Managing mobile learning in a higher education environment

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KEY WORDS

Mobile learning, mobile technologies, management of m-learning, mobile conception of society, mobility of the technologies, mobility of the students, mobility of the lecturers, mobility of higher education, educational management systems, technology systems, competitive advantage, technology infrastructure, mobile culture, student expectations, lecturer expectation, mobile technology assets, mobile technology actions, attitude towards mobile technologies, mobile Internet, web of connectivity, increase capacity, quality teaching, quality learning, effectiveness, productivity, educational content delivery.

ABSTRACT

The aim of this study is to conduct a thorough theoretical study on **mobile learning (m-learning)** in order to achieve the primary objective of the study which is to develop a general framework to implement and manage **mobile technologies** in a higher education environment.

The focus of the literature study was to research the state of mobile technologies and their relevance to teaching and learning. The literature study investigate the implications of mobile technologies for students, lecturers and thus for the institution and provided an overview of frameworks found in literature with the emphasis on the **management of m-learning** within the higher education institution.

M-learning is part of a new **mobile conception of society**, with the mobility of the technologies impacting on the **mobility of the students**, the lecturers and ultimately on the **mobility of higher education**. Literature suggests that, while m-learning is proving to be innovative, the factors that most strongly impact on the ultimate success or failure of m-learning will depend on human factors, the balancing of technological ideals and pedagogical imperatives, and the successful management of the interface between human **educational systems** and **technology systems**. The proposed general framework focuses on addressing key issues related to m-learning from the perspective of the student, the lecturer and thus the institution. In order to remain competitive higher education needs to be diligent in maintaining the complex **technology infrastructure** that supports a thriving **mobile culture** that will meet and exceed the expectations of both lecturers and students.

The empirical research conducted had as objectives to investigate the **mobile technology assets** of respondents with regard to the hardware and the software that they own, the

mobile technology actions of respondents in regard to what they do with the mobile technology that they own and to investigate the respondent's **attitude towards mobile technologies**. A survey was designed and distributed to a sampling of the academic staff and students of the North-West University (NWU) in South Africa, specifically the Potchefstroom Campus.

There is ample proof from the empirical study that there is a gap with regard to the level of accessibility, usage, and attitude with regards to the different interest groups in the higher education environment. Higher education institutions should invest in investigating these gaps further and in leveraging off the benefits of the effective management of these technologies to improve teaching and learning.

The final chapter concludes with a summary of the secondary objectives researched in the literature (Chapter two) and empirical research (Chapter three) chapters in order to support recommendations towards the primary objective of this study. The rapid pace of adoption and advancement of mobile technologies creates opportunities for new and innovative services provided through such mobile devices. Higher education finds itself in the early innings of the **mobile Internet** pulling both lecturers and students towards the same place: smaller, faster, cheaper devices working together in a **web of connectivity**.

Recommendations were made in this final chapter on how higher education institutions can leverage the benefits of the effective management of mobile technologies to improve teaching and learning. M-learning has the potential to **increase the capacity** of higher education through improving **efficiency and productivity** of teaching and learning**.** M-learning could address challenges related to **quality of teaching** such as continuous professional training, lifelong upgrading, connecting with academics worldwide and communicating effectively with students. Higher education is discovering the potential of m-learning to promote student engagement and improving the **quality of learning**. Management of higher education institutions and systems, management of policymaking including storage and analysis of data, construction and assessment of policy scenarios, and tracer studies or academic tracking systems can be improved through the use of m-learning.

Mobile technologies will continue to increasingly become an integral part of students' and lecturers' private and day to day lives and m-learning will be integral in **educational content delivery**. Additional research is required to study the effective and optimal implementation of m-learning. A better understanding of the benefits and leverage thereof is required and additional research should provide answers to these questions.

SLEUTELWOORDE

Mobiele leer, mobiele tegnologieë, die bestuur van m-leer, mobiele konsep van die samelewing, die mobiliteit van tegnologie, die mobiliteit van studente, mobiliteit van dosente, mobiliteit van hoër onderwys, akademiese bestuurstelsels, mededingende voordeel, tegnologie-infrastruktuur, mobiele kultuur, verwagtinge van die student, verwagtinge van die dosent, mobiele tegnologie bates, mobiele tegnologie aksies, houding teenoor mobiele tegnologieë, mobiele internet, kapasiteit te verhoog, kwaliteit van onderrig, gehalte van leer, doeltreffendheid, produktiwiteit, akademiese inhoud aflewering.

OPSOMMING

Die doel van die studie is om 'n deeglike teoretiese studie te doen oor **mobiele leer (m-leer)**. Die primêre doel van die studie is om 'n algemene raamwerk te ontwikkel, vir die implementering en bestuur van mobiele tegnologie in 'n hoër onderwys omgewing.

Die fokus van die literatuurstudie is om die stand van **mobiele tegnologie** en die relevansie van hierdie tegnologie ten opsigte van onderrig en leer te ondersoek. Die literatuurstudie ondersoek die implikasies van mobiele tegnologie vir studente, dosente en dus vir die instelling. 'n Oorsig van m-leer raamwerke in die literatuur met die klem op die **bestuur van die m-leer** word bespreek.

