=68) Mean and Standard Deviation	**Female (n=107)** Mean and Standard Deviation	**Significance**
Access the internet for educational content via your mobile phone	3.63 (.224)	3.82 (.193)	F=.087 df=174
SMS notifications or study notes	3.65 (.221)	4.14 (.187)	F=1.210 df=174
Mobile quizzes	3.21 (.226)	4.21 (.196)	F=11.010* df=174
Mobile blogging	2.90 (.230)	3.67 (.208)	F=3.701 df=174
Full integrated mobile application	3.19 (.232)	3.94 (.177)	F=4.313 df=174
To upload lecture recordings as audio or video (podcasting)	3.75 (.267)	4.29 (.217)	F=1.614 df=174

Note: Standard Deviation is shown in brackets, * $p < 0.008$

The last ANOVA test was used to determine whether the type of mobile devices that an educator owns will influence how they view different mobile learning initiatives. As shown in Table 25 the type of mobile device was associated with attitudes toward four mobile learning initiatives. These initiatives are; 1) Access the internet for educational content via a mobile phone; 2) Mobile quizzes; 3) Mobile blogging; 4) Full integrated mobile application. Educators with mid to high range mobile devices were more likely to be more positive to mobile leaning initiatives that take advantage of higher end devices. By comparison, students with high end devices were more enthusiastic about all of the initiatives except for mobile quizzes.

Table 35: Analysis of variance between mobile device types carried by educators and their attitude towards a range of mobile learning initiatives

	Low-end (n=81) Mean and Standard Deviation	**Mid to High-end (n=83)** Mean and Standard Deviation	**Significance**
Access the internet for educational content via your mobile phone	3.42 (.187)	4.07 (.220)	F=22.702* df=163
SMS notifications or study notes	3.63 (.202)	4.48 (.234)	F=6.523 df=163
Mobile quizzes	3.49 (.223)	4.60 (.243)	F=12.699* df=163
Mobile blogging	3.12 (.227)	3.63 (.218)	F=17.745* df=163
Full integrated mobile application	3.25 (.212)	4.05 (.194)	F=22.917* df=163
To download and view lecture recordings as audio or video (podcasting)	3.96 (.258)	4.19 (.220)	F=1.931 df=163

Note: Standard Deviation is shown in brackets, * $p < 0.008$

5.3 Qualitative Analysis

Open-ended questions on the questionnaire invited comments from educators about mobile learning. Three major themes emerged from these comments. Each is discussed below, in order of frequency.

The first theme related to the time constraints of educators. A number of comments discussed how time was needed for educators to assess, plan and build their skills with mobile technology. They emphasised that this time commitment should be supported by the employers of the educators. For example one educator stated:

> *... Institutions do not provide enough time and resources to enable its efficient use by staff. There is woeful back-up and generally while training courses are made available management has not yet found how to increase the hours in the day from 24 to 36 - or are not prepared under present financial circumstances to reduce workloads while new technology is embraced... (E83)*

While another stated:

> *…For me one problem would be having the time to learn about the technology and to plan how I might utilise it to benefit learners. (E153)*

The second theme related to technical constraints of mobile learning. A number of educators pointed out the limitations of mobile technology in terms of its reliability and the different devices that both students and educators hold. For example:

> *…Current e-students are not uniformly [equipped] or capable of downloading current e-learning resources let alone ML resources. .. (E77)*

The differences in devices which educators and students own make it very hard for educators to identify the type of tools that could be introduced into the learning environment. Also, the constantly changing range of devices on offer makes it hard to develop enduring learning activities. For example:

> *I'd love to include mobile learning in my papers, but I think it is too soon to fully embrace it. The foreseen technology changes would not justify the amount of work to properly set up mobile learning. The [variety] of devices in use by students support that view. (E113)*

Related to this concern are the cost of these devices and the cost of necessary services that are associated with mobile device usage. For example:

> *… [I] may need new phone - will [my institute] pay for us to obtain updated technology? (E53)*

In addition, support from institutions was once again highlighted in relation to using mobile technology. For example:

> *…We need to move with the times and get the support [from our institutes for things like] equipment and training… (E66)*

> *…I would need to be fully instructed in its uses for me to feel confident to use it as a teaching tool. (E32)*

The last theme relates to the need for better understanding of the benefits of mobile learning. There were a number of educators that felt mobile learning had the potential to provide greater access to learning however some felt that more research was needed to fully understand these advantages before they would be prepared to adopt mobile learning into their teaching anytime soon.

> *…What real advance does this offer, and at what cost borne by whom, does ML offer over e-learning and broadband. So all in all it is all very good having educationalists saying that these methods will enhance teaching etc but at the coalface it can just make life miserable and frustrating for the under resourced lecturer…(E77)*

> *Not sure how much benefit this adds over just having the material online. Will be interested to try it and find out. (E12)*

> *I think this would be very good for students when they are completing practical components of their courses off site. [Mobile Technology] would enable [students'*

> *to] access to learning material whilst putting their new knowledge into practice. A fantastic support. (E50)*

Overall these three themes capture the opinions of educators regarding mobile learning. They show that mobile learning is still very much on the periphery for many educators and that a number of important hurdles need to be overcome before wide spread adoption.

CHAPTER 6: DISCUSSION

This thesis set out to examine how ICT self-efficacy, ICT-teaching self-efficacy, motivational orientation and student readiness for self-directed learning affected attitudes to, and adoption of, mobile learning. Each of these constructs was found to impact aspects of mobile learning attitude and intention to adopt, though the extent and nature of the influence varied between student and educator.

This chapter discusses the impact of each factor on the perception and adoption of mobile learning. This discussion has three parts. First, a summary of the main findings is given; next the influence of each factor on the adoption of mobile learning is discussed. Finally, the student adoption model is discussed in terms of age, gender and institute attendance (the educator sample was insufficient for multigroup analysis).

6.1 Summary of Findings

Intention to adopt mobile learning is determined by a complex set of interrelated motivational, perceptual and belief factors. While there are significant similarities at a structural level between student intentions and those of educators, there are differences between them at the level of specific factors. There were 20 significant relationships in the student model and 18 in the educator model. Appendix K outlines and compares the significant hypotheses between the two models.

Student adoption of mobile learning was directly influenced by their perception of how easy mobile learning was to use and the perceived usefulness of mobile learning. In the educator model only perceived usefulness was shown to influence mobile learning adoption, however, ease of use was found to influence the perceived usefulness of mobile learning (this relationship was also found in the student model).

ICT self-efficacy and the level of self-directness of students were found to have the strongest influence on student adoption of mobile learning and their perception of how useful and easy mobile technology was to use in support of their learning. In the educator model ICT self-efficacy and ICT-teaching self-efficacy were shown to have the strongest influence on their perception of how useful and easy mobile technology was to use in support of their teaching. Motivational orientation was found to have only a small influence in both models.

6.1.2 Student Model

The student adoption model (Figure 33) confirmed that the perception of ease of use and usefulness of mobile learning had the strongest influence on students' intention to adopt mobile learning. This means that if students are to adopt mobile learning they must see mobile technology as being easy to use and believe that it offers major benefits over existing learning methods. The model also establishes that to a lesser extent general ICT skill plays a direct role on their intention to adopt. The results indicate that students that are more skilled at a range of basic computing tasks are more likely to adopt mobile learning. The level of student self-directness also plays a minor direct role in student adoption. In particular students that have a strong desire to learn and are self-managed will more likely to adopt mobile learning.

While the factors described above played a direct role on adoption, ICT self-efficacy, learner self-directedness and motivation were found to have a direct influence on student perceptions of ease of use and usefulness of mobile learning. Perceived ease of use was shown to have the strongest influence over perceived usefulness with the other factors playing a minor role.

Students' skill using mobile technology and their level of anxiety using ICT had a minor impact on their perception of how easy mobile learning would be to use. Students that were competent mobile technology users were more likely to perceive mobile learning as easy to use, whereas students who were highly anxious about using ICT were more likely to perceive mobile learning as difficult to use. ICT anxiety was the strongest influence on the perception of ease of use. ICT anxiety and mobile skill were also shown to impact students' perception of usefulness. Students that were competent mobile users' perceived mobile technology as useful for learning whereas anxious students were more likely see it as less useful.

Two other factors that were shown to play a minor role in the overall perception of usefulness of mobile learning were the students' desire for learning and their level of self-control. Students with a strong desire to learn and/or those that needed to be in control of their own learning felt that mobile technology was a useful tool to support their learning. Lastly the model also indicated the strong role of motivation in perception of usefulness; students that were extrinsically motivated saw mobile learning as useful.

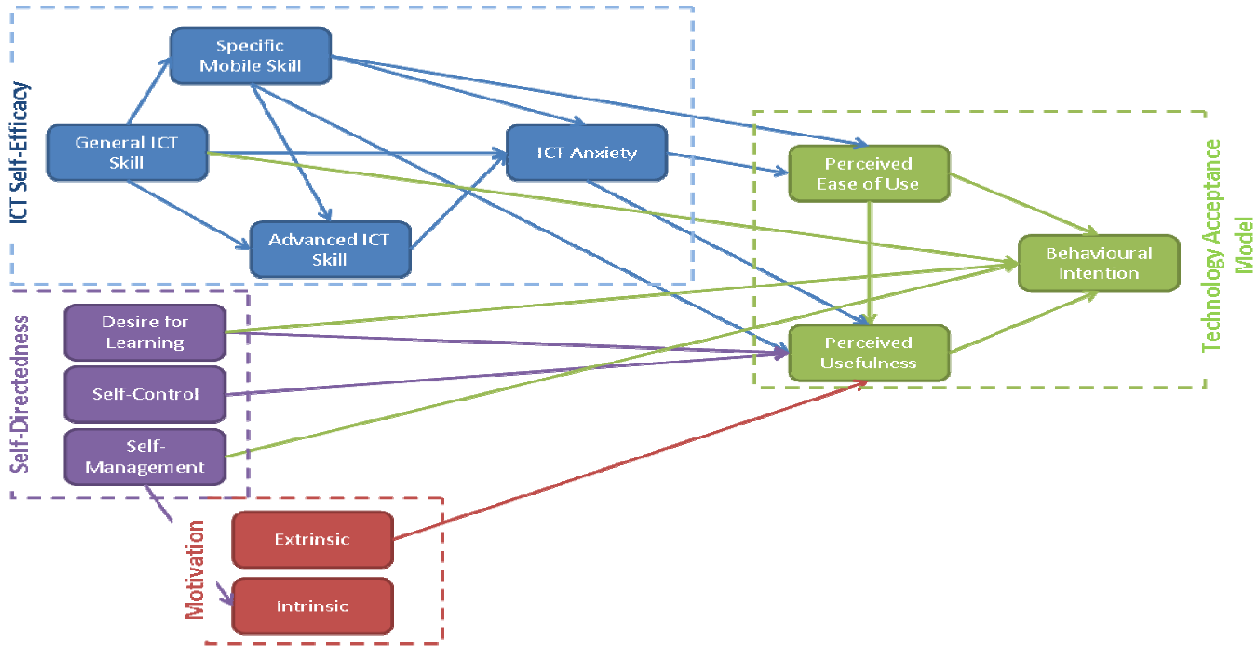


Figure 33: The student mobile learning adoption model

6.2.1 Educator Model

A number of factors were found to be influential in the educator adoption model (Figure 34). Educator intentions to adopt mobile learning were impacted by three factors. In order of strength these were: the educational benefits for both students and educators (perceived usefulness); the general ICT ability of educators (general ICT skill) and the perceived ease of use for teaching and learning (perceived ease of use).

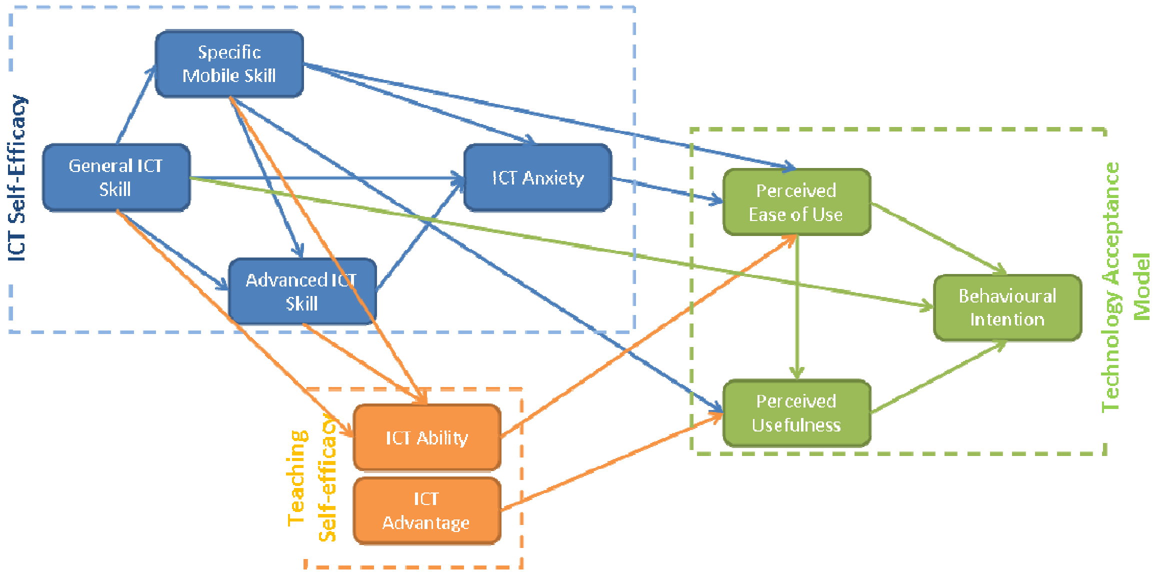


Figure 34: The educator mobile learning adoption model

The perceived usefulness of mobile learning was in turn influenced by two factors: the level of experience with using mobile technology (specific mobile skill); and the skill level of educators when using ICT in their classes (ICT-teaching self-efficacy: perceived advantage). Specific mobile self-efficacy had the highest influence on perceived usefulness, with the two measures of ICT-teaching self-efficacy having a relatively equal but smaller influence.

The perceived ease of use of mobile learning was influenced by three factors which were, in order of strength: the perceived advantage that educators felt that technology brought to teaching (ICT-teaching self-efficacy: perceived advantage); the level of anxiety educators felt when using technology (ICT anxiety) and the level of mobile learning skill educators had (specific mobile self-efficacy). Levels of intrinsic and extrinsic motivation were not found to have any significant influence on attitude to or adoption of mobile learning.

These factors and their relationships are now discussed in detail. The technology acceptance model (TAM) factors of perception of ease of use and usefulness is first discussed since the literature indicates that these two factors should have the strongest and most direct influence on intention to adopt. Although this study found support for the notion that these two factors play an important role in adoption, evidence was found that other factors also make a significant contribution. Discussion of these factors as extensions to the TAM model and as influences on mobile learning perceptions and intention to adopt follows.

6.2 Perception of Usefulness and Ease of Use and Its Effect on Mobile Learning Adoption

The adoption models derived from the analysis (see Figure 33 and 34) found that the behavioural intentions of educators and students to adopt mobile learning was strongly influenced by the perceived ease of use and usefulness of mobile learning. Support was found for three hypotheses:

Students and educators who view mobile learning technology as:

- *useful will be more likely adopt mobile technology*
- *easy to use will be more likely to:*
    - *have a positive opinion of mobile learning usefulness.*
    - *adopt mobile technology.*

The findings related to these 3 hypotheses are discussed below:

6.2.1 Perception of usefulness

The perception of usefulness was determined by whether the individual found technology a helpful support for their teaching or learning. For students this meant that they believed it assisted them to learn more effectively or efficiently. For educators it meant seeing the technology as providing substantial advantage to student learning or their own teaching. The qualitative results made it clear that these positive perceptions of usefulness were interpreted by students and educators as issues of convenience, specifically speed of access, immediacy and efficient use of time. These are related to the benefits identified by Kynäslahti (2003) as convenience, expediency and immediacy. However, Kynäslahti's terms seem to overlap in meaning, since expediency and immediacy might both be considered aspects of convenience rather than distinct constructs.

6.2.1.1 Convenience: Speed of access

This study found that the convenience of mobile learning was an important consideration for both students and educators. The role of convenience of mobile technology has been explored in the literature in a general sense but little research has been done to identify which dimensions determine convenience.

The first dimension of convenience suggested by the results is the speed of access. Mobile technology can be used to save resources, such as time and effort. In particular mobile learning can be seen as enabling quicker access to learning resources. Mobile technology enables students to access leaning quickly as the device is carried on their person and is always in stand-by mode, unlike laptops or desktop computers that are mostly tied to a location and need to be booted up before learning material can be engaged with. Students stated that given the opportunity they would use their mobile device for access, for example *"I have an iPhone and I believe I would use it to learn things whenever I'm away from my computer."[S41].*

The mobile device offers a suite of tools that are always on hand and readily accessible. This increased access was described by a student as mobile learning *"…will be very handy, because nowadays most people have mobile with them all the time."* [S455]. In addition mobile technology is not only easy to carry but can be used for fast access to learning content in class and for learning:

> *I completely agree about mobile learning [being convenient and beneficial] because I own an iPhone and I take it to class every time to access the quizzes provided and also lecture notes and it makes everything easier for me. I do not have to waste money to print out every lecture notes I can just look it up on my iPhone. [S224].*

The speed of access is supported by the portability of mobile technology. Since mobile technology is typically always carried around on the person it is far more convenient to take out the phone to access content than it is to take out a laptop computer or having to pre-print out lecture slides. Students can exert less effort and therefore make learning more convenient. In particular two students in this study described how mobile technology can help eliminate the need to for pre-printing lecture notes. For example, one reported:

I already use my Smartphone for reading lecture notes during lectures, it is very handy as it is a small device but easily allows me to follow the notes whilst taking my own on pad and pen - and I avoid printing out countless amounts of paper. [S83]

These tools also offer quick access in terms of enabling users to quickly find information. Students can search through podcasts on their device to answer instant issues. Educators are able to send out messages that they know students will be able to access almost instantly; feedback can also be received just as quickly (Chan & Lee, 2005).

6.2.1.2 Convenience: Immediacy

Mobile learning enables immediate learning. Students can use this technology when and where they need it. This can take place both inside and outside the classroom, for example one student states that mobile technology "would be good [for people] who regularly take public transport to work and study part-time." This concept was further illustrated by another student who described how information could be provided when needed without having to delay answering the question.

I often use my phone when I am watching TV. I often use it to look up things that intrigue or spark my interest while watching a programme. I often use it to look up things which me and my partner disagree on. The ease of quickly looking up something is really great. [S346].

Communication and interaction are enhanced when there is little or no delay between interactions. This was illustrated by a student in this study that stated:

I do think that will help with learning as it could be more interactive, if the lecturers did podcasts as well it would be fantastic for revision, especially if you could save them for use in study later on. In the quiz mobile games for study etc was mentioned, I think this would be a really good idea as I think the majority of students find it hard to learn just by sitting and listening, if they could play a game about it or something like that I think they would retain a lot more information. I also think it will make uni a lot more accessible for those people who often can't make lectures etc because of work/family, the podcasts they could pretty much do the lectures when they had time. [S731]

This evidence of the benefit of immediacy in mobile learning builds on the study by Stone, Briggs, and Smith (2002) on the effectiveness of using two-way SMS communication to improve communication between students and educators. They found that SMS was favourably viewed by students because of the speed of the communication and its overall convenience. Kynäslahti's (2003) agrees, he argues that mobile learning enables immediate interaction. A study by Chinnery (2006), found that immediacy was important when motivating students to use mobile learning in English language learning. He asserts that when students learn a new language it was an important that they are able to access support when needed and receive immediate feedback.

Other studies have also investigated how mobile technology can support immediate learning by enabling easier communication and collaboration between students and educators (Bolliger, et al., 2010; Chan & Lee, 2005; Chan, et al., 2006; Lazzari, 2009) and provide more convenient interaction to facilitate the education process (Yuen & Yuen, 2003). However this interaction does not necessarily have to have a learning focus it could also be support focused. The following illustrates one student perception of how mobile technology could be used in education:

> *I believe that Mobile Learning would be beneficial if it were used as a source of administration information (exam dates, times, upcoming dates, reminders etc). However, to be able to receive short sharp and concise lecture information would be highly beneficial (eg: highlighted points that were in the lecture, or information regarding the key points to concentrate study on etc.) [S49].*

6.2.1.3 Convenience: Efficient use of small chunks of time

Due to the portability of mobile technology, learning can be conducted in small chunks of time. Since we are living in a time when both students and educators are time poor mobile learning allows students to maximise small units of time that would otherwise be wasted. Time poorness was investigated by Jeffrey (2009) who found that students were constantly struggling to find time for learning due to competing external pressures. This lack of time negatively impacts on students' performance. This issue was also described by one of the students in this study

> *I work full time as well as study, so it would be invaluable to be able to access study material using my mobile device to help juggle my time. Listening to podcast lectures, reviewing notes and readings and reviewing forum posts while I'm in transit*

> *to/from work, during breaks etc would assist me hugely in keeping on top of my Uni stuff. [S134].*

Students and educators felt that mobile technology could provide convenient access to learning that would enable them to better manage their time and use moments that would otherwise be wasted; boosting their productivity and time management. Many commented that they already used their mobile devices in spare moments, for example one student stated that they would read their course readings and review forum postings when in transit; another described how they used their mobile device to look up information when away from the computer. Mobile learning that is convenient to use will afford users the opportunity to more effectively utilise their time. This finding provides support for Seppälä and Alamäki (2003, p. 333) who also found that mobile technology enabled educators to use their "waiting moments to conduct educational activities". In the Seppälä and Alamäki's study, mobile technology was used by trainee teachers in short bursts when they were waiting or idle and by educators to write notes or memos and uploaded pictures to share with trainees.

Mobile learning can encourage learning as it can be easily used for short periods of time and does not require extensive set up or time for loading. This was described by one student as:

> *I believe [mobile technology] should really help in our learning, especially if it could include audio files as a support. You can take it anywhere and encourage people to learn as they have more tools they can access. [S612]*

Collectively, the three dimensions of convenience; speed of access, immediacy and efficient use of time afford students better opportunities to "dip in and out" of the learning content when wanted. In this study students and educators saw SMS messages as a particularly valuable mobile learning tool as they are short and do not seriously distract the user from other activities for long periods of time. SMS messages were considered more convenient than traditional email as mobile devices are always carried on the person. Similarly, podcasts (audio clips and video clips) were viewed favourably, providing support for Bolliger and colleagues (Bolliger, et al., 2010). These podcasts applications are not confined to a particular time or place but are portable and also enable students to rewind and re-listen to content at their convenience (Chan & Lee, 2005).

6.2.1.4 Other aspects that influence the perceived usefulness of mobile learning

In addition to positive comments regarding mobile learning, there were concerns expressed related to cost and real benefits. A number of educators expressed doubt about the role mobile learning could play in education. This was illustrated in one comment by an educator that stated, *"[I am] not sure how much benefit [mobile learning] adds over just having the material online."* [E12]. Many educators have not ruled out the potential of mobile learning but there seems to be a need to clarify the role of mobile technology in education, for example:

> *What real advance does [mobile learning] offer, and at what cost borne by whom, does [mobile learning] offer over e-learning and broadband? So all in all it is all very good having educationalists saying that these methods will enhance teaching etc but at the coalface it can just make life miserable and frustrating for the under resourced lecturer…[E77].*

These concerns represent possible barriers to the adoption process if they are not addressed. Educators need to feel comfortable that mobile technology can offer benefits without detracting from existing methods or requiring unreasonable effort. Rajasingham (2011) found substance for these feelings of caution in the early exploration of elearning. These early forays into elearning resulted in a number of failures, not due to weakness in the technology but to implementation errors made by the people and institutions (Rajasingham, 2011). Only once the benefits of elearning were demonstrated did elearning become better accepted and mainstream.

Cost was a concern mentioned by both educators and students. Excessive costs of development, equipment and services have to potential to significantly impact future adoption. Educators were concerned with the cost and time it would take to develop and implement mobile learning activities and called on their institutions to support them. For example one educator stated that *"I would need to be fully instructed in its uses for me to feel confident to use it as a teaching tool."* [E32]. Other educators felt the support from institutions should take the form of access to equipment and money to pay for mobile services. For example once educator stated that, *"[I] may need a new phone - will [my institution] pay for us to obtain updated technology?"* [E77]. Another felt that, as an educator *"We need to move with the times and get the support [from our institutions for things like] equipment and training". [E66].*

Students also were concerned about the cost of devices and services (such as data services) they would be expected to use. For example one student pointed out that "*phones that have the capacity to do these things are too expensive" [S122].* Others agree that mobile learning is a good idea but as yet, too costly, *"I think it is a great idea, the difference would be if there is a cost for this service"* [S502]. Institutions considering enhancing their services to students through mobile technology will need to consider how such costs will be managed. Passing them on directly to students may meet with resistance.

The cost of technology also been identified by others as an issue. Traxler (2003) identified it as a hindrance to adoption. He determined five different costs related to developing and deploying mobile learning systems; content development costs, teaching costs, software development costs, hardware costs and usage costs such as phone charges. Who should cover these costs continues to be debated in education but will need to be resolved before mobile learning became more mainstream (Williams, 2009).

6.2.2 Perceived ease of use

The ease of use of mobile learning relates to the amount of effort a student or educator must invest when using mobile technology to support their learning or teaching. Perceived ease of use is a subjective judgement by the users and has been defined as the extent to which a person believes that using a technology will be free of effort (Hackbarth, et al., 2003). This implies two different dimensions, including how much effort is needed to learn the technology, and how easy it is to make the technology perform the way the user wants. The concept of perceived ease of use has been generally adopted in IS research to understand individual adoption of technology and has been incorporated into a number of adoption models. For example the Innovation Diffusion Theory uses the term ease of use to explain adoption. Moore and Benbasat (1996) define ease of use as the degree to which an innovation is perceived as being difficult to use. Other adoption theories have used the concept of ease of use, but attach different labels to the construct. For example, Venkatesh et al.'s (2003) Unified Theory of Acceptance and Use of Technology (UTAUT) refers to the term effort expectancy, which they define as the degree of ease associated with the use of the system (Venkatesh, et al., 2003). The Thompson, Higgins, & Howell's (1991) Model of PC Utilisation refers to ease of use as complexity. Complexity is defined as the degree to which a system is perceived as relatively difficult to understand and use. Other research also considers ease of use to be the flexibility of the technology to achieve the users' goals (Venkatesh, 2000).

This study found that even when mobile learning was seen as useful, it also needed to be seen as easy to use to have a positive influence on behavioural intention to adopt. If content is difficult to access, search, download or excessive in length, the usefulness of the mobile activity is undermined. If educators need to spend hours trying to develop audio or video presentations it is less likely that they will consider those applications as appropriate or useful learning tools. This may explain why educators in this study expressed little interest in using fully integrated mobile applications as these can be complex to develop and use. Educators may be deterred from using some mobile functiontionality if it involves additional work or complexity. This is particularly true when there are issues of compatibility; most mobile applications are device specific therefore finding an application that works across all student devices may be difficult. In addition, the diversity of mobile types also impacts on the ability to support applications as these may work slightly differently across phone models.

The influence of perceived ease of use on adoption of technology has been well established in the literature (Gefen, et al., 2000). Generally, findings show that if the performance benefits of a technology are outweighed by the effort it takes to use the device it is less likely that the technology will be adopted (Legris, Ingham, & Collerette, 2003). Studies confirming this relationship in the context of mobile learning are limited (see for example Akour, 2009; Huang, et al., 2007; Theng, 2009) and this larger scale empirical study brings greater clarity and certainty to the debate.

One activity that did not seem to be seen as 'easy to use' in a mobile context was mobile blogging which was one of the least likely to be used mobile applications by educators. It is possible this is due to the nature of blogging which typically involves written reflections and discussions and mobile devices are ill equipped for long textual writing (Ebner, et al., 2010). Comas-Quinn, Mardomingo and Valentine (2009) argue that mobile blogging lends itself better to other types of blogging such as uploading photos and audio recordings directly to the blog via Multimedia Message System (MMS). It may be that because of the newness of mobile blogging educators are not be aware of alternative forms of mobile blogging and this limits their perception of the ease of use of this activity. Support for this interpretation is found in the work of Hegarty et al. (2009) on digital information literacy. They found that low familiarity with digital tools and applications severely limited the ability of participants to identify new or creative uses of technology for solving problems or facilitating work (Hegarty, Penman, Kelly, Jeffrey, Coburn & McDonald, 2009).

6.2.3 Conclusion

This study demonstrated that perceived ease of use and usefulness have a direct impact on behavioural intention to adopt mobile learning. Both student and educator models found that perceived usefulness had a direct influence on the intention of users to adopt mobile learning. If users saw mobile learning as useful for their learning and teaching they are more likely to adopt mobile learning. For students, the perceived ease of use of mobile technology also directly influenced future adoption. Students that perceived mobile technology as easy to use were more likely to adopt mobile learning, since they saw its adoption as not requiring excessive effort. However no such relationship could be found for educators. This may be because the role of the educators would also involve developing and managing the mobile learning and this may be more complex than simply using it.

The finding that perceived usefulness is directly related to the intention of users to adopt mobile learning has been supported in the literature, however only in terms of students. Perceived usefulness and relative advantage positively influences a students' attitude to mobile learning adoption (Carlsson, Carlsson, Hyvönen, Puhakainen, & Walden, 2006; Donaldson, 2011; Huang, et al., 2007; Theng, 2009; Wang, et al., 2009). Theng (2009) found that the perceived usefulness of mobile learning had a positive effect on the overall goal of users to use mobile devices as a learning tool. In particular, he found that students were more willing to adopt learning activities that they saw as most useful. Donaldson (2011) described mobile learning usefulness in terms of its usefulness in learning, productivity, time on learning activities, and grades. This was consistent with this study however usefulness towards achieving (grades) was not assessed. The results of this study confirm the importance of the perceived usefulness of mobile learning for student adoption.

This study provides evidence that perceived usefulness also plays an important role in educator intention to adopt mobile learning, extending the literature on the role of usefulness in technology adoption. For educators the usefulness of mobile learning was explored in terms of its usefulness in student learning, educator and student productivity and its ability to encourage self-directed learning. As shown in both student and educator adoption models, perceived usefulness had the strongest influence on adoption, a finding repeated in other studies (Donaldson, 2011; Wang, et al., 2009). The more educators' see mobile learning as being useful to their own teaching and their students' learning the more likely they are to adopt mobile learning. This is particularly important, as educators largely act as gate-keepers to the introduction of technology into learning. When educators resist technology innovation, their students are relatively constrained in their ability to incorporate innovative technology in their own learning. These findings throw new light on the role that educators play in the whole process of technology adoption in education.

In the student adoption model perceived ease of use was shown to have a direct influence on student intention to adopt mobile learning. Perceived ease of use also influenced the perceived usefulness of mobile learning. However, in the educator model only the second relationship was found, where perceived ease of use was a mediator of behavioural adoption through its influence on perceived usefulness. The finding that perceived ease of use is directly related to the behavioural intention of students to adopt mobile learning and also influences the perception of usefulness provides further support for the literature (Carlsson, et al., 2006; Theng, 2009). However, a few studies have found no direct relationship to behavioural intention. These studies found that while perceived ease of use was a mediator of this relationship in that it influenced perceived usefulness and attitudes toward mobile learning it did not directly influence students intention to adopt mobile learning (Akour, 2009; Donaldson, 2011; Huang, et al., 2007; Wang, et al., 2009). The difference between these findings may be explained by the role that mobile learning currently plays in the particular student group. Perceived ease of use has been shown to play a lesser influencing role in technology adoption when the particular technology has been well established within that particular student group (Davis, 1989; Donaldson, 2011). Therefore mobile learning may be more strongly established in some population groups than others, therefore explaining the differences in these results. This study further clarifies the role of perceived usefulness in mobile learning adoption for New Zealand tertiary students. It shows that perceived ease of use has a strong influence on adoption and is directly related to both perceived usefulness and intention to adopt mobile learning. This study determined that students who saw mobile learning as free from effort and were not anxious about using mobile technology in their learning would perceive mobile learning as useful and express an intention to adopt mobile learning.

This study also clarifies the role of perceived ease of use on the adoption of mobile learning by educators. It found that perceived ease of use played only an indirect role in the adoption of mobile learning. The influence of perceived ease of use is mediated through the educator perceptions of usefulness on adoption of mobile learning. Educators that were 1) anxious about using mobile technology in their teaching; 2) felt that it would make teaching harder, 3) that they didn't have the necessary knowledge or skills to implement mobile technology in their teaching and need extensive support were not likely to perceive mobile learning as useful. This is the first time this relationship has been established empirically. It is not completely clear why perceived ease of use plays a smaller role in educator adoption than in student adoption but it may be because educators have the more complex role of integrating mobile learning into the educational context. This involves designing, integrating and learning the mobile activities. For students adoption is relatively less complex. Even if regarded as easy to use by educators, the amount of effort required can only be justified by a high level of usefulness to both educator and student.

It is therefore clear that perceived ease of use and usefulness play an important role in determining the behavioural intention of students and educators to adopt mobile learning technology. Based on this, students and educators who see mobile learning technology as free from effort and providing benefit to their teaching and learning are more likely to adopt mobile learning. In addition, the perceived ease of use of mobile learning will influence the perception of how useful mobile technology will be for learning and teaching. Therefore users who see mobile learning technology as free from effort will more likely see it as useful.

6.3. The Impact of Self-Efficacy on Adoption of Mobile Learning

Self-efficacy is the belief of an individual that they will be successful in whatever they are doing (Bandura, 2010). This study used self-efficacy in two ways, the ICT self-efficacy of students and educators to successfully used ICT and the ICT-teaching self-efficacy of educators to successfully integrate ICT into their teaching. The first, ICT self-efficacy, concerns the way students and educators perceive their ability to use ICT in their daily lives. Two aspects of self-efficacy were measured, the first was the level of experience users have with a range of ICT tasks. The second measured the level of anxiety users have when using ICT. ICT-teaching self-efficacy assessed the ability of educators to integrate ICT into their teaching and the educators' belief about its relative benefit to the learning process.

These two versions of self-efficacy were thought to play different roles in the adoption of mobile learning. The following section first discusses the role of ICT self-efficacy in the adoption of mobile learning (Section 7.3.1) for both students and educators and the second section deals with ICT-teaching self-efficacy and its effect on the adoption of mobile learning by educators (Section 7.3.2).

6.3.1 ICT Self-efficacy and the adoption of mobile learning

ICT self-efficacy plays a significant role on the attitudes of students and educators to the perceived ease of use and usefulness of mobile learning and their intention to adopt it (see Figures 36 and 37). ICT self-efficacy mediates the relationships between perceived ease of use, usefulness and behavioural intention.

ICT self-efficacy is a subset of self-efficacy and has been described as an individual's judgment of their capability to use ICT (Cázares, 2010). According to Igbaria and Iivari, (1995) an individual's ICT self-efficacy has been shown to have a positive effect on the individuals' attitude, use and adoption of technology (Albion, 2001; Lambert & Gong, 2009; Liaw, 2008). An individual's ICT self-efficacy is expected therefore to have an impact on the user's attitude towards and use of ICT in the classroom. ICT self-efficacy has been shown to be influenced by the level of anxiety that users feel when using ICT (Beckers, et al., 2007).Therefore, the level of ICT anxiety had a negative relationship with ease of use and perceived ease of use. Support was found for the following hypotheses:

Students and educators with:

- *high levels of past experience with mobile technology are more likely to see mobile learning as easy to use and useful*
- *high levels of anxiety are less likely to see mobile learning as easy use*
- *higher levels of skill in one area will be more likely to be proficient in other areas*
- *advanced skills in ICT are less to feel anxious about using ICT*

Students with:

- *high general ICT competency will more likely to adopt mobile learning*
- *high levels of anxiety will influence the perceived usefulness of mobile learning*

Educators with:

- *high general ICT competency are more likely to see mobile learning as easy to use*
- *high levels of perceived computer control will not see mobile learning as useful*

An individual's ICT self-efficacy has been shown in this study to have a positive effect on the individual's attitude, use and adoption of technology, a finding that supports Igbaria and Iivari (1995). It also accords with other research suggesting that perceived efficacy for using computers leads to a higher likelihood of using them for both students and educators (Albion, 2001; Lambert & Gong, 2009; Liaw, 2008). The following section discusses these findings in detail in three sections: Self-efficacy related to prior experience, ICT anxiety and perception of control.