M-leer is deel van 'n nuwe **mobiele konsep van die samelewing**, met die mobiliteit van die tegnologie wat 'n impak het op die **mobiliteit van studente**, die **mobiliteit van dosente** en uiteindelik op die **mobiliteit van hoër onderwys**. Die literatuur dui daarop dat, terwyl m-leer innoverend blyk te wees, die faktore wat die sterkste impak op die uiteindelike sukses of mislukking van m-leer, sal afhang van menslike faktore, die balansering van tegnologiese ideale en pedagogiese imperatiewe, en die suksesvolle **bestuur** van die interaksie tussen menslike **akademiese bestuurstelsels** en tegnologie. Die voorgestelde algemene raamwerk fokus op die bespreking van belangrike kwessies wat verband hou met mobiele leer uit die perspektief van die student, dosent en die hoër onderwys instelling. Ten einde kompeterend te bly moet hoër onderwys die komplekse **tegnologie-infrastruktuur** en **mobiele kultuur** van die instelling bestuur, om sodoende die verwagtinge van beide dosente en studente aan te spreek.

Die empiriese navorsing se doelwitte is om die **mobiele tegnologie bates** van die respondente met betrekking tot die hardeware en sagteware wat hulle besit, die **mobiele tegnologie aksies** van die respondente ten opsigte van wat hulle doen met die mobiele tegnologie, en respondent se **houding teenoor mobiele tegnologie** te ondersoek. 'n Vraelys is ontwerp en versprei onder die akademiese personeel en studente van die Noordwes-Universiteit (NWU) in Suid-Afrika, spesifiek die Potchefstroom-kampus.

Daar is genoeg inligting ingesamel deur die empiriese studie om te staaf dat daar 'n leemte met betrekking tot die vlak van toeganklikheid, gebruik en houding met betrekking tot die verskillende belangegroepe in die hoër onderwys omgewing bestaan ten opsigte van mobiele tegnologie. Hoër onderwys instellings moet belê in navorsing om hierdie gapings verder te ondersoek en voordeel te trek uit die potensiaal wat m-leer bied ten opsigte van die verbetering van die doeltreffendheid van onderrig en leer.

Die finale hoofstuk sluit af met 'n opsomming van die sekondêre doelwitte wat in die literatuurstudie (hoofstuk twee) en empiriese navorsings (hoofstuk drie) hoofstukke bespreek word, ten einde aanbevelings te ondersteun ten opsigte van die primêre doel van hierdie studie. Die vinnige tempo van tegnologiese verandering skep geleenthede vir nuwe en innoverende dienste wat gelewer kan word deur middel van 'n mobiele toestelle. Hoër onderwys bevind homself in die wegspringblokke van die **mobiele Internet** en in 'n web wat gedryf word deur konnektiwiteit.

Aanbevelings is gemaak in die laaste hoofstuk oor hoe hoër onderwys instellings kan voordeel trek uit die doeltreffende bestuur van mobiele tegnologie en onderrig en leer daardeur te kan verbeter. M-leer het die potensiaal om die **kapasiteit** van hoër onderwys te verhoog, deur die **doeltreffendheid en produktiwiteit** van onderrig en leer te verbeter. M-leer kan uitdagings tot die **gehalte van onderrig** soos deurlopende professionele opleiding, en lewenslange leer aanspreek. M-leer het die potensiaal om studente betrokkenheid te bevorder en **leer te verbeter**. Die **bestuur van akademiesestelsels**, die stoor en ontleding van data, beplanning en evaluering van beleid deur middel van situasie analise, en om akademiese vordering te bestuur kan deur mobiele tegnologie verbeter word.

Mobiele tegnologieë sal voortgaan om toenemend 'n deel van die studente en dosente se private lewens te speel en m-leer sal ’n integrale deel word van **opvoedkundige inhoud aflewering.** Meer navorsing is nodig om die doeltreffende en optimale implementering van m-leer te bestudeer.

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CHAPTER 1
ORIENTATION AND PROBLEM STATEMENT

1.1 INTRODUCTION

Academic leadership in managing information and communication technologies (ICT), including mobile devices and applications, will impact the successful implementation of mobile learning, here further referred to as m-learning, in a higher education environment. The growing demand among students and lecturers for improved educational accessibility, convenience and lower costs, is radically changing the environment of higher education.

Being mobile can be defined as being detachable, unfixed or not limited to a location, constantly transferable and freely movable from one place to another (Khaddage, Lanham & Zhou, 2009:18). Mobile devices may include but are not limited to mobile phones, handheld personal computers, tablets, netbooks, and laptops as well as devices such as the iPod touch that are able to run mobile applications (Educause, 2010a:7). Internet capable mobile devices are furnished with wireless application protocol (WAP) and wireless fidelity (Wi-Fi) capacities in order to deliver content and instruction that can enable students to learn at anytime and anywhere (El-Hussein & Cronje, 2010:17). Thus, m-learning, refers to any educational interaction delivered through mobile technology and accessed at a student's convenience from any location (Educause, 2010a:7).