6.3.1.1 ICT skill self-efficacy and its effect on mobile learning adoption

One element seen to determine self-efficacy is a users past computer experience and skill (Hasan, 2003; Hasan & Ahmed, 2010; Potosky, 2002). A user that has an extensive background with ICT tasks will have a higher self-efficacy belief and therefore believe they have a greater level of ICT ability. In this study ICT skill was divided into three types, general ICT skill, advanced ICT skill and specific mobile skill. General ICT skill assessed the competency of users in relation to general computing tasks, such as using word processing software, searching and emailing on the Internet and doing basic mobile activities, such as texting and calling. Advanced ICT skill assessed the competency of users in relation to more advanced computing, such as modifying images and sounds and using advanced software (such as Skype). Specific mobile skill related to using mobile technology for more complex mobile learning activities, such as accessing the Internet, emailing and sending photos.

The relationships found in the student adoption model of this study suggest that general ICT skill and experience with mobile technology (specific-mobile learning self-efficacy) influenced the intention of students to adopt mobile learning. In the educator model, general ICT skill also directly influenced adoption. However, unlike the student model, the specific mobile skill of educators influenced the perception of ease of use of mobile technology but was not directly related to behavioural intention. No relationship was found between the advanced use of ICT and the adoption of mobile learning. The finding that advanced ICT skill did not play a significant role on the perception of how easy to use mobile technology was, nor on the perception of usefulness is interesting and new. Previous research does not seem to have investigated the relationship of specific areas of ability and adoption. These findings suggest that general ICT experience plays a more influential role in adoption than more specific or more advanced ability. This may mean that more advanced experience of ICT does not necessarily increase the perception of usefulness, ease of use or the intention to adopt. Future research is necessary to determine whether this link exists in other contexts and what the mechanism is that explains it.

In addition to the findings discussed above, both models indicate that becoming skilled in one area promotes the development of skill in others areas. Highly skilled general ICT users are more likely to be highly skilled mobile technology users and highly skilled mobile technology users and general ICT users are more likely to be highly skilled in advanced ICT. As Shih et al (2006) explained, the layering of skills show that confidence and favourable experiences in ICT will build on each other, such that users are more likely to learn new skills as they get more competent with their existing skills (Shih, Muñoz, & Sánchez, 2006). This indicates the importance of taking into account the overall ICT skill of students and educators rather than focusing on mobile technology alone when introducing mobile technology to students and educators. When preparing students and educators for mobile learning, a wider focus is needed on how ICT is supported and introduced. Educators need to be aware that an existing level of ICT skill is recommended before students are introduced to mobile learning. Since many of the activities carried out on a mobile device are also undertaken on a computer, it may be beneficial to learn how to effectively carry out them on computer before progressing to a mobile environment. Activities such as email and surfing the Internet are both possible using a computer and a mobile device. If a user is familiar and comfortable with carrying out these tasks on a computer it may be less daunting to carry out these tasks on a smaller device such as mobile phone.

6.3.1.1.1 General ICT skill

This study for the first time is able to demonstrate the influence of general ICT skill on mobile learning adoption, a relationship that has not previously been found in the literature. For example, a study by Lu and Viehland (2008), found no support for the notion that past e-learning experience influenced mobile learning adoption. However, in the general computer literature there is evidence that students, who are competent computer users, are more likely to perceive new technology positively and are more ready to adopt new technology (Shih, et al., 2006). The same relationship between general skill and adoption of new technology has also been found for educators. For example, in an early study by Cox, Preston and Cox (1999) teachers who were already regular users of ICT were more likely to have higher levels of confidence in using ICT in their teaching and were more likely to extend their use of ICT further in the future. This finding has been supported in other studies, such as in Mueller, et al. (2008) who found that educators with direct experience of ICT were more confident using a wider range of technology. The finding in this study provides support for the notion that general ICT skill has an important role in the future adoption of mobile learning.

Students that were confident, comfortable and skilled general users of ICT were more likely to intend to adopt mobile learning in this study. Using self-efficacy theory Moersch (1995, p. 41) provides an explanation for this finding: “individuals with a low level of self efficacy will often choose a level of innovation that they believe they can handle, which may or may not be the best or most effective option. Conversely, those individuals with high levels of self-efficacy are most inclined to accept change and choose the best option”. Therefore students with higher levels of general ICT self-efficacy felt more confident about exploring new ways of interacting and these may be more effective for their needs. Thus students who were confident with using computers were more willing to explore better ways support their learning, increasing the probability that they would be able to make mobile technology work to better advantage than their less confident counterparts. Their experiences with other technologies better equipped them to determine the benefits and costs of mobile learning (Saadé & Kira, 2007).

In the educator model, educators who were competent general ICT users reported feeling more at ease with mobile technology. This higher level of skill influenced their perceptions of new technology (Paraskeva, et al., 2008). Highly skilled general users of ICT were less likely to find the introduction of new technology daunting and requiring considerable effort (Chai, Ling Koh, Tsai, & Lee Wee Tan, 2011). Prior experience with ICT in everyday lives of the educator will also have a flow on effect into whether they use ICT in their teaching (Chen, 2010b). A wide range of research has shown that the competency of educators to use ICT is a strong determinant of the level of technology use in teaching (Bauer & Kenton, 2005; Chen, 2010b; Franklin, 2007). Teo (2009b) recommends that educators should be given access to a wide variety of technology because a wide experience with ICT will enable them to more effectively build their knowledge on how to integrate technology into their teaching. This study suggests that this experience does not necessary need to be at an advanced level but may be suitable at more general level since it is exposure to a range of technology that is the driver.

6.3.1.1.2 Mobile Self-efficacy

Both adoption models indicate that high usage and experience with mobile technology increases the perception of ease of use and usefulness of mobile learning. Previous research has shown that past experience with a specific technology is a key determinant of the future adoption of technology (Ajzen & Fishbein, 1980; Kidwell & Jewell, 2008; Saadé & Kira, 2009). In particular, research has shown that hands-on experience has a significant impact on the perceived ease of use of a system (Venkatesh & Davis, 1996). A user that has used mobile technology will have a different opinion of the ease of use of mobile learning once they have actually used that technology. Prior experience with mobile technology influences how easy to use mobile learning technology is perceived to be.

Previous experience with mobile technology specifically, also enables users to evaluate more accurately how valuable mobile learning will be in supporting their learning and teaching. Familiarity with a specific technology will help support the extension and experimentation of other forms of technology. Therefore as the user become more skilled in using mobile technology they will be more likely to explore new mobile uses. A person that seldom uses mobile technology or has a low level of skill with the technology is less likely to experiment or deviate from existing use and therefore less likely to see mobile learning as easy to use. Compared with unskilled and tentative users, confident users would be more likely to expand the use of the device and learn new tricks and ways to increase the efficiency of the device. This has been highlighted by Lefoe, Olney, Wright, and Herrington (2009) who found that educators who became more familiar with their mobile devices developed a better understanding of how mobile learning activities could be developed and incorporated, and in particular the affordances which mobile technology offered education.

The link between mobile self-efficacy and prior experience to ease of use and perception of usefulness has been referred to in a number of studies (Akour, 2009; Theng, 2009). Overall, experienced users of mobile technology are more likely to extend the use of mobile from work and social environment into the educational environment. Users that use their mobile phones for social and work reasons such as making calls, sending messages, surfing Facebook or sending email are already comfortable with using mobile technology. Therefore the leap from doing these activities that support their social and work lives to supporting their academic learning becomes more reasonable. These users are not only familiar and therefore comfortable with these general tasks but they are also likely to see how new tasks could be added to their existing abilities which could be used to support their teaching and learning.

The relationship between previous use and perception of ease of use has been found to be significant in a number of studies related to computer use and adoption (Padilla-Meléndez, et al., 2008; Shih, et al., 2006). However, the influence of mobile technology experience on mobile learning adoption has seldom been addressed. Studies relating to mobile technology usage have typically focused on experience with other similar non-mobile similar items, for example in mobile banking they have often compared experience with e-banking (Kleijnen, Wetzels, & De Ruyter, 2004). They typically compare the mobile version with the existing web based usage and draw a parallel with existing experience in the web based version as influencing the perception of ease of use in the mobile version. In this study, participants had no experience of mobile learning; however they did have experience using mobile technology.

6.3.1.1.3 Conclusions

Overall, the study found evidence that ICT skills were associated with higher perceptions of mobile technology as being easy to use and useful. This relationship was found in students who were highly skilled mobile technology users and felt mobile learning to be beneficial to their learning and free from effort. Educators who were highly skilled in general computing activities also saw mobile learning as being free from effort.

6.3.1.2 ICT Anxiety as a determinant of mobile learning adoption

Student and educator anxiety were found to have a strong negative impact on the perception of ease of use for mobile learning and, in the case of the students, perceived usefulness. Students that feel uncomfortable and avoid using ICT will not see mobile learning as easy to use and useful. For educator ICT anxiety, evidence was found that it negatively impacted the perceived ease of use of mobile learning.

ICT anxiety is an emotional response resulting from the fear that use of ICT may result in a negative outcome, such as damaging the equipment or looking foolish (Barbeite & Weiss, 2004). Little previous research has specifically investigated the effect that ICT anxiety has on mobile learning, however, the effect ICT anxiety has on an individual's adoption and use of technology in education has been identified in a number of studies (Barbeite & Weiss, 2004; Beckers & Schmidt, 2003; Rahimi & Yadollahi, 2011; Wang, 2007). Other studies have shown that anxiety about computer use will negatively influence an individual's use and adoption of ICT in their teaching and learning (Phelps & Ellis, 2002; Teo, 2011; Wilfong, 2006). For educators, ICT anxiety influenced the perceived ease of use of mobile learning. Phelps and Ellis (2002) found that educators who perceived their technological competence to be low often felt threatened and overwhelmed when using ICT in the classroom, a finding confirmed later by Jeffrey et al, (2011). Therefore anxiety will make the adoption of new technology seem harder and may ultimately result in educators avoiding the introduction of new technology into their teaching. This study therefore confirms the role of ICT anxiety on mobile learning adoption, a finding not been previously discussed in the literature.

ICT anxiety, as seen in both student and educator adoption models, decreases as the level of experience or skill with computer and mobile technology rises. As found in other research, as a user becomes more experienced with computers they are more likely to form a positive attitude to them (Shih, et al., 2006). As individuals become more confident and familiar with technology they are more likely to feel less anxious and more confident with its use. Anxiety typically arises from the fear of the unknown and the confidence to cope with changes (Beckers, Rikers, & Schmidt, 2006). When individuals become more secure and positive about their technology usage, they are more likely to relax and not feel as anxious about its use (Beckers & Schmidt, 2003; Cowan & Jack, 2011). This will be because they have developed an assurance that they can cope with learning new technology and solve any issues that may arise.

6.3.1.2.1 Conclusions

This study confirmed that anxiety and users' experience, which had been found to influence adoption in other more general computer context, were also important factors in the adoption of mobile learning adoption. Users that were skilled at using ICT were more likely adopt mobile learning. In addition users with high ICT anxiety are less likely to adopt mobile learning. The study also supports the notion that building user experience with ICT will reduce the anxiety of students and educators.

6.3.2 ICT-teaching self-efficacy use as a determinant of mobile learning adoption

The constant introduction of new educational technology to support learning and teaching provides numerous opportunities for teachers to provide stimulating and effective learning. Those teachers who fail to see the value in technology, and resist its introduction, are less likely to seek out new technology, and integrate it into their teaching (Duncan-Howell & Lee, 2007).

Teaching self-efficacy is the belief by the educator that they are able to teach their students. According to Gibbs (2003, p. 3), educators who exhibit high levels of teaching self-efficacy tend to "persist in failure situations, take more risks with the curriculum, use new teaching approaches, make better gains in students' achievement and have more motivated students". When this form of self efficacy is extended to the context of integrating ICT into teaching it describes teachers who view technology as an effective way to enable student learning. Research has shown that positive educator beliefs about technology are an important and measurable factor in the level of integration of technology into their teaching (Zhao & Cziko, 2011). In this study ICT-teaching self-efficacy had a major impact on educator perception of mobile learning. In particular, support was found for the hypothesis:

- *educators who have higher levels of ICT-teaching self-efficacy will see mobile learning as easy to use and useful*

Two factors were found to determine the ICT-teaching self-efficacy of educators, the first was their ability to use ICT in the classroom effectively and the second was their belief that ICT added some benefit to student learning. The results of this study found that the ability of educators to use ICT generally in their teaching impacted on their perception of how easy mobile learning would be to integrate into their teaching. Competent users of ICT in teaching were more likely to see integrating mobile learning as relatively effort free. Additionally, educators with a strong belief in the benefits of ICT perceived mobile learning as useful.

General ICT self-efficacy discussed earlier is distinct from self-efficacy about one's ability to integrate ICT in teaching. As highlighted by Ertmer & Ottenbreit-Leftwich, (2010) there is a difference between an educator knowing how to use technology generally and using it effectively in the classroom. Personal and instructional uses of ICT are very different and educators need to be confident in the pedagogical practices of integrating technology into the classroom. Educators who are confident in their ability to integrate and manage technology in their teaching are more willing to incorporate a range of technologies into their teaching (Hew & Brush, 2007). Educator confidence about integrating technology into their teaching strongly impacts their perception of how manageable mobile learning will be. On the other hand, educators who have higher levels of anxiety about integrating technology in their teaching are more likely to avoid using ICT in the class and will typically undervalue its benefits.

A positive attitude to ICT by educators was a major player in the adoption processes. Educators who saw ICT as providing a positive benefit to student learning were very likely to integrate ICT into their teaching. By comparison, the ICT self-efficacy ability of educators has only a minor influence on mobile learning adoption compared to the influence of educator ICT-teaching self-efficacy ability and anxiety about using ICT. This finding offers some support for that of Drent and Meelissen (2008), who found that low ICT competence is often described as an obstacle for the integration of ICT into education. However the findings of this study suggest only a small indirect effect on the actual integration of ICT by educators since a number of other influences seem to play a larger role in determining integration. Drent and Meelissen (2008) surmised that the attitude and the goals of educators played a more important role in their use of technology than their ICT competence.

Educator beliefs about whether ICT brings any significant advantage or benefit to the education environment will play a significant role in adoption of mobile learning. While the relationship between a positive perception of ease of use and usefulness to ICT and the adoption of technology into teaching has been discussed extensively in a large number of studies (Albirini, 2006; Baek, et al., 2008; Caspi & Gorsky, 2005; Gibbs, 2003; Mahdizadeh, et al., 2008), its relationship to mobile learning adoption has not been widely explored. This study therefore provides new insight into the role of ICT teaching self-efficacy and mobile learning adoption.

Recognition of the advantages that ICT, and in particular mobile learning, for educators and students alike is a key factor in the adoption of mobile learning. Research has shown that the quality of learning can be enhanced when ICT is adopted as an intellectual 'multi-tool' that is adaptable to learners' needs (Leach, Moon, & Power, 2002). For example, ICT has been identified as a way to enhance students' critical thinking and information handling skills, and to help them to develop higher levels of conceptualisation and problem solving (Ruiz-Primo, 2009). Mobile learning, in particular, offers a unique learning experience that enhances existing learning practices (Naismith, et al., 2005). The portability of mobile technology enables learning the can surpass traditional learning tools, making learning therefore truly possible anywhere and anytime.

Educators, who possess a positive attitude towards ICT use in education, will tend to be more focused on how they can use computers and other tools in teaching and have more efficient strategies for using technology (Teo, et al., 2008). Having efficient strategies on how to use technology will build confidence when using technology and thus increase the likelihood of success when implementing ICT (Shapka & Ferrari, 2003). The enthusiasm of educators should flow on to students give them greater confidence when using ICT.

In the educational environment it is educators who will be more likely to introduce mobile learning into the classroom, since educators are typically the catalysts for change (Metz, 2009). A student may be able to independently adopt mobile technology in their learning, at least in an informal way, but it is likely to be limited, However, educators, because of the greater complexity of their role in integrating technology in learning, as opposed to simply using it, need time to properly explore and develop learning activities. This time factor was highlighted in this study by a number of educators, for example:

> *It's like any new teaching and learning opportunity - takes a while to get your head around, but once you recognise the benefits and learn the capabilities of the technology it becomes integrated into aspects of your practice. For me one problem would be having the time to learn about the technology and to plan how I might utilise it to benefit learners [E134].*

The study also found that educators felt they needed support in terms of training and time to enable them to explore new technology:

> *The major problems with technology and its use in education are: 1. Institutions do not provide enough time and resources to enable its efficient use by staff. There is woeful back-up and generally while training courses are made available management has not yet found how to increase the hours in the day from 24 to 36 - or are not prepared under present financial circumstances to reduce workloads while new technology is embraced [E83].*

As described by Lim and Khine (2006) support is a vital part of introducing any new technology into education. Duncan-Howell & Lee (2007) argued that “teachers need access to more training, more information and more opportunities to see and use new technologies for themselves” (p.229). The role of time and support is just as vital to mobile learning adoption as it is for general ICT adoption.

The requirement for educator support has been discussed at length in the literature (Butler & Sellbom, 2002). Venkatesh, et al. (2003) in their Unified Theory of Acceptance and Use of Technology (UTAUT) model incorporated institutional support as a factor in the adoption of technology. In the UTAUT, support is described as providing users with relevant resources and knowledge, and making assistance readily available (Donaldson, 2011). Studies have shown that the provision of resources, training and relevant information to users will positively affect user's adoption of information technology (Venkatesh, et al., 2003). Support has also been shown to influence student adoption of mobile learning (Akour, 2009; Donaldson, 2011; Naismith, et al., 2005). However, this is the first study that found the role of support to be important in the adoption of mobile learning by educators. Support is necessary for the adoption of mobile learning by educators and in particular, times to learn how to use new technology and also to learn how to incorporate it into their teaching.

6.4 Motivational Orientation as a Determinant of Mobile Learning Adoption

Previous research has shown that mobile learning can help develop interest or enable new ways to teach that are unique and exciting (Bae, et al., 2005; Chmiliar, 2010, Goh & Hooper, 2007). As described in Jones, Issroff, Scanlon, Clough and Mcandrew (2006), mobile learning was found to enhance student motivation by; allowing students to have control over their own goals; enabling students to develop a sense of ownership and control over their learning; offering students the opportunity to develop collaborative activities whereby enhancing motivation though working with others; by enabling fun and interactive learning; and by enabling learning to happen in context. Overall, learning activities that develop and encourage student interest are highly desirable and this is something that mobile technology can offer students.

Mobile learning can help encourage or facilitate the motivation to learn (Jones & Issroffa, 2007; Rau, Gao, & Wu, 2008; Ruchter, et al., 2010; Shih, 2008). However, the adoption models suggest that the motivation of users plays only a minor role in the adoption of mobile learning. The student adoption model linked extrinsic orientation to the adoption of mobile learning. Extrinsically motivated learners may be motivated by the fun or novelty of the device or may feel that mobile learning is not really like learning. Alternatively, they may consider mobiles to have a utilitarian function to make learning more efficient and therefore requiring less effort. No relationship was found between motivation and mobile learning adoption in the educator model. Support was found for the following hypothesis:

- *Students that are extrinsically motivated will see mobile learning as useful*

6.4.1 Student findings related to motivational orientation

This study found no relationship between intrinsic motivation and mobile learning adoption. These results are echoed in Rau, Gao, and Wu (2008) who found that extrinsic motivation, but not intrinsic motivation, had an effect on learner adoption of mobile learning. They started from the assumption that intrinsically motivated students were influenced by perceived enjoyment and pleasure whereas extrinsically motivated students are more likely to be motivated by achieving or receiving a desired outcome. In the case of mobile learning, students were motivated by the novelty of using the mobile phone itself to perform and learn. For extrinsically motivated learners the addition of a tool was seen as a motivating factor whereas intrinsically motivated learners were already motivated and did not need additional external stimulus. The mobile device was the focus and therefore the motivating factor for the extrinsically motivated student, not the learning itself as would be the case for intrinsically motivated learners.

An example of how mobile learning can stimulate motivation is found in Rau, Gao, and Wu's (2008). They argued that mobile learning can be used as a way to develop student – educator relationships and thus through this communication stimulate student motivation. The study identified the use of SMS (Short Message Service) messages between educators and students as a way to motivate and stimulate students learning. The results of this study found that SMS communication was seen as a non-threatening way to communicate with students which enabled educators to motivate learners and even promote higher exam performance. SMS communication had been widely adopted by younger students and these students were very comfortable with receiving SMS messages. Younger students perceived SMS as a convenient way to communicate and were very comfortable when using SMS to communicate with others. Kitsantas and Chow (2007) explored the idea of using short messages from students to educators to help reduce students feeling embarrassed when seeking help in learning. They investigated how short messages negated the need for students to describe in embarrassing detail their problem.

6.4.2 Educator findings related to motivational orientation

Research has shown that motivation may play a role in the adoption and use of computer technology by educators (Albirini, 2006; Sang, et al., 2010; Sørebø, et al., 2009). Mueller, et al (2008) analysed how elementary teachers who integrated computer technology into their teaching typically had higher levels of work related intrinsic motivation. Mueller, et al (2008) described teachers who integrated technology into their teaching as more intrinsically motivated than their low integration counterparts due to the challenge that integrating technology into the teaching environment presents. Mueller, et al (2008) theorised that integrating technology into the classroom requires a higher level of effort on the part of the educator and that this effort provided few rewards outside the intrinsic satisfaction of meeting the challenge. This finding has also been supported by a number of other researchers (Becker, 1994; Becker & Ravitz, 1999) who stated that educators who are intrinsically motivated are more likely to take the initiative and challenge of computer supported instruction. They stressed that training and support may not address this lack of enthusiasm unless the interaction with technology was less of a challenge. This study was unable to confirm a relationship between educator motivation and the perception or adoption of mobile learning.

6.4.3 Conclusions

The results of this study found that motivation played a relatively small role in the student adoption of mobile learning. Students who are extrinsically motivated were more likely to see mobile learning as beneficial to their learning because of factors related to the use of mobile technology, such as the fun and novelty factor of mobile technology. For these students, the use of mobile technology shifts the focus away from the learning itself (which would typically motivate intrinsic learners) but may provide a fun way for extrinsic learners to learn. On the other hand, no relationship was found between educators' work related motivation and their adoption of mobile learning.

6.5 The Impact of Self-Directedness and Adoption of Mobile Learning

Self-directedness implies that a learner takes responsibility for their own learning and is able to learn without continuous reliance on others (Brookfield, 2009). Self-directed learners are able to plan, carry out and evaluate their own learning (Deepwella & Malikb, 2008). Tertiary students are expected to have some level of self-directness to be successful in their studies.

Technology can facilitate the ability of students to access a wide range of tools and resources that they can use to extend and support their self-directed learning (Long, 2003). Self-directedness has been found to be strong predictor of academic success in online environments (Deepwella & Malikb, 2008; Song & Hill, 2007). Elearning environments require a certain level of self- directedness and the nature of mobile learning would be expected to require at least the same level, and maybe more since it enables learning outside the traditional learning environment.

Wang et al., (2009) found that learners were more likely to adopt mobile learning if they had a high level of self-directedness. However, while Donaldson (2011) found no such relationship, he conceded that this may have been due to the limited way self-directedness was characterised in his study. Self-directedness was operationalised in terms of self-management. To avoid this problem this study defined self-directedness as comprising three related dimensions, namely the desire for learning, the need for self-management and for self-control (over learning) as recommended by Fisher, King, and Tague (2001; Fisher & King, 2010). These three dimensions were examined for their role in the adoption of mobile learning.

It was found that self-directedness does play a major role in the adoption of mobile learning. Two of the dimensions of self-directedness, students' desire for learning and ability for self-management, had a direct impact on student adoption. On the other hand, need for control over their learning was not directly related to an intention to adopt, but it was related to the perceived usefulness of mobile learning. Similarly, students that had a desire to learn were also more likely to perceive mobile learning as useful. Support was found for the following hypotheses:

- *Students with a strong need for self-management will more likely to adopt mobile learning*
- *Students with a strong level of self-control will see mobile learning as useful*
- *Students who have a strong desire for learning will see mobile learning and are more likely adopt mobile learning in the future*

Student comments also supported the importance of the role of self-directedness in the adoption of mobile learning. A number of students were already using mobile technology to support their learning without direction from educators, with some students eager to extend their use of mobile technology to support their learning. For example one student stated that they could not wait to access learning on their iPad and iPhone, but also wished they could have a custom built application that would allow them to use their Learning Management System (LMS) more effectively. Another student wrote about how they already have tried to get connected to her own LMS and how it would benefit the learning if she was given access:

> *[Mobile learning is an] excellent idea. Coincidentally I sent an e-mail a few days asking about how [I] could I have access to stream with my PDA/phone, as I tried and it doesn't work. Unfortunately, I didn't receive an adequate answer, I believe I was misunderstood. I work full time in rural areas, and to be able to access stream on my phone would be wonderful and very convenient. I do carry with me (PDA SD card) the readings and study guide etc, but that is just not enough [S56].*

A small number of studies have examined the link between the self-management dimension of self-directedness and mobile learning adoption. Wang, Wu and Wang (2009) established that an individual who is highly autonomous would be more likely to use mobile learning than an individual who was less autonomous. However, later studies by Lowenthal (2010) and Donaldson (2011) found no relationship between self-management and behavioural intention to adopt mobile learning. Lowenthal's work, although based on Wang, Wu and Wang's (2009), used a relatively small sample (n=113) compared to Wang, Wu and Wang's (2009) study (n=330) and conducted the study in a different country (US rather than Taiwan). Lowenthal (2010) provided no explanation for his findings. Donaldson (2011) argued that operationalising self-directedness as the single dimension of self-management was the cause of the no finding in Lowenthal's (2010) study.

There have not been any empirical studies assessing the direct effects of self-control on the adoption of mobile learning. Self-control relates to the need of the student to have control over their learning. Students that have a need for self-control but feel that they have no control over the learning process are more likely to disengage (Regan, 2005). These learners are more likely to feel in control when they can be involved in determining their learning goals and activities (Ponton & Carr, 2000). A number of studies have asserted that mobile learning enables students to take greater control over their own learning. For example Ryu, Cui, and Parsons (2010) explained that mobile learning supports learner collaboration and through this, students are able to expand and develop their own learning. They claimed that mobile learning can encouraged playful, exploratory behaviours that enable learners to experience a feeling of control over the whole learning activity. The result was that they were motivated to work on tasks for longer and be less distracted. Further to this, Zeng and

Luyegu (2011) argued that user mobility made students more likely seek out (pulled) their own learning rather than learning necessarily being pushed onto the learner. They concluded that the ability of the learners to control their own learning processes and outcomes were important factors in their use of mobile technology. However, neither of these, nor other studies have tested these claims. This study provides early empirical evidence of the relationship between self-control and the perceived usefulness of mobile learning and showed that higher self-control will positively influence the perception of usefulness of mobile learning. Students who feel that they wish to control their own learning will see mobile learning as a good opportunity to do this; the mobility enables students to dictate when and where the learning takes place and what learning will be covered.

As explored by Hedman and Gimpel (2010), an individual's desire to learn and explore new things will often drive adoption of new technology. Mobile devices in particular offer a novelty value that stimulates an interest and curiosity to learn about the new technology. In this study, desire for learning had a strong influence on mobile learning adoption. Students with a strong desire for learning saw mobile learning as useful and indicated a strong intention to adopt mobile learning. Desire for learning as characterised by Fisher et al. (2001) has not be investigated before in terms of adoption of mobile learning. These findings provide strong evidence that students desire to learn will drive adoption of mobile learning.

6.5.1 Conclusion

This study brings clarity to the conflicting findings from studies on self-directedness. This study defined self-directness according to three dimensions and found that these were related to intention to adopt mobile learning. Students that preferred to self-manage their own learning generally intended to adopt mobile learning. Mobile learning personalises applications to the user. When mobile learning activities are perceived as giving students greater control over their own learning, mobile learning is seen as being useful. Finally, students with a strong desire for learning perceived mobile learning as useful and indicated intention to it.

6.6 The Influence of Gender, Age and Institution Attendance on Students' Perception

Three demographic factors; gender, age and institution attendance were found to have a small influence on student perception, and adoption of, mobile learning. These findings are discussed below.

6.6.1 Gender

The influence of gender on the adoption of technology has interested researchers since computers became a common feature in the workplace (Ong & Lai, 2006). This interest was extended into the academic environment and many studies have found significant differences between male and female adoption of technology (Imhof, et al., 2007)

Studies examining gender differences and technology have produced mixed results. For example, females have been found to be more positive about podcasting in some studies (Bolliger, et al., 2010; Wehrwein, Lujan, & DiCarlo, 2007), but no significant differences were able to be established in others (Kraetzig & Arbuthnott, 2006). Studies into mobile learning have found similar conflicting results. For example, Arning & Ziefle (2007) found that gender had only a weak effect on factors that influence adoption. They argued that gender had a small effect on technical confidence and the perceived usefulness of mobile technology. In particular they found that young male users showed a higher level of technical confidence compared to young female users, and young male adults showed a more positive attitude to perceived usefulness of mobile learning than older male adults. The opposite was shown for female participants, where older females were more positive about the usefulness of mobile learning than younger females. Other studies have found no significant gender difference in perception and adoption of mobile learning (Akour, 2009; Donaldson, 2011; Wang, et al., 2009).

Support was found in this study for the notion that males and females differed on factors that influence mobile learning adoption. When comparing adoption between males and females the study showed that the factors investigated in this study had better explanatory value of male adoption than their female counterparts. This finding suggests that there may be other factors, not used in this study, which would further explain females' adoption of mobile learning. Other studies into student adoption of mobile learning have shown that factors such as the social interaction aspect of mobile learning positively influenced female's adoption more than male adoption of mobile learning (Wang, et al., 2009).

In this study the ICT skills of males had a greater positive effect on perceived ease of use of mobile learning than for females. Therefore males with a strong ICT skill were more likely to perceive mobile learning positively. This finding extends Arning & Ziefle's (2007) study that found that males felt a higher level of confidence with using technology. This study provides support for the notion that that prior experience by males and confidence play an important role in the adoption of mobile learning.

For females, self-directedness had a stronger impact on the perception of usefulness of mobile learning than it did for males. The literature on this issue lacks clarity with a number of conflicting results (Akour, 2009; Chen, Wang, & Lin, 2006; Wang, et al., 2009). The findings of this study contribute to this debate and provide support for the argument that the level of self-directedness a female has positively influences their perceived usefulness of mobile learning. This confirms Wang, et al.'s (2009) finding that self-management of learning was found to be a stronger determinant of intention for females than for males.

One final gender difference was found in motivation. Extrinsic motivation in males had a more significant positive impact on the perceived usefulness of mobile learning than for females. This finding provides support for the work of Nysveen, Pedersen, & Thorbjørnsen (2005) who found that male adoption of mobile learning was more likely to be influenced by external motivation than it was with females.

6.6.2 Age

The role of a user's age on their adoption of technology has been investigated by a number of researchers (Arning & Ziefle, 2007; Saadé & Kira, 2007; Zajicek & Hall, 2000). For example Zajicek & Hall (2000) showed that older users typically perceived technology as less useful and less easy to use because of the time they predict that it would take them to learn and use technology. This study tested this finding in the context of mobile learning adoption and found support for the limited research that suggests age negatively influences the rate of adoption of mobile learning.

Age influences perception and adoption of mobile learning through general ICT skill, desire for learning, level of self-management and perception of usefulness. General ICT skill played a moderate role in older students' adoption of mobile learning but not in that of younger students'. In addition, the level of desire to learn and self-management of users had a positively influence on older student perception of how useful mobile learning would be. Finally perceived usefulness and self-control played a more important role in mature students' adoption than for younger students.

These findings bring greater clarity to the literature on the relationship between age and mobile learning. Younger students have been found to have a stronger positive perception of the ease of use of mobile learning that positively influenced their intention to adopt mobile learning (Arning & Ziefle, 2007; Wang, et al., 2009). Wang, et al., (2009) found that for older users effort expectancy (perception of ease of use) influenced their intention to adopt mobile learning. This was not the case for younger students. They explained this finding as resulting from younger users having a relatively higher computer self-efficacy and this self-efficacy influencing the perception of how much effort mobile learning may be to adopt. Therefore younger users felt that adoption of mobile learning required little effort and was therefore not a factor in their adoption.

This study found that perceived usefulness by older students had a greater influence on their adoption of mobile learning than for younger students, a finding supported by other (Arning & Ziefle, 2007). This finding indicates that younger users find mobile learning more useful. This may be because younger students are more comfortable with mobile technology and are more likely to adopt mobile technology into their daily lives (Watten, Kleiven, Fostervold, Fauske, & Volden, 2008).

By contrast, Donaldson (2011) found that age did not play a role in student adoption of mobile learning nor did he find that self-directedness had a differential influence on adoption between age groups. The findings in this study however provide evidence that all three factors of self-directedness had some level of influence on adoption based on age. Self-management was important to older user's perception of usefulness. This may be because older users tend to be more self-directed and thus wish to be able to manage their own learning. For younger students self-control had a strong relationship to usefulness not apparent in older students. The latter finding showed that desire for learning had a stronger effect on perceived usefulness for older students. This may be that since older students are typically more driven to achieve they may perceive mobile learning as a way to study more effectively or at least offering some benefit over alternative methods (Murphy & Roopchand, 2003).

6.6.3 Institution attendance

One of the differences between universities and polytechnics in New Zealand is their focus; polytechnics focus more on applied professional and vocational qualifications compared to universities, which are more theoretically underpinned. Polytechnics also place less reliance on traditional lectures where classes tend to be larger than in universities (Smyth, Hyatt, Nair, & Smart, 2009). In many polytechnic degrees, there is a greater use of practical work – via internships, placements in industry or other forms of cooperative education (Smyth, et al., 2009). Because of these differences, it is possible that students who attend these institutions will differ in terms of the factors that influence their adoption of mobile learning.

The final comparison considered in this study was to test whether the attendance at either a university or polytechnic would influence the likelihood of adopting of mobile learning and which different factors impacted on adoption. The findings showed that there was a significant difference between polytechnics and universities and their adoption of mobile learning in relation to their mobile and general skill, and their desire for learning. The findings indicated that the level of mobile ability a student has influenced polytechnic student perception of ease of use but not that of university students. This may because university students had higher end devices and their familiarity with these mobile tools diminished the importance of ease of use to them. The study also found that polytechnic students' general ICT self-efficacy played a direct role in their adoption of mobile learning. Polytechnic students with high ICT self-efficacy were more likely to adopt mobile learning but no such relationship was found for university students. Finally, the study found that for university students a strong desire for learning influenced their perception of usefulness of mobile learning, a result not seen in the polytechnic group.

This study suggests that polytechnic and university students differ in terms of the factors that influence their adoption of mobile learning and these differences imply that different approaches are needed to for adoption of mobile learning.

CHAPTER 7: RECOMMENDATIONS AND CONCLUSION

The overarching goal of this study was to contribute to the limited understanding of mobile learning adoption in tertiary education and create a clearer picture of factors that influence student and educator adoption. The findings from the study suggest a number of recommendations to facilitate the integration of mobile learning into a tertiary education environment. This study indicates that student and educator perceptions of mobile learning should to be considered when introducing new technology into the tertiary environment. Technology integration can often incur considerable costs, in terms of both time and money, and it is important to maximise the likelihood of success. Since students and educators are directly impacted by new technology it is important to consider their needs and attitudes towards the new technology. This study brings together a comprehensive picture of the factors and attitudes that influence student and educator perceptions of mobile learning and determines which factors influence mobile learning adoption. A number of these factors are interrelated and thus should be considered as a whole.

This final chapter discusses the practical implications of the five factors that have been shown to influence students and educators adoption: perceived ease of use, perceived usefulness, self-efficacy, motivation and level of self- directedness. This chapter also includes a discussion of the overall significance of this study, its limitations, followed by an overall conclusion to the study.

7.1 Recommendations for the Introduction of Mobile Learning into Tertiary Education

The recommendations relate to issues that individual lecturers, developers and instructional designers, researchers and teaching institutions need to consider when implementing some form of mobile learning activities. The main recommendations outlined below are ordered in terms of their impact on adoption:

- Remove technical obstacles to ensure that all mobile learning initiatives are as easy as possible to use with little initial learning needed. Provide IT support and access to training. Pilot initiatives before a major rollout.

- Promote the benefits of the mobile learning initiative so that they are clear and evident to all parties by ensuring students and educators are aware of the advantages to their learning and teaching. Provide opportunities for educators and students to explore mobile learning and support them in their exploration. Sandboxes are a good mechanism for this.

- Develop strategies for students and educators who may have negative attitudes as a result of previous ICT experiences. These resisters may require additional support and training over and above the standard.

- Support educators' exploration of mobile learning. This support can be in the form of resources, time and pedagogical support.

- Use the novelty factor of mobile technology as a way to capture student interest.

- Scaffold student learning with mobile devices rather than expecting a self-directed approach. Slowly build student self-directness so that they are not anxious or feel lost when using mobile learning,

Each of these recommendations will be discussed below within the context of the five factors assessed in this study.

7.1.1 Recommendation One: Focus on ease of use

The perceived ease of use of mobile learning had the biggest impact on the adoption of mobile learning. Not only did the perceived ease of use directly influence the intended adoption of mobile learning it also increased the perceived usefulness of mobile learning. This finding therefore highlights the need to focus on the mobile learning initiative itself. Activities need to be designed to that are easy use and do not require extensive learning. Research into the design of mobile learning to ensure mobile learning is effort free has been small but is growing in momentum (for example Churchill & Hedberg, 2008; Mike, Dan, & Oliver, 2002; Parsons, Ryu, & Cranshaw, 2006; Sharples, 2000; Sharples, Corlett, & Westmancott, 2002). Churchill and Hedberg's (2008) suggestions are useful in this context:

- Design mobile learning content so it fills the screen thus increasing the size of the content. Related to this is the use of a landscape format as this provides a wider area to show content.

- Minimise the need for scrolling

- Design for short tasks since interaction with a mobile device is often purposeful and usually for only short periods of time. The interaction should also be centred around the task and should only try to accomplish a few things using one step interactions
- Provide zoom facilities to enlarge the display beyond the physical limits of the screen
- Allow the design of movable, collapsible, overlapping, semitransparent interactive panels

Design and development checklists on good design principles and problems to avoid are a simple way of getting standardisation between courses in an institution and verifying that educators have actively considered the major issues.

7.1.2 Recommendation two: Highlight the benefits

The second most influential factor in adoption of mobile learning was the perceived usefulness of mobile learning. For students and educators to invest time and effort into learning they need to be convinced of its benefits. Educators need to be enthusiastic and convinced that mobile learning will offer their students a significant advantage over existing learning methods. Enthusiasm will encourage educators to explore new usage and encourage students to use it. Showcasing successful projects to educators can enthuse and inspire them to explore the potential in their own teaching as concrete examples often have more impact than abstract directives or exhortations. Educators also need to be given the opportunity to explore mobile technology for themselves. This exploration will enable them to develop their own understanding of mobile technology

Changes that have major implications for the way students interact with their institution or learning environment should be dealt with at an institutional level. For course specific initiatives, educators can provide explanations at the class level.

Students should be also be encouraged to trial new mobile initiatives before actually having to use it, for example, allowing them to submit a dummy assignment with new technology before having to submit the real thing.

7.1.3 Recommendation three: Develop for those who may have negatives attitudes from previous experiences

After perceived usefulness and ease of use of mobile learning, ICT self-efficacy was shown to have the next strongest influence on adoption. Students and educators with strong ICT skills were shown to be more likely to perceive mobile learning as easy to use. Therefore it is important to anticipate negatives attitudes from those with low ICT self-efficacy. Providing support, and scaffolding ICT experiences will help make mobile learning less daunting and encourage adoption.

Anxiety was shown to seriously reduce the likelihood of adoption therefore support and encouragement when introducing mobile learning will be important for a substantial group of educators and students. Support and guidance in a safe environment will help these individuals feel more at ease and willing to trial the mobile device. If users are worried about damaging the system or being unable to do the activity, they are less likely to engage, and are more likely to give up early rather than persevere. Accessibility to support for all participants is important. For example, a trial assessing the viability of mobile device usage in a number of schools in England found that almost all respondents in the pilot were dissatisfied with the amount of training they received (Perry,2003). Perry (2003) stressed the vital nature of support for both educators and students when introducing new technology. Training and support where also found to be important by Naismith, Lonsdale, Vavoula and Sharples (2005). They found that specialist training and dissemination of good practice is necessary in order for staff to exploit the whole range of capabilities that mobile computing offers. In addition, they emphasise the need for educators and students to have sufficient time to familiarise themselves with new devices before full implementation of any mobile learning.

When new initiatives permit educators and students to use their own mobile devices, rather than one mandated by the institution, then the familiarity they already have provides a good foundation for them to further explore its usage in new areas and practices (Kulkulska-Hulme & Traxler, 2005; Lefoe, et al., 2009).

7.1.4 Recommendation four: Provide educators with support when undertaking mobile learning initiatives

Educators’ ICT-teaching self-efficacy was shown to also play a major role in the adoption of mobile learning. The factors that will influence their adoption related specifically to their perception of technology in teaching and their self accessed ability to integrate technology into their teaching.

As shown in the comments by educators that took part in this study, educators need time to learn how to use the new technology as well as explore its opportunities. It was important that educational institutions support this. Educators can only build their ability to integrate mobile learning into their teaching if they are given the chance to play with the technology. Therefore it is recommended that educators be given opportunities to learn about and play with mobile technology. It is not sufficient to simply offer educators workshops related to mobile technology use but they also need time outside of their teaching schedules to explore these new technologies on their own.

If educators are expected to be innovative in their teaching they should be financially supported in their quest to explore new ways to teach. Support should not only be in terms of time but also in relation to technical and financial support. Studies have shown that educators that are given access to a range of technology and given time to explore these tools in an environment that is relaxed are more likely to adopt in the future (Attewell & Gustafsson, 2002; Cobcroft, Towers, Smith, & Bruns, 2006; Seppälä & Alamäki, 2003; Traxler, 2009; Zawacki-Richter, Brown, & Delport, 2009; Zeng & Luyegu, 2011)..

There is also a need for designing and developing pedagogical sound learning interactions before the implementation of mobile learning (Motiwalla, 2007; Stone, 2004b). According to Taylor, et al. (2006) mobile learning is a unique tool for learning and specific learning theories are needed to enable effective integration of mobile learning into the educational area. Taylor, et al. (2006) goes on to stress that mobile technology can be implemented to support both formal and informal learning, enable dynamic context and adopt constructive and social activity. Overall, mobile learning is unique in that it enables learning outside the classroom and allows learning to be student, as well as educator, lead. Learning is more centred on the learner due to the personal nature of mobile learning. Mobile learning theories that have been developed include theories that are underpinned by behavioural theory (for example Naismith, et al., 2005; O'Malley, et al., 2003), constructivist and collaborative learning (for example Holzinger, Nischelwitzer, & Meisenberger, 2005; Naismith, et al., 2005; Sharples, et al., 2005; Zurita & Nussbaum, 2004), situated and context aware learning (for example Sharples, 2000; Sharples, et al., 2005; Yuan-Kai, 2004), problem-based learning (for example Holzinger, Nischelwitzer, & Meisenberger, 2005; Naismith, et al., 2005; Sharples, 2002) and socio-cultural theory of learning (for example Taylor, 2004; Taylor, et al., 2006), have all been discussed in terms of mobile learning. However there has been little consensus and formalisation of the theory specific to mobile learning (Motiwalla, 2007). Overall, educators need to have a sound pedagogical foundation for adopting mobile learning and a clear understanding about the way learning theory can shape and develop the teaching activity.

7.1.5 Recommendation five: Develop students level of self-directiveness before adopting self-directed mobile learning approaches

The students' level of self-directedness strongly influences their perception of usefulness and intention to adopt mobile learning. This highlights the role of self-directedness as an indirect influence on adoption: students who want to control and manage their learning will perceive mobile learning more positively. However students who are less self-directed need to be slowly introduced to these more self-directed tasks. Designers of mobile learning activities and tools should scaffold and build students self-directedness, so that students do not feel overwhelmed or unsure when using mobile technology (Wang, Wu & Wang (2009).

The recommendation for both educators and researchers is to develop mobile learning activities that give students progressively more opportunities to manage their own learning. This should include tools which they can elect to use when and where they want. Tools that specifically help them to self-manage or control their own learning, when integrated into learning activities on mobile, will foster self directedness.

Students that are highly motivated to learn will always seek new ways to learn. However students need to be made aware of how mobile learning can better support their learning if they are to be encouraged to adopt.

7.1.6 Recommendation six: Harness the novelty factor of mobile learning and use the technology to make learning more engaging

This study found that motivational orientation only played a minor role in students' adoption of mobile learning. The study suggested that mobile technology itself may be a motivating factor. Mobile learning could be seen as fun and not just another tool that students need to learn. It is therefore recommended when integrating mobile technology into teaching it is done in a way that makes the learning more interesting and fun, providing educators with another opportunity to capture learners' attention (Sharples, Taylor, & Vavoula, 2005).

Students that enjoy using new technology are likely to early adopters of mobile learning and they should be encouraged to further explore its usage. This was seen clearly in the comments section of the student survey where a number of students indicated that they were already experimenting with mobile learning on an informal basis. Thus educators should and provide learners the opportunity to experiment and push boundaries. In addition, institutions should not try to be restrictive about students' mobile device usage, dampening enthusiasm.

7.1.7 Conclusion

Overall, this study has highlighted a number of recommendations for those who may be involved in integrating mobile learning. These recommendations apply to educators, researchers and institutions interested in implementing mobile technology in learning.

7.2 Limitations

Structural equation modelling was selected as the appropriate methodology assessing mobile learning adoption. The adoption of structural equation modelling enabled a complex analysis of theoretical models, testing of hypothesises and drawing inferences about the nature of causal relationships. This study aimed to establish some of the groundwork for further understanding of influences on the adoption of mobile learning. Support was found for some of the previous small-scale work done on mobile learning and new findings were also made. However, this was a cross-sectional study and longitudinal research is needed to establish the causality of relationships identified more firmly.

The sample size of both student and educator samples were relatively small. A larger sample would have enabled the sample to be split and enabled more group analysis. This particularly applies to the educator sample, it was not possible to ascertain the effects of gender and other demographic details on the results of the model. However the sample was large enough sample for structural equation modelling to be reliability carried out.

Another limitation of this study was that the sampling of students and educators was not completely random. Students and educators were able to opt out of the study and it is unknown what the impact of this is on the results. However the relatively large sample of students helped to minimise this issue. The response rate may have been a factor in the educator sample, where it was impossible to determine the number of educators that were invited to participate in this study, so the response rate could not be calculated.

The study itself was based on the Technology Adoption Model (TAM). The technology adoption model starts by from the position that people are already using the particular technology and then predicts future use. This study did not assume that participants had any experience of mobile learning but relied on users' experience with mobile technology. Participants were expected to project their understanding of mobile technology to a situation of using that technology for learning. This approach of developing a mobile learning adoption model based on limited experience is not new and a number of studies have used this same approach (Akour, 2009; Lu & Viehland, 2008; Theng, 2009). In addition, future usage was calculated from a stated intention to adopt. Extensive empirical research has confirmed the causal link between intention to adopt and actual future adoption therefore giving some credence to using behavioural intention as an indicator of actual future adoption (Davis, 1989; Dillon, 2001; Venkatesh, 2000).

A further consideration is the modest amount of variance accounted for in the educator model. In the student model factors, such as ease of use and usefulness, explained a relatively sufficient 58% of the variance in behavioural intention. However, the educational model account for the much lower figure of only 12%. This strongly suggests other factors will have an impact on the behavioural adoption of educators. This finding therefore indicates more research is needed.

In summary, while this study is not without limitations, the methods adopted resulted in significant findings in an area that is new and emerging with little empirical research. Overall even considering the limitation, these findings add significant value o to our understanding of mobile learning adoption.

7.4 Conclusion

This study examined the factors that influenced intention to adopt mobile learning for students and educators. Although this study was largely exploratory it also aimed to confirm existing factors identify in the literature that influence adoption. This study has shown that ease of use and perceived usefulness had the strongest influence on student mobile learning adoption, however, students' extrinsic motivation, their level of anxiety, desire for learning and self-management were also related to mobile learning and influenced overall adoption. For educators it was found that perceived usefulness had the strongest influence on adoption, with educator perception and ability to use ICT in teaching having the strongest influence on attitudes to mobile learning.

The investment into new technology is expensive and a time consuming proposition and the possibility of failure is very real if not properly considered. Often decisions to introduce new technology fail to consider both student and educator perspectives, risking wasted effort and resources, and a failure to realise the full benefits of the new technology (Birch & Burnett, 2009; Davis, 1989; Davis & Wiedenbeck, 2001; Hsbollah & Idris, 2009; Verhoeven, et al., 2011). Thus user acceptance is an important factor in determining the adoption of mobile learning, and in higher education, the success of mobile learning depends upon both the student and educators acceptance of the technology.

The perception of educators must be taken into account as they are the facilitators of the learning activity (Aubusson, et al., 2009). Students are able to utilise technology in their learning however it is typically educators that will drive or inhibit technology use. Therefore factors that influence their adoption and integration of technology into their teaching should be an important starting point. If educators do not see the need nor feel compelled to adopt technology, it is very unlikely that the new technology will gain traction. Even when new technology is imposed on educators by institutions they will still play a crucial role in the continual success of the implementation. Resistance of educators can undermine the future of any new initiative.

Research has shown that the perceptions of students will also play a role in the success of any new venture, as it is the students who will be using the technology in their learning (Lu & Viehland, 2008). Students needs need to be considered as well as their overall perceptions and attitudes to the new technology. Students can have a very different perception of technology and different levels of technology literacy to educators and therefore it is important for institutions to consider the role of the student in technology adoption (Suprateek & John, 2003).

This study has found differences between the factors that influence adoption by students and those by educators. It also identified underlying factors that influence both students and educators' acceptance of mobile learning. This study has developed a cognitive framework that models the acceptance of mobile learning for these two groups. By incorporating existing studies and potential factors into a mobile learning adoption model it has helped to uncover why students and educators may adopt or resist mobile learning therefore building a platform for future research.

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APPENDIX A: INFORMATION SHEET FOR EDUCATORS

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EDUCATORS' INFORMATION SHEET

Mobile Learning adoption and the implications on teaching and learning

The following study is conducted in partial fulfillment of the requirements for a Doctorate degree at Massey University, Albany, New Zealand.

This research will survey educators from around New Zealand currently teaching at a tertiary institute. You need not have been involved in any mobile learning activity nor do you need to have used a mobile phone to respond to this survey. Your participation is voluntary and no distinguishing details will be recorded. The research involves completing a questionnaire. This questionnaire is focused on determining your perception of mobile learning. The term M-Learning or Mobile Learning refers to the use of handheld devices such as PDAs (Personal Digital Assistant), mobile phones, and any other handheld information technology device that many be used in teaching and learning, for example using a smartphone to access course work on the Internet, using an Mp3 player to listen to lecturers, or using a PDA to answer course based exercises like a quiz.

Participants:
Teaching staff teaching at a tertiary institute in New Zealand.

Project Procedures:
Information will be collected from the completion and submission of a survey.

If you would like to obtain a summary of the findings of the research please contact the researcher at the following email address, K.MacCallum@Massey.ac.nz.

Participation Involvement:
Please use the following link to access the survey. The survey should not take more than 20 minutes to complete. The survey is available from: http://mlearnstudy.info/survey/index.php?sid=73597

Data Management:
The information collected will be stored in a secure database and will be disposed once research has been completed. The information collected will be anonymous and no identifying information will be collected. No one other than the researcher will be able to access the information stored in the database.

Participant's Rights:
You are under no obligation to accept this invitation. Completion and return of the questionnaire implies consent. You have the right to decline to answer any particular question.

Committee Approval Statement:
This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researchers named below are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researchers, please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethics & Equity), telephone 06 350 5249, email humanethics@massey.ac.nz.

Please contact the researcher, Kathryn Mac Callum or her any of her supervisors, if you have any questions about this study.

Kathryn Mac Callum (***K.MacCallum@Massey.ac.nz***)

Supervisors:

Lynn Jeffrey (*L.M.Jeffrey@massey.ac.nz*) Kinshuk (*Kinshuk@ieee.org*) Hokyoung Ryu (*h.ryu@massey.ac.nz*)

APPENDIX B: THE EDUCATOR SURVEY

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Teacher characteristics and experience and the perception of Mobile Learning

Researcher - **Kathryn Mac Callum** (*K.MacCallum@Massey.ac.nz*) *Main Supervisor* - **Lynn Jeffrey** (*L.M.Jeffrey@Massey.ac.nz*)

This questionnaire is focused on determining your perception of mobile learning. The term M-Learning or Mobile Learning (ML) refers to the use of handheld devices such as PDAs, mobile phones, and any other handheld information technology device that many be use in teaching and learning, for example using a smartphone to access course work on the Internet, using an Mp3 player to listen to lecturers, or using a PDA to answer course based exercises like a quiz.

This questionnaire will take approximately 15 – 20 minutes to complete. Your answers will be greatly appreciated. Please note: You need not have used a mobile devices before or been involved in any mobile learning activity to answer these questions.

PART ONE: Please circle the most applicable option that states you skill with using the computer and mobile device to carry out the following activities:		Never used	Not very skilled	Fairly skilled	Skilled	Moderately Skilled	Highly skilled	Extremely skilled
Please state your level of skill with using the <u>computer</u> (if you have not used a computer before skip this section):								
1	To play digital music files (e.g. iTunes) without accessing the internet	1	2	3	4	5	6	7
2	To create/edit audio and video	1	2	3	4	5	6	7
3	To manage/manipulate digital photos	1	2	3	4	5	6	7
Please state your level of skill for using the <u>Internet</u> (if you have not used the <u>Internet</u> before skip this section):								
4	To make phone calls (e.g. Skype)	1	2	3	4	5	6	7
5	To use social networking software on the web (e.g. Facebook, MySpace etc)	1	2	3	4	5	6	7
6	To look up reference information for study purposes	1	2	3	4	5	6	7
7	To send or receive email	1	2	3	4	5	6	7
8	To buy or sell things (e.g. Trade Me)	1	2	3	4	5	6	7
Please state your level of skill with using a <u>mobile device</u> (if you have not used a mobile device before skip this section):								
9	To Text / SMS people	1	2	3	4	5	6	7
10	To call people	1	2	3	4	5	6	7
11	To download and play games or applications from the Internet	1	2	3	4	5	6	7
12	To send pictures or movies to other people	1	2	3	4	5	6	7
13	To play, and upload music (such as MP3 or the radio)	1	2	3	4	5	6	7
14	To access information /services on the web	1	2	3	4	5	6	7
15	To take digital photos/movies	1	2	3	4	5	6	7
16	To send or receive email	1	2	3	4	5	6	7

PART TWO: please circle the level of whether you agree or disagree with the following statements relating to how you feel about using digital technology such as computers and mobile technology often called *Information and Communication Technology* (ICT)		Strongly agree	Agree	Slightly agree	Neither agree / disagree	Slightly disagree	Disagree	Strongly Disagree
1	I enjoy using and learning new technology	7	6	5	4	3	2	1
2	I could probably teach myself most things I need to know about computers	7	6	5	4	3	2	1
3	I feel insecure about my ability to use ICT	7	6	5	4	3	2	1
4	I find that I quickly adopt new technology	7	6	5	4	3	2	1
5	I can make the computer do what I want it to do	7	6	5	4	3	2	1
6	If I have a problem using the computer, I could usually solve it one way or another	7	6	5	4	3	2	1
7	I am in complete control when I use a computer	7	6	5	4	3	2	1
8	ICT is difficult to use	7	6	5	4	3	2	1
9	I do not enjoy working with technology	7	6	5	4	3	2	1
10	I need someone to tell me the best way to use a computer	7	6	5	4	3	2	1
11	ICT frustrates me	7	6	5	4	3	2	1

PART THREE: please circle the level of whether you agree or disagree with the following statements relating to how you feel about using *Information and Communication Technology* (ICT) in your teaching.		Strongly agree	Agree	Slightly agree	Neither agree / disagree	Slightly disagree	Disagree	Strongly Disagree
1	I see ICT as tools that can complement my teaching	7	6	5	4	3	2	1
2	ICT provide variety in instruction and in content for my students	7	6	5	4	3	2	1
3	ICT provides opportunities for individualized instruction	7	6	5	4	3	2	1
4	ICT allows me to bring current information to the class	7	6	5	4	3	2	1
5	ICT allow students an opportunity to play while learning	7	6	5	4	3	2	1
6	Using ICT has improved my effectiveness as a teacher	7	6	5	4	3	2	1
7	I feel I am trained well enough to use a variety of ICT tools when teaching	7	6	5	4	3	2	1
8	I have enough support at my teaching institute to be able to use technology in the I want to	7	6	5	4	3	2	1
9	I find computer equipment reliable	7	6	5	4	3	2	1
10	I spend more time planning/preparing for classes where I use ICT than when I don't	7	6	5	4	3	2	1
11	I feel frustrated more often when I use ICT in my classes than when I don't use them	7	6	5	4	3	2	1
12	I like to tinker or "play" with computers myself	7	6	5	4	3	2	1
13	When I use ICT my teaching style changes	7	6	5	4	3	2	1
14	I had positive experiences with computers when I was younger	7	6	5	4	3	2	1
15	I have positive ICT experiences at my teaching institute	7	6	5	4	3	2	1
16	In general, I am interested in ICT technology	7	6	5	4	3	2	1

	PART FOUR: please circle the level of whether you agree or disagree with the following statements relating to how you work.	Strongly agree	Agree	Slightly agree	Neither agree / disagree	Slightly disagree	Disagree	Strongly Disagree
1	The more difficult the problem, the more I enjoy trying to solve it	7	6	5	4	3	2	1
2	I want my work to provide me with opportunities for increasing my knowledge and skills	7	6	5	4	3	2	1
3	To me, success means doing better than other people	7	6	5	4	3	2	1
4	I prefer to figure things out for myself	7	6	5	4	3	2	1
5	I am keenly aware of the earning goals I have for myself	7	6	5	4	3	2	1
6	Curiosity is the driving force behind much of what I do	7	6	5	4	3	2	1
7	I enjoy tackling problems that are completely new to me	7	6	5	4	3	2	1
8	I prefer work I know I can do well over work that stretches my abilities	7	6	5	4	3	2	1
9	I seldom think about salary and promotion	7	6	5	4	3	2	1
10	I believe that there is no point in doing a good job if nobody else knows about it	7	6	5	4	3	2	1
11	I am strongly motivated by the money I can earn	7	6	5	4	3	2	1
12	I am strongly motivated by the recognition I can earn from other people	7	6	5	4	3	2	1
13	I have to feel that I'm getting something in return for everything I do	7	6	5	4	3	2	1
14	I often will look for work that challenges me	7	6	5	4	3	2	1
15	It is important for me to have an outlet for self-expression	7	6	5	4	3	2	1
16	I want other people to see and appreciate how good I really can be in my work	7	6	5	4	3	2	1
17	What matters most to me is enjoying what I do	7	6	5	4	3	2	1
18	I enjoy relatively simple, straightforward tasks	7	6	5	4	3	2	1

	PART FIVE: please circle the level of whether you agree or disagree with the following statements relating to what you think about *Mobile Learning* (ML) and using *Mobile Technology* (MT) in your teaching.	Strongly agree	Agree	Slightly agree	Neither agree / disagree	Slightly disagree	Disagree	Strongly Disagree
1	I would find mobile technology (MT) useful in my teaching	7	6	5	4	3	2	1
2	I believe that using MT would enable me to accomplish tasks more quickly	7	6	5	4	3	2	1
3	I believe MT offers increase accessed to leaning material by my students	7	6	5	4	3	2	1
4	I see Mobile Learning (ML) as a way to offer more flexibility to my students compare to e-learning	7	6	5	4	3	2	1
5	I believe that using a mobile device to access learning content would take longer that simply using a computer	7	6	5	4	3	2	1
6	I see ML as a way to improve student learning as it allows students to access learning content anywhere and anytime	7	6	5	4	3	2	1
7	I see ML as a way of encouraging more interaction by students and educators	7	6	5	4	3	2	1
8	I see ML as a way to enhance/encourage my students self-directed learning	7	6	5	4	3	2	1
9	I believe I would find it easy to use a mobile device to support my teaching	7	6	5	4	3	2	1
10	I think it might take me a while to get comfortable with using a mobile device for teaching	7	6	5	4	3	2	1
11	ML requires too much time to support and setup	7	6	5	4	3	2	1
12	I feel that I would have the knowledge necessary to implement and use MT in my teaching	7	6	5	4	3	2	1
13	ML would not be compatible with how I teach	7	6	5	4	3	2	1
14	I believe that I would need a strong level of support from the IT staff to help me with setting and using the technology	7	6	5	4	3	2	1
15	Using MT for learning/teaching is a good idea.	7	6	5	4	3	2	1
16	MT will make learning and teaching more interesting.	7	6	5	4	3	2	1
17	MT will increase student's interest	7	6	5	4	3	2	1
18	Working with the MT will be fun.	7	6	5	4	3	2	1
19	I would be anxious about having to use my mobile device to help support my learning	7	6	5	4	3	2	1
20	I would feel uncomfortable about using MT in front of others in case I am unable to work it correctly	7	6	5	4	3	2	1
21	Overall I would be interested in including ML if I had the opportunity in the future	7	6	5	4	3	2	1
22	I can see how I could incorporate ML it into my teaching	7	6	5	4	3	2	1
23	ML is too expensive in terms of the cost of the devices, services, maintenance repair and upgrades, and support from an IT etc	7	6	5	4	3	2	1
24	I do not think I will implement ML until I have see other educators using it successfully	7	6	5	4	3	2	1

	PART SIX: please circle what features you think would be interested in if it was including into your class	Not at all Interested	Slightly interested	Somewhat interested	interested	Moderately interested	Very interested	Extremely interested
1	Access educational content online via your mobile phone	1	2	3	4	5	6	7
2	SMS notifications or study notes	1	2	3	4	5	6	7
3	Mobile quizzes	1	2	3	4	5	6	7
4	Mobile blogging	1	2	3	4	5	6	7
5	Full integrated mobile application	1	2	3	4	5	6	7
6	To upload lecture recordings as audio or video (podcasting)	1	2	3	4	5	6	7

Please include any other comments:

PART SIX: DEMOGRAPHIC INFORMATION

1. Gender: ☐ Male ☐Female
2. Age: ☐Under 20 ☐20 – 29 ☐30 – 39 ☐ 40 – 49 ☐ over 50
3. Faculty which you work in? ______________________________
4. Please select your ethnic grouping/s ☐European ☐Māori ☐Pacific peoples ☐Asian ☐Other: ___________
5. How often do you carry a mobile device around? ☐ I don't own one ☐ Never ☐ Seldom ☐ Occasionally ☐ Always
6. Please rate the type of mobile phone you own (please note if you have more than one just rate the most advanced)

Low End: I can only text and make calls ☐ ☐ ☐ ☐ ☐ **High End:** Fully functional smart device with all the latest features

Thank you for completing this questionnaire if you have any questions please contact the researcher at the above details

APPENDIX C: INFORMATION SHEET FOR STUDENTS

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EDUCATORS' INFORMATION SHEET

Student's characteristics, experiences and the perception of Mobile Learning

The following study is conducted in partial fulfillment of the requirements for a Doctorate degree at Massey University, Albany, New Zealand.

This research will survey students from around New Zealand currently enrolled in a tertiary institute. You need not have been involved in any mobile learning activity nor do you need to have used a mobile phone to respond to this survey. Your participation is voluntary and no distinguishing details will be recorded. The research involves completing a questionnaire. This questionnaire is focused on determining your perception of mobile learning. The term M-Learning or Mobile Learning refers to the use of handheld devices such as PDAs (Personal Digital Assistant), mobile phones, and any other handheld information technology device that many be used in teaching and learning, for example using a smartphone to access course work on the Internet, using an Mp3 player to listen to lecturers, or using a PDA to answer course based exercises like a quiz.

Participants:
Students enrolled at any tertiary institute in New Zealand.

Project Procedures:
Information will be collected from the completion and submission of a survey.

If you would like to obtain a summary of the findings of the research please contact the researcher at the following email address, K.MacCallum@Massey.ac.nz.

Participation Involvement:
A link to the survey will be available from the following link, you will be asked to complete and submit the survey online. The survey should not take more than 20 minutes to complete. The survey is available from: http://survey.mlearnstudy.info/

Data Management:
The information collected will be stored in a secure database and will be disposed once research has been completed. The information collected will be anonymous and no identifying information will be collected. No one other than the researcher will be able to access the information stored in the database.

Participant's Rights:
You are under no obligation to accept this invitation. Completion and return of the questionnaire implies consent. You have the right to decline to answer any particular question.

Committee Approval Statement:
This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researchers named below are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researchers, please contact Professor Sylvia Rumball, Assistant to the Vice-Chancellor (Ethics & Equity), telephone 06 350 5249, email humanethics@massey.ac.nz.

Please contact the researcher, Kathryn Mac Callum or her any of her supervisors, if you have any questions about this study.

Kathryn Mac Callum (K.MacCallum@Massey.ac.nz)

Supervisors:
Lynn Jeffrey (*L.M.Jeffrey@massey.ac.nz*) Kinshuk (*Kinshuk@ieee.org*) Hokyoung Ryu (*h.ryu@massey.ac.nz*)

APPENDIX D: THE STUDENT SURVEY

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Learner characteristics and experience and the perception of Mobile Learning

Researcher - **Kathryn Mac Callum** *(K.MacCallum@Massey.ac.nz)* *Main Supervisor* - **Lynn Jeffrey** *(L.M.Jeffrey@Massey.ac.nz)*

This questionnaire is focused on determining your perception of mobile learning. The term M-Learning or Mobile Learning (ML) refers to the use of handheld devices such as smart phones, mobile phones, and any other handheld information technology device that many be use in teaching and learning, for example using a mobile phone to access course work on the Internet, using an Mp3 player to listen to lecturers, or using a smart phone to answer course based exercises, like a quiz.

This questionnaire will take approximately 15 – 20 minutes to complete. Your answers will be greatly appreciated. Please note: You need not have used a mobile devices before or been involved in any mobile learning activity to answer these questions.

	PART ONE: please circle the most applicable option that states you skill with using the computer and mobile device to carry out the following activities:	Never used	Not very skilled	Fairly skilled	Skilled	Moderately Skilled	Highly skilled	Extremely skilled
	Please state your level of skill with using the computer (if you have not used a computer before skip this section):							
1	To play digital music files (e.g. iTunes) without accessing the internet	1	2	3	4	5	6	7
2	To create/edit audio and video	1	2	3	4	5	6	7
3	To manage/manipulate digital photos	1	2	3	4	5	6	7
	Please state your level of skill for using the Internet (if you have not used the Internet before skip this section):							
4	To make phone calls (e.g. Skype)	1	2	3	4	5	6	7
5	To use social networking software on the web (e.g. Facebook, MySpace etc)	1	2	3	4	5	6	7
6	To look up reference information for study purposes	1	2	3	4	5	6	7
7	To send or receive email	1	2	3	4	5	6	7
8	To buy or sell things (e.g. Trade Me)	1	2	3	4	5	6	7
	Please state your level of skill with using a mobile device (if you have not used a mobile device before skip this section):							
9	To text / SMS people	1	2	3	4	5	6	7
10	To call people	1	2	3	4	5	6	7
11	To download and play games or applications from the Internet	1	2	3	4	5	6	7
12	To send pictures or movies to other people	1	2	3	4	5	6	7
13	To play, and upload music (such as MP3 or the radio)	1	2	3	4	5	6	7
14	To access information /services on the web	1	2	3	4	5	6	7
15	To take digital photos/movies	1	2	3	4	5	6	7
16	To send or receive email	1	2	3	4	5	6	7

	PART TWO: please circle the level of whether you agree or disagree with the following statements relating to how you feel about using digital technology such as computers and mobile technology often called *Information and Communication Technology* (ICT)	Strongly agree	Agree	Slightly agree	Neither agree / disagree	Slightly disagree	Disagree	Strongly Disagree
1	I enjoy using and learning new technology	7	6	5	4	3	2	1
2	I could probably teach myself most things I need to know about computers	7	6	5	4	3	2	1
3	I feel insecure about my ability to use ICT	7	6	5	4	3	2	1
4	I find that I quickly adopt new technology	7	6	5	4	3	2	1
5	I can make the computer do what I want it to do	7	6	5	4	3	2	1
6	If I have a problem using the computer, I could usually solve it one way or another	7	6	5	4	3	2	1
7	I am in complete control when I use a computer	7	6	5	4	3	2	1
8	ICT is difficult to use	7	6	5	4	3	2	1
9	I enjoy working with technology	7	6	5	4	3	2	1
10	I need someone to tell me the best way to use a computer	7	6	5	4	3	2	1
11	ICT frustrates me	7	6	5	4	3	2	1

	PART THREE: please circle the level of whether you agree or disagree with the following statements relating to how you learn.	Strongly agree	Agree	Slightly agree	Neither agree / disagree	Slightly disagree	Disagree	Strongly Disagree
1	I manage my time well	7	6	5	4	3	2	1
2	I want to learn new information	7	6	5	4	3	2	1
3	I prefer to set my own goals	7	6	5	4	3	2	1
4	I am self disciplined	7	6	5	4	3	2	1
5	I enjoy learning new information	7	6	5	4	3	2	1
6	I like to make decisions for myself	7	6	5	4	3	2	1
7	I am organized	7	6	5	4	3	2	1
8	I have a need to learn	7	6	5	4	3	2	1
9	I am responsible for my own decisions/actions	7	6	5	4	3	2	1
10	I set strict time frames	7	6	5	4	3	2	1
11	I enjoy a challenge	7	6	5	4	3	2	1
12	I am in control of my life	7	6	5	4	3	2	1
13	I have good management skills	7	6	5	4	3	2	1
14	I enjoy studying	7	6	5	4	3	2	1
15	I have high personal standards	7	6	5	4	3	2	1

	PART FOUR: please circle the level of whether you agree or disagree with the following statements relating to how you approach your learning.	Strongly agree	Agree	Slightly agree	Neither agree / disagree	Slightly disagree	Disagree	Strongly Disagree
1	The more difficult the problem, the more I enjoy trying to solve it	7	6	5	4	3	2	1
2	I want my study to provide me with opportunities for increasing my knowledge and skills	7	6	5	4	3	2	1
3	To me, success means doing better than other people	7	6	5	4	3	2	1
4	I prefer to figure things out for myself	7	6	5	4	3	2	1
5	I am keenly aware of the earning (financial) goals I have for myself	7	6	5	4	3	2	1
6	Curiosity is the driving force behind much of what I do	7	6	5	4	3	2	1
7	I enjoy tackling problems that are completely new to me	7	6	5	4	3	2	1
8	I prefer work I know I can do well over work that stretches my abilities	7	6	5	4	3	2	1
9	I seldom think about grades and awards	7	6	5	4	3	2	1
10	I believe that there is no point in doing a good job if nobody else knows about it	7	6	5	4	3	2	1
11	I am strongly motivated by the grades I can earn	7	6	5	4	3	2	1
12	I am strongly motivated by the recognition I can earn from other people	7	6	5	4	3	2	1
13	I have to feel that I'm getting something in return for everything I do	7	6	5	4	3	2	1
14	I often will attempt the more complex problems in class to challenge myself	7	6	5	4	3	2	1
15	It is important for me to have an outlet for self-expression	7	6	5	4	3	2	1
16	I want other people to see and appreciate how good I really can be in my study	7	6	5	4	3	2	1
17	What matters most to me is enjoying what I do	7	6	5	4	3	2	1
18	I enjoy relatively simple, straightforward tasks	7	6	5	4	3	2	1

	PART FIVE: please circle the level of whether you agree or disagree with the following statements relating to what you think about *Mobile Learning* (ML) and using *Mobile Technology* (MT) in your learning.	Strongly agree	Agree	Slightly agree	Neither agree / disagree	Slightly disagree	Disagree	Strongly Disagree
1	I would find mobile technology (MT) useful in my learning	7	6	5	4	3	2	1
2	MT would enable me to access learning content more quickly	7	6	5	4	3	2	1
3	MT will enable me to access learning content more often	7	6	5	4	3	2	1
4	Taking a mobile-supported course would provide me with an efficient way to utilise my time	7	6	5	4	3	2	1
5	I believe it would be more convenient to access learning content via a mobile device over using a computer	7	6	5	4	3	2	1
6	I believe that it would take me longer to accomplish learning tasks using a mobile device	7	6	5	4	3	2	1
7	I believe I would find it easy to use a mobile device to support my learning	7	6	5	4	3	2	1
8	I think it might take me awhile to get comfortable with using a mobile device for learning	7	6	5	4	3	2	1
9	I feel that I would have the knowledge necessary to use a mobile device to support my learning	7	6	5	4	3	2	1
10	Mobile Learning (ML) would not be compatible with how I learn	7	6	5	4	3	2	1
11	I believe I would be more willing to use MT if I had support if I needed help	7	6	5	4	3	2	1
12	Using MT for learning is a good idea	7	6	5	4	3	2	1
13	MT will make learning more interesting	7	6	5	4	3	2	1
14	Working with the mobile technology will be fun	7	6	5	4	3	2	1
15	I would be anxious about having to use my mobile device to help support my learning	7	6	5	4	3	2	1
16	I would be concerned if ML was a required component of my study	7	6	5	4	3	2	1
17	Currently MT and the associated services are too expensive	7	6	5	4	3	2	1
18	Overall, I think mobile learning would be beneficial to my learning and I would be willing to adopt it, if I had the opportunity, in the future	7	6	5	4	3	2	1

	PART SIX: Please indicate how interested you would be about having the following content accessible on from a mobile device.	Not at all Interested	Slightly interested	Somewhat interested	interested	Moderatel y interested	Very interested	Extremely interested
1	Access the Internet for educational content via your mobile phone	1	2	3	4	5	6	7
2	SMS notifications or study notes	1	2	3	4	5	6	7
3	Mobile quizzes	1	2	3	4	5	6	7
4	Mobile blogging	1	2	3	4	5	6	7
5	To view lecture slides or readings	1	2	3	4	5	6	7
6	To download and view lecture recordings as audio or video (podcasting)	1	2	3	4	5	6	7

Please include any other comments:

PART SIX: DEMOGRAPHIC INFORMATION

1. Gender: ☐ Male ☐Female
2. Age: ☐Under 20 ☐20 – 29 ☐30 – 39 ☐ 40 – 49 ☐ over 50
3. What qualification are you currently working towards? ______________________________
4. Please select your ethnic grouping/s ☐European ☐Māori ☐Pacific peoples ☐Asian ☐Other: ___________
5. How often do you carry a mobile device around? ☐ I don't own one ☐ Never ☐ Seldom ☐ Occasionally ☐ Always
6. Please rate the type of mobile phone you own (please note if you have more than one just rate the most advanced)

Low End: I can only text and make calls ☐ ☐ ☐ ☐ ☐ **High End:** Fully functional smart device with all the latest features

Thank you for completing this questionnaire if you have any questions please contact the researcher at the above details

APPENDIX E: PARAMETER ESTIMATES FOR FINAL STRUCTURAL MODEL

PARAMETER ESTIMATES FOR STUDENT FINAL STRUCTURAL MODEL

A complete list of parameter estimates, standard errors, and significance values for observed variables and latent constructs for the final partially-mediated structural model (*n* = 446).

Observed Variable		Latent Variable	Unstand-ardised Estimate	Standard Error	Critical Ratio	Significance Level (*p* <)	Standardised Regression Weights
Structural Weights							
PEOU	<---	SMS	0.75	0.31	2.41	.016	0.12
PU	<---	SMS	0.20	0.30	6.04	.001	0.25
BI	<---	GICTS	0.15	0.06	2.74	.006	0.09
SMS	<---	GICTS	0.98	0.07	14.45	.001	0.57
ExICTS	<---	GICTS	0.32	0.07	4.56	.001	0.23
ExICTS	<---	SMS	0.29	0.04	7.63	.001	0.38
PEOU	<---	Anx	-0.21	0.05	-4.75	.001	-0.23
PU	<---	Anx	-0.23	0.05	-4.665	.001	-0.19
Anx	<---	SMS	-0.09	0.04	-2.15	.032	-0.12
Anx	<---	GICTS	-0.34	.07	-4.71	.001	-0.26
Anx	<---	ExICTS	-0.30	0.05	-6.11	.001	-0.23
PU	<---	EM	0.31	0.05	6.37	.001	0.25
PU	<---	DfL	0.19	0.08	2.24	.025	0.11
PU	<---	SC	0.22	0.09	2.492	.013	0.12
BI	<---	DfL	0.25	0.07	3.51	.001	0.13
BI	<---	SM	0.14	0.05	3.16	.001	0.11
SC	<---	Anx	-0.06	0.03	-2.48	.013	-0.10
PU	<---	PEOU	0.51	0.05	10.04	.001	0.41
BI	<---	PEOU	0.81	0.05	3.75	.001	0.31
BI	<---	PU	0.72	0.04	18.42	.001	0.66

Squared Multiple Correlations

Constructs	Squared multiple correlations
Behavioural intention	.583
Perception of Usefulness	.368
Ease of Use	.076
Specific Mobile Skill	.327
Expert ICT Skill	.299
Anxiety	.186
Self-Management	.181

PARAMETER ESTIMATES FOR EDUCATOR FINAL STRUCTURAL MODEL

A complete list of parameter estimates, standard errors, and significance values for observed variables and latent constructs for the final partially-mediated structural model (*n* = 196).

Observed Variable		Latent Variable	Unstand-ardised Estimate	Standard Error	Critical Ratio	Significance Level (*p* <)	Standardised Regression Weights
Structural Weights							
PEOU	<---	SMS	0.16	0.05	3.83	.001	0.32
PU	<---	SMS	0.07	0.04	2.54	0.01	0.22
BI	<---	SMS	0.09	0.05	1.70	.019	0.28
SMS	<---	GICTS	0.92	0.06	17.07	.001	0.79
ExICTS	<---	GICTS	0.37	0.10	4.63	.001	0.71
PEOU	<---	Anx	-0.23	0.06	-3.96	.001	-0.29
Anx	<---	SMS	-0.16	0.07	-2.40	.017	-0.23
Anx	<---	GICTS	-0.37	.11	-3.13	.002	-0.39
PEOU	<---	SEabl	0.55	0.07	1.10	.008	0.08
PU	<---	SEabl	0.01	0.09	1.10	.008	0.08
PU	<---	SEAtt	0.27	0.11	2.75	.006	0.20
SEabl	<---	SMS	0.23	0.06	3.11	.002	0.31
SEabl	<---	GICTS	0.21	0.06	3.11	.002	0.24
PU	<---	PEOU	0.15	0.07	1.59	0.11	0.16
BI		PU	0.17	0.09	1.91	0.06	0.14

Squared Multiple Correlations

Constructs	Squared multiple correlations (SMC)
Behavioural intention	.042
Perception of Usefulness	.077
Ease of Use	.447
Specific Mobile Skill	.629
Expert/Specialised ICT Skill	.423
Anxiety	.364
ICT-teaching self-efficacy- ability	.366

APPENDIX F: PARAMETER ESTIMATES FOR MULTI-GROUP ANALYSIS (GENDER)

PARAMETER ESTIMATES FOR MULTI-GROUP ANALYSIS (GENDER)

Complete list of parameter estimates, standard errors, and significance values for observed variables and latent constructs for the testing of the moderated structural model.

MALES
(*n* = 180)

Observed Variable		Latent Variable	Unstand-ardised Estimate	Standard Error	Critical Ratio	Significance Level (*p* <)
PEOU	<---	SMS	0.23	0.06	3.92	.001
PU	<---	SMS	0.30	0.05	5.91	.001
PEOU	<---	GICTS	0.24	0.11	2.23	.026
PEOU	<---	ExICTS	0.17	0.08	2.30	.021
BI	<---	GICTS	0.07	0.072	0.965	027
SMS	<---	GICTS	0.91	0.10	10.82	.001
ExICTS	<---	GICTS	0.52	0.10	5.25	.001
ExICTS	<---	SMS	0.23	0.06	4.00	.001
PEOU	<---	Anx	-0.30	0.07	-4.36	.001
PU	<---	Anx	0.19	0.07	2.666	.008
Anx	<---	SMS	0.14	0.06	2.26	.024
Anx	<---	GICTS	-0.51	0.11	-4.53	.001
Anx	<---	ExICTS	-0.29	0.08	-3.56	.001
PU	<---	EM	0.32	0.08	4.21	.001
PU	<---	DfL	0.27	0.10	2.71	.007
PU	<---	SC	0.08	0.12	0.65	.007
BI	<---	DfL	0.23	0.08	2.82	.005
BI	<---	SM	0.05	0.06	0.75	.005
IM	<---	SM	0.14	0.05	2.88	.004
PU	<---	PEOU	0.42	0.08	5.23	.001
BI	<---	PEOU	0.17	0.07	2.52	.012
BI	<---	PU	0.83	0.05	16.03	.001

Squared Multiple Correlations

Constructs	Squared multiple correlations
Behavioural intention	.662
Perception of Usefulness	.373
Ease of Use	.143
Specific Mobile Skill	.388
Expert ICT Skill	.387
Anxiety	.256
Self-Management	.202

FEMALES
(*n* = 227)

Observed Variable		Latent Variable	Unstand-ardised Estimate	Standard Error	Critical Ratio	Significance Level (*p* <)
PEOU	<---	SMS	0.08	0.03	2.37	.018
PU	<---	SMS	0.19	0.03	5.67	.001
BI	<---	ExICTS	0.07	0.04	1.68	.092
BI	<---	GICTS	0.11	0.06	1.75	.08
SMS	<---	GICTS	1.07	0.07	14.44	.001
ExICTS	<---	GICTS	0.32	0.07	4.56	.001
ExICTS	<---	SMS	0.23	0.04	7.64	.001
PEOU	<---	Anx	-0.21	0.05	-4.67	.001
PU	<---	Anx	0.22	0.05	4.36	.001
Anx	<---	GICTS	-0.27	0.07	-4.16	.001
Anx	<---	ExICTS	-0.26	0.04	-5.70	.001
PU	<---	EM	0.32	0.05	6.52	.001
PU	<---	SC	0.33	0.08	4.45	.001
BI	<---	DfL	0.25	0.07	3.53	.001
BI	<---	SM	0.14	0.05	3.08	.002
IM	<---	SM	0.13	0.04	3.55	.001
PU	<---	PEOU	0.51	0.05	9.87	.001
BI	<---	PEOU	0.18	0.05	3.67	.001
BI	<---	PU	0.72	0.04	18.41	.001

Squared Multiple Correlations

Constructs	Squared multiple correlations
Behavioural intention	.582
Perception of Usefulness	.363
Ease of Use	.080
Specific Mobile Skill	.327
Expert ICT Skill	.399
Anxiety	.181
Self-Management	.180

APPENDIX G: PARAMETER ESTIMATES FOR MULTI-GROUP ANALYSIS (AGE)

PARAMETER ESTIMATES FOR MULTI-GROUP ANALYSIS (AGE)

Complete list of parameter estimates, standard errors, and significance values for observed variables and latent constructs for the testing of the moderated structural model.

AGE 29 AND BELOW

(*n* = 288)

Observed Variable		Latent Variable	Unstand-ardised Estimate	Standard Error	Critical Ratio	Significance Level (*p* <)
PEOU	<---	SMS	0.09	0.04	2.38	.017
PU	<---	SMS	0.19	0.04	4.66	.001
SMS	<---	GICTS	1.11	0.10	11.47	.001
ExICTS	<---	GICTS	0.22	0.09	2.53	.012
ExICTS	<---	SMS	0.26	0.05	5.74	.001
PEOU	<---	Anx	-0.22	0.05	-4.13	.001
PU	<---	Anx	0.17	0.06	2.91	.004
Anx	<---	SMS	-0.11	0.05	-2.14	.033
Anx	<---	GICTS	-0.33	0.09	-3.48	.001
Anx	<---	ExICTS	-0.32	0.06	-5.20	.001
PU	<---	EM	0.34	0.06	5.37	.001
PU	<---	DfL	0.18	0.10	1.90	.057
PU	<---	SC	0.24	0.11	2.18	.029
BI	<---	DfL	0.26	0.07	3.52	.001
IM	<---	SM	0.10	0.05	2.24	.025
PU	<---	PEOU	0.44	0.06	7.11	.001
BI	<---	PEOU	0.20	0.06	3.46	.001
BI	<---	PU	0.71	0.05	15.24	.001

Squared Multiple Correlations

Constructs	Squared multiple correlations
Behavioural intention	.567
Perception of Usefulness	.332
Ease of Use	.082
Specific Mobile Skill	.310
Expert ICT Skill	.218
Anxiety	.150
Self-Management	.158

AGE 30 AND ABOVE
(n = 121)

Observed Variable		Latent Variable	Unstand-ardised Estimate	Standard Error	Critical Ratio	Significance Level (p <)
PEOU	<---	SMS	0.08	0.03	2.37	.018
PU	<---	SMS	0.21	0.03	6.19	.001
BI	<---	GICTS	0.15	0.06	2.74	.006
SMS	<---	GICTS	1.07	0.07	14.39	.001
ExICTS	<---	GICTS	0.32	0.07	4.55	.001
ExICTS	<---	SMS	0.29	0.04	7.65	.001
PEOU	<---	Anx	-0.21	0.05	-4.67	.001
PU	<---	Anx	0.21	0.05	4.21	.001
Anx	<---	GICTS	-0.28	0.06	-4.42	.001
Anx	<---	ExICTS	-0.26	0.05	-5.68	.001
PU	<---	EM	0.31	0.05	6.25	.001
PU	<---	DfL	0.30	0.07	4.28	.001
BI	<---	SM	0.14	0.05	3.16	.002
BI	<---	DfL	0.25	0.07	3.50	.001
IM	<---	SM	0.13	0.04	3.57	.001
PU	<---	PEOU	0.52	0.05	10.04	.001
BI	<---	PEOU	0.18	0.05	3.77	.001
BI	<---	PU	0.72	0.04	18.56	.001

Squared Multiple Correlations

Constructs	Squared multiple correlations
Behavioural intention	.587
Perception of Usefulness	.362
Ease of Use	.080
Specific Mobile Skill	.327
Expert ICT Skill	.299
Anxiety	.181
Self-Management	.180

APPENDIX H: PARAMETER ESTIMATES FOR MULTI-GROUP ANALYSIS (INSITUTION TYPE)

PARAMETER ESTIMATES FOR MULTI-GROUP ANALYSIS (INSTITUTION)

Complete list of parameter estimates, standard errors, and significance values for observed variables and latent constructs for the testing of the moderated structural model.

UNIVERSITY
(*n* = 298)

Observed Variable		Latent Variable	Unstand-ardised Estimate	Standard Error	Critical Ratio	Significance Level (*p* <)
PU	<---	SMS	0.21	0.04	5.35	.001
SMS	<---	GICTS	1.11	0.09	12.88	.001
ExICTS	<---	GICTS	0.35	0.08	4.33	.001
ExICTS	<---	SMS	0.32	0.04	7.77	.001
PEOU	<---	Anx	-0.24	0.05	-4.70	.001
PU	<---	Anx	0.20	0.06	3.60	.001
Anx	<---	GICTS	-0.22	0.08	-2.91	.004
Anx	<---	ExICTS	-0.34	0.05	-6.52	.001
PU	<---	EM	0.33	0.06	5.67	.001
BI	<---	SM	0.08	0.05	1.64	.102
PU	<---	SC	0.32	0.09	3.76	.001
BI	<---	DfL	0.22	0.07	3.05	.002
IM	<---	SM	0.11	0.04	2.74	.006
PU	<---	PEOU	0.48	0.06	8.62	.001
BI	<---	PEOU	0.18	0.05	3.63	.001
BI	<---	PU	0.75	0.04	18.46	.001

Squared Multiple Correlations

Constructs	Squared multiple correlations
Behavioural intention	.594
Perception of Usefulness	.342
Ease of Use	.063
Specific Mobile Skill	.326
Expert ICT Skill	.345
Anxiety	.210
Self-Management	.152

POLYTECHNIC
(n = 149)

Observed Variable		Latent Variable	Unstand-ardised Estimate	Standard Error	Critical Ratio	Significance Level (p <)
PEOU	<---	SMS	0.08	0.03	2.41	.016
PU	<---	SMS	0.19	0.03	5.74	.001
BI	<---	GICTS	0.11	0.06	1.75	.080
SMS	<---	GICTS	1.08	0.07	14.52	.001
ExICTS	<---	GICTS	0.30	0.04	8.09	.001
PEOU	<---	Anx	-0.21	0.05	-4.75	.001
PU	<---	Anx	0.22	0.05	4.27	.001
Anx	<---	GICTS	-0.44	0.06	-7.46	.001
PU	<---	EM	0.32	0.05	6.40	.001
BI	<---	SM	0.14	0.05	3.08	.001
PU	<---	SC	0.33	0.08	4.38	.001
BI	<---	DfL	0.25	0.07	3.53	.001
IM	<---	SM	0.13	0.04	3.50	.001
PU	<---	PEOU	0.51	0.05	9.87	.001
BI	<---	PEOU	0.18	0.05	3.69	.001
BI	<---	PU	0.72	0.04	18.60	.001

Squared Multiple Correlations

Constructs	Squared multiple correlations
Behavioural intention	.582
Perception of Usefulness	.363
Ease of Use	.076
Specific Mobile Skill	.329
Expert ICT Skill	.247
Anxiety	.115
Self-Management	.181

APPENDIX I: FACTOR ANALYSIS – STUDENT

ROTATED COMPONENT MATRIX FOR ICT SKILL

Rotated Component Matrix[a]

	Component		
	1	2	3
Component 1: SPECIFIC MOBILE SKILL			
Use a mobile phone to access information/services on the web	**.838**	.243	.222
Use a mobile phone to play, and upload music (such as MP3 or the radio	**.828**	.110	.277
Use a mobile phone to send pictures or movies to others	**.815**	.221	.174
Use a mobile phone to download and play games or applications from the Internet	**.796**	.186	.238
Use a mobile phone to send or receive email	**.760**	.151	.236
Use a mobile phone to take digital photos or movies	**.712**	.426	.142
Use the web to use social networking software on the web (e.g. Facebook, MySpace etc)	**.444**	.383	.346
Component 2: GENERAL ICT SKILL			
Use the web to send or receive email	.132	**.823**	.225
Use a mobile phone to text/ SMS people	.453	**.717**	-.010
Use a mobile phone to call people	.464	**.713**	-.100
Use the web to look up reference information for study purposes	.041	**.640**	.319
Use the web to buy or sell things (e.g. Trade Me)	.230	**.573**	.370
Component 3: EXPERT/SPECIALISED ICT SKILL			
Use a computer to create/edit audio and video	.195	.003	**.820**
Use a computer to manage/manipulate digital photos	.131	.165	**.788**
Using a computer to play digital music files (e.g. iTunes) without accessing the Internet	.271	.198	**.700**
Use the Internet to make phone calls (e.g. Skype)	.246	.235	**.501**
Means	4.96	5.87	4.30
SD	1.643	.999	1.391
Reliabilities	.92	.81	.85

a. Rotation converged in 5 iterations.

ROTATED COMPONENT MATRIX FOR ICT SELF-EFFICACY (Perceived control, anxiety and attitude)

Rotated Component Matrix[a]

	Component	
	1	2
Component 1: ICT ATTITUDES AND PERCIEVED CONTROL I can make the computer do what I want it to do	**.839**	.116
I am in complete control when I use a computer	**.829**	.210
If I have a problem using the computer, I could usually solve it one way or another	**.770**	.174
I could probably teach myself most things I need to know about computers	**.720**	.148
I enjoy using and learning new technology	**.613**	.251
Component 2: ICT ANXIETY		
ICT is difficult to use (R)	-.213	**-.771**
ICT frustrates me (R)	-.113	**-.733**
I feel insecure about my ability to use ICT (R)	-.140	**-.721**
I need someone to tell me the best way to use a computer	.071	**.673**
I enjoy working with technology	.359	**.664**
I find that I quickly adopt new technology	.373	**.509**
Means	5.22	5.37
SD	1.130	1.044
Reliabilities	.80	.84

a. Rotation converged in 3 iterations.

ROTATED COMPONENT MATRIX FOR MOTIVATION

Rotated Component Matrixa

	Component	
	1	2
Component 1: INTRINSIC MOTIVATION		
I enjoy tackling problems that are completely new to me	**.892**	-.109
The more difficult the problem, the more I enjoy trying to solve it	**.874**	-.135
I often will attempt the more complex problems in class to challenge myself	**.830**	-.115
I prefer to figure things out for myself	**.822**	.088
I want my study to provide me with opportunities for increasing my knowledge and skills	**.804**	.003
Curiosity is the driving force behind much of what I do	**.800**	.080
It is important for me to have an outlet for self-expression	**.773**	.149
What matters most to me is enjoying what Ido	**.558**	.154
Component 2: EXTRINSIC MOTIVATION		
I am strongly motivated by the recognition I can earn from other people	.504	**.940**
I have to feel that I'm getting something in return for everything I do	.462	**.823**
I want other people to see and appreciate how good I really can be in my study	.225	**.828**
I believe that there is no point in doing a good job if nobody else knows about it	.104	**.806**
I prefer work I know I can do well over work that stretches my abilities	.113	**.785**
I enjoy relatively simple, straightforward tasks	.005	**.775**
I am strongly motivated by the grades I can earn	.281	**.731**
I am keenly aware of the earning (financial) goals I have for myself	.141	**.669**
I seldom think about grades and awards	.098	**.5869**
Means	4.26	5.03
SD	.906	1.034
Reliabilities	.74	.70

a. Rotation converged in 3 iterations.

ROTATED COMPONENT MATRIX FOR SELF-DIRECTION

Rotated Component Matrixa

	Component		
	1	2	3
Component 1: SELF-MANAGEMENT			
I manage my time well	**.846**	.038	.148
I am organized	**.798**	.137	.211
I set strict time frames	**.781**	.200	.048
I am self disciplined	**.695**	.152	.274
I have good management skills	**.576**	.421	.228
Component 1: DESIRE FOR LEARNING	.353	**.745**	-.105
I enjoy studying			
I have a need to learn	.243	**.726**	.219
I enjoy learning new information	.017	**.715**	.435
I want to learn new information	.072	**.703**	.355
I enjoy a challenge	.148	**.528**	.464
Component 1: SELF-CONTROL			
I like to make decisions for myself	.168	.269	**.739**
I am in control of my life	.345	-.001	**.680**
I am responsible for my own decisions/actions	.027	.475	**.660**
I prefer to set my own goals	.388	.271	**.501**
I have high personal standards	.288	.449	**.481**
Means	4.98	5.71	5.84
SD	1.168	.819	.822
Reliability	.85	.81	.78

a. Rotation converged in 8 iterations.

ROTATED COMPONENT MATRIX FOR TAM

Rotated Component Matrix[a]

	Component	
	1	2
Component 1: PERCIEVED USEFULNESS		
MT will enable me to access learning content more often	**.844**	.231
MT would enable me to access learning content more quickly	**.840**	.208
I would find mobile technology (MT) useful in my learning	**.838**	.221
Taking a mobile-supported course would provide me with an efficient way to utilise my time	**.831**	.235
MT will make learning more interesting	**.827**	.192
Using MT for learning is a good idea	**.800**	.265
Working with the mobile technology will be fun	**.792**	.189
I believe it would be more convenient to access learning content via a mobile device over using a computer	**.697**	.164
I believe I would find it easy to use a mobile device to support my learning	**.682**	.308
I believe I would be more willing to use MT if I had support if I needed help	**.581**	-.206
Component 1: PERCEIVED EASE OF USE		
I would be anxious about having to use my mobile device to help support my learning (R)	-.012	**.727**
I think it might take me awhile to get comfortable with using a mobile device for learning (R)	.111	**.711**
I would be concerned if ML was a required component of my study (R)	.173	**.696**
I believe that it would take me longer to accomplish learning tasks using a mobile device (R)	.229	**.608**
Mobile Learning (ML) would not be compatible with how I learn	.320	**.594**
Means	4.79	3.7
SD	1.296	1.135
Reliability	.94	.74

a. Rotation converged in 3 iterations.

Note: Only items referring to Perceived Ease of Use and Usefulness analyzed

APPENDIX J: FACTOR ANALYSIS – EDUCATORS

ROTATED COMPONENT MATRIX FOR ICT SKILL

Rotated Component Matrix[a]

	Component		
	1	2	3
Component 1: SPECIFIC MOBILE SKILL			
Use a mobile phone to send or receive email	**.980**	.119	.197
Use a mobile phone to access information/services on the web	**.917**	.175	.395
Use a mobile phone to take digital photos or movies	**.819**	.377	.383
Use a mobile phone to send pictures or movies to others	**.805**	.366	.487
Component 2: GENERAL ICT SKILL			
Use the web to send or receive email	-.031	**.882**	.335
Use the web to buy or sell things (e.g. Trade Me)	.171	**.862**	.143
Use the web to look up reference information for study purposes	.051	**.816**	.397
Use a mobile phone to call people	.486	**.804**	.071
Use the web to use social networking software on the web (e.g. Facebook, MySpace etc)	.379	**.793**	.246
Use a mobile phone to text/ SMS people	.509	**.638**	.159
Use the Internet to make phone calls (e.g. Skype)	.424	**.499**	.197
Component 3: EXPERT/SPECIALISED ICT SKILL			
Use a computer to create/edit audio and video	.330	.255	**.898**
Using a computer to play digital music files (e.g. iTunes) without accessing the Internet	.229	.293	**.890**
Use a computer to manage/manipulate digital photos	.313	.424	**.805**
Use a mobile phone to download and play games or applications from the Internet	.585	.091	**. 804**
Use a mobile phone to play, and upload music (such as MP3 or the radio	.591	.308	**.715**
Means	3.45	5.63	3.92
SD	2.112	1.120	1.702
Reliability	.93	.84	.85

ROTATED COMPONENT MATRIX FOR ICT SELF-EFFICACY (Perceived control, anxiety and attitude)

	Component	
	1	2
Component 1: ICT ANXIETY		
ICT is difficult to use	**.827**	-.020
ICT frustrates me	**.811**	-.089
I feel insecure about my ability to use ICT	**.798**	-.214
I need someone to tell me the best way to use a computer	**.765**	.487
Component 2: ATTIITUDE AND CONTROL		
I enjoy working with technology	.551	**.941**
I can make the computer do what I want it to do	-.232	**.843**
If I have a problem using the computer, I could usually solve it one way or another	.048	**.715**
I could probably teach myself most things I need to know about computers	-.124	**.638**
I enjoy using and learning new technology	-.093	**.433**
I am in complete control when I use a computer	.189	**.108**
Means	3.65	3.61
SD	1.512	1.505
Reliability	.78	.650

ROTATED COMPONENT MATRIX FOR ICT TEACHING SELF-EFFICACY

Rotated Component Matrix[a]

	Component	
	1	2
Component 1: ICT ABILITY		
I see ICT as tools that can complement my teaching.	**.900**	.130
ICT provide variety in instruction and in content for my students.	**.873**	.151
ICT allows me to bring current information to the class	**.816**	.206
ICT provides opportunities for individualized instruction.	**.754**	.000
Component 2: ICT ATTITUDE		
I feel frustrated more often when I use ICT in my classes than when I don't use them (R)	.053	**.765**
I have positive ICT experiences at my teaching institute.	-.149	**.754**
I had positive experiences with computers when I was younger	.263	**.659**
I feel I am trained well enough to use a variety of ICT tools when teaching	.210	**.657**
I have enough support at my teaching institute to be able to use technology I want to	.146	**.598**
Means	4.47	5.51
SD	1.352	.807
Reliabilities	.87	.73

a. Rotation converged in 3 iterations.

ROTATED COMPONENT MATRIX FOR MOTIVATION

Rotated Component Matrixa

	Component	
	1	2
Component 1: INTRINSIC MOTIVATION		
The more difficult the problem, the more I enjoy trying to solve it	**.910**	-.120
I often will look for work that challenges me	**.826**	-.043
I prefer to figure things out for myself	**.809**	.017
It is important for me to have an outlet for self-expression	**.779**	.130
Curiosity is the driving force behind much of what I do	**.573**	.103
I enjoy tackling problems that are completely new to me	**.360**	.044
I prefer work I know I can do well over work that stretches my abilities (R)	**-.359**	.118
I want my work to provide me with opportunities for increasing my knowledge and skills	**-.337**	.166
I enjoy relatively simple, straightforward tasks (R)	**.201**	.053
What matters most to me is enjoying what I do	**-.066**	.008
Component 2: EXTRINSIC MOTIVATION		
To me, success means doing better than other people	.220	**.889**
I am strongly motivated by the money I can earn	-.261	**.794**
I believe that there is no point in doing a good job if nobody else knows about it	.039	**.765**
I want other people to see and appreciate how good I really can be in my work study	-.008	**.728**
I seldom think about salary and promotion (R)	-.195	**.495**
I have to feel that I'm getting something in return for everything I do	.163	**.441**
I am keenly aware of the earning (financial) goals I have for myself	.072	**.414**
I am strongly motivated by the recognition I can earn from other people	-.127	**.377**
Mean	5.06	3.95
SD	1.149	1.149
Reliability	.75	.66

a. Rotation converged in 3

ROTATED COMPONENT MATRIX FOR TAM

Rotated Component Matrix[a]

	Component	
	1	2
Component 1: PERCEIVED USEFULNESS		
MT will make learning and teaching more interesting	**.829**	.073
I see ML as a way of encouraging more interaction by students and educators	**.758**	-.053
I see ML as a way to improve student learning as it allows students to access learning content anywhere and anytime	**.746**	.134
I see ML as a way to enhance/encourage my students self-directed learning	**.734**	.171
MT will increase student's interest	**.639**	.190
I believe that using MT would enable me to accomplish tasks more quickly	**.513**	.343
I believe MT offers increase accessed to leaning material by my students	**.351**	-.072
I would find mobile technology (MT) useful in my teaching	**.340**	.020
I see Mobile Learning (ML) as a way to offer more flexibility to my students compared to e-learning	**.230**	.020
Component 2: PERCIEVED EASE OF USE		
I would be anxious about having to use my mobile device to help support my learning (R)	.052	**.891**
I think it might take me a while to get comfortable with using a mobile device for teaching (R)	.443	**.857**
I believe I would find it easy to use a mobile device to support my teaching	.413	**.854**
I feel that I would have the knowledge necessary to implement and use MT in my teaching	.227	**.829**
I would feel uncomfortable about using MT in front of others in case I am unable to work it correctly (R)	-.078	**.811**
ML requires too much time to support and setup (R)	-.276	**-.687**
I believe that using a mobile device to access learning content would take longer that simply using a computer (R)	-.275	**-.618**
Means	5.25	4.49
SD	1.130	1.190
Reliability	.67	.70

a. Rotation converged in 3 iterations.

Note: Only items referring to Perceived Ease of Use and Usefulness analyzed

APPENDIX K: COMPARISON BETWEEN EDUCATOR AND STUDENTS HYPOTHESES

Summary of hypothesis	Hypothesised Path	Supported in Student Model?	Supported in Educator Model?
H1-3 a and b: A student/educator with higher levels of skill with general ICT skill (H1), advanced ICT skill (H2), specific mobile skill (H3) will more likely to see mobile learning as easy to use and useful.	**H1a**: GICTS → PEOU	No	Yes
	H1b: GICTS → PU	No	No
	H2a: SMS → PEOU	Yes	No
	H2b: SMS → PU	Yes	No
	H3a: ExICTS → PEOU	No	No
	H3b: ExICTS → PU	No	No
H4-6: A student/educator with higher levels of skill with general ICT skill (H4), advanced ICT skill (H5), specific mobile skill (H6) will more likely to adopt mobile learning.	**H4**: GICTS → BI	Yes	Yes
	H5: SMS → BI	No	Yes
	H6: ExICTS → BI	No	No
H7-9: As a student/educator becomes more skilled in one area of ICT usage the more likely they will adopt a wider use of a range of ICT technologies.	**H7**: GICTS → SMS	Yes	Yes
	H8: GICTS → ExICTS	Yes	Yes
	H9: SMS → ExICTS	Yes	No
H 10 a and b: A student/educator with low ICT anxiety will more likely to see mobile learning as easy to use and useful.	**H10a**: Anx→ PEOU	Yes	Yes
	H10b: Anx→ PU	Yes	No
H11: A student/educator with a low ICT anxiety will more likely to adopt mobile learning.	**H11**: Anx → BI	No	No
H12-14: As a student/ educator becomes more competent with ICT they more likely that they will have less anxiety.	**H12:** SMS → Anx	Yes	Yes
	H13: GICTS → Anx	Yes	Yes
	H14: ExICTS → Anx	Yes	No
H15-16 a and b: An educator with higher levels of ICT-teaching self-efficacy will more likely to see mobile learning as easy to use and useful.	**H15a:** SEabl → PEOU	N/A	Yes
	H15b: SEabl → PU	N/A	Yes
	H16a: SEAtt → PEOU	N/A	No
	H16b: SEAtt → PU	N/A	Yes
H17 -18: An educator with higher levels of ICT-teaching self-efficacy will more likely to adopt mobile learning.	**H17:** SEabl → BI	N/A	No
	H18: SEAtt → BI	N/A	No
H19-20 a and b: A student/ educator who is highly internally (H19) or externally (H20) motivated will more likely to see mobile learning as easy to use and useful.	**H19a**: IM → PEOU	No	No
	H19b: IM → PU	No	No
	H20a: EM → PEOU	No	No
	H20b: EM → PU	Yes	No
H21-22: A student/ educator who is highly internally or externally motivated will more likely to adopt mobile learning.	**H21**: IM → BI	No	No
	H22: EM → BI	No	No

Summary of hypothesis	Hypothesised Path	Supported?	
H 23-25a and b: A student with higher levels of self directed readiness will more likely to see mobile learning as easy to use and useful.	**H23a:** DfL → PEOU	No	N/A
	H23b: DfL → PU	Yes	N/A
	H24a: SC → PEOU	No	N/A
	H24b: SC → PU	Yes	N/A
	H25a: SM → PEOU	No	N/A
	H25b: SM → PU	No	N/A
H26-28: A student with higher levels of self directed readiness will more likely indicate their intention to adopt mobile technology.	**H26:** DfL → BI	Yes	N/A
	H27: SC → BI	No	N/A
	H28: SM → BI	Yes	N/A
H29: Students who are strongly intrinsically motivated would more likely be strongly self-directed.	**H29a:** IM → DfL	No	N/A
	H29b: IM → SC	No	N/A
	H29c: IM → SM	Yes	N/A
H30: A student/ educator who perceives mobile learning as ease to use will have positive perception of mobile leaning usefulness.	**H30**: PEOU → PU	Yes	Yes
H31: A student/ educator who perceives mobile learning as useful will more likely indicate that they would likely adopt mobile technology in the future.	**H31**: PEOU → BI	Yes	No
H32: A student/ educator who perceives mobile learning as easy to use will more likely indicate that they would likely adopt mobile technology in the future.	**H32**: PU → BI	Yes	Yes
H33: An educator who is competent using ICT is more likely to have higher levels of ICT-teaching self-efficacy.	**H33a:** SMS → SEabl		Yes
	H33b: GICTS → SEabl		Yes
	H33c: ExICTS → SEabl		No

APPENDIX L: ETHICS NOTIFICATION

Massey University

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9 December 2009

Kathryn MacCallum
3 Kokako Place
Taradale
NAPIER

Dear Kathryn

Re: Mobile Learning Adoption and the Implications for Teaching and Learning

Thank you for your Low Risk Notification which was received on 8 December 2009.

Your project has been recorded on the Low Risk Database which is reported in the Annual Report of the Massey University Human Ethics Committees.

The low risk notification for this project is valid for a maximum of three years.

Please notify me if situations subsequently occur which cause you to reconsider your initial ethical analysis that it is safe to proceed without approval by one of the University's Human Ethics Committees.

Please note that travel undertaken by students must be approved by the supervisor and the relevant Pro Vice-Chancellor and be in accordance with the Policy and Procedures for Course-Related Student Travel Overseas. In addition, the supervisor must advise the University's Insurance Officer.

A reminder to include the following statement on all public documents:

> *"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.*
>
> *If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director (Research Ethics), telephone 06 350 5249, e-mail humanethics@massey.ac.nz".*

Please note that if a sponsoring organisation, funding authority or a journal in which you wish to publish requires evidence of committee approval (with an approval number), you will have to provide a full application to one of the University's Human Ethics Committees. You should also note that such an approval can only be provided prior to the commencement of the research.

Yours sincerely

J O'Neill

John G O'Neill (Professor)
Chair, Human Ethics Chairs' Committee and Director (Research Ethics)

cc Dr Lynn Jeffrey
Department of Management and International Business
Albany

Assoc Prof John Monin, HoD
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