Institutions of higher education have increasingly invested more money, resources and time in technology initiatives (Alexander, 2001: 240). Demands on funding and the emergence of new technology-based delivery systems are opening the door to competitors and new educational organisations that will compete directly for students as customers (Bradmore & Smyrnios, 2009:4). In this dissertation the researcher intend to investigate these technological initiatives and m-learning innovations in order to develop a general framework for the implementation of mobile technologies in a higher education institution.

1.2 BACKGROUND TO THE STUDY

The United Nations population division predicts that in 2011 the world population will have reached 7.000.000.000 (Potter, 2011:1). The International Telecommunications union (ITU), a United Nations agency, estimates that there will be 5.3 billion mobile subscriptions in the

world by the end of 2010. They further state that the number of people accessing the mobile Internet is growing fast and is expected to overtake the personal computer as the most popular way to get on the web within five years. The International Data Corporation (IDC) estimated that there were more than 450 million mobile Internet users worldwide in 2009; this will have passed the 1 billion mark by 2013 (Framingham, 2009:1). The ITU estimated that mobile cellular subscription in South Africa rose from nearly 14 million in 2002 to over 42 million in 2007, indicating that just over 90% of the total number of telephone subscribers (landline plus mobile phone) in South Africa are mobile telephone users (Hodgkinson-Williams & Ng'ambi, 2009:6).

Table 1.1: Mobile phone penetration in South Africa

Mobile cellular subscribers					As % of total telephone subscribers
Thousands		*CAGR (%)	Per 100 inhabitants	Percentage digital	
2002	2007	2002-07	2007	2007	2007
13,702.00	42,300.00	25.3	87.1	100.0	90.1

Source: Adapted from Hodgkinson-Williams & Ng'ambi, (2009:7).

*Compound annual growth rate.

The technological structures for wireless telephony and computing are in place with the successful development of bluetooth, wireless application protocol (WAP), general packet radio system (GPRS) and universal mobile telecommunications system (UMTS), (Keegan, 2005:31). A number of different mobile wireless devices are being used in higher education. These include web-enabled wireless phones (e.g., smart phones), web-enabled wireless handheld computers (e.g. palmtop, and tablet computers), wireless laptop computers, and Personal Digital Assistants (PDAs) (Kim Mims & Holmes, 2006:83).

According to Keegan (2005:31) wireless technologies and applications are replacing wired ones, and with it distance learning (d-learning) and electronic learning (e-learning) are moving towards mobile learning (m-learning). M-learning is concerned with student mobility, in the sense that students should be able to engage in educational activities without constraints of having to do so in a tightly delimited physical location (Kukulska-Hulme & Traxler, 2005:1). One of the biggest challenges faced by higher education in South Africa is to provide support and education for students who are geographically isolated from their lecturers and peers, particularly in rural South Africa. University of South Africa (UNISA) as a distance education institution is facing the challenge to provide support and education for students who are geographically isolated from their lecturers and peers, particularly in rural South Africa.

A pilot study conducted at UNISA, involved the use of MXit, a social network tool that is generally popular and inexpensive to use, to encourage students to interact with one another and to offer mutual help and support in a process of collective learning (Kuklska-Hulme, 2010:183).

In another example m-learning is utilised in a three-year pan-European research and development programme that uses mobile technology to teach basic literacy and numeracy skills. It is targeted at young adults aged 16 to 24, who are deemed to be 'at-risk' because they are mainly outside of formal education, and in low skilled employment or unemployed. This initiative aims to give them better future prospects. The infrastructure supporting this project includes a learning management system and a custom designed micro portal interface, m-portal, contributed by project partner Ultralab. This facilitates access to m-learning materials and services from a variety of mobile devices plus web and TV access. Technologies such as SMS, VoiceXML and picture messaging are implemented in a device-independent way via mobile phones, smart phones, handheld computers and networked laptop computers (Lonsdale, Naismith, Sharples & Vavoula, 2006:17).

Technological innovations such as m-learning are not guaranteed to have a positive impact. It can bring complex issues to the fore regarding adoption, integration and financing, as technological innovation mostly lags behind organisational innovation (Oblinger, 2010:4). Information technology has set in motion fundamental changes to the nature of higher education, and higher education leaders need to manage the transformational process. Higher education institutions are organisations with structures and values that protect the *status quo;* the governance processes are geared towards constraining and controlling change (Koester, 2011:40). However, change is inevitable and should be managed with consideration for honouring time held traditions.

Advances in mobile technologies are rapidly changing with innovations from high-tech materials such as graphene and wireless recharging. South Africa's mobile broadband is ahead of many other countries boasting 21.1Mb/s HSPA+ connectivity. This will continue to grow as more and more competitors are researching better technologies (Simons, 2011:1). The improvement in infrastructure will continue to be the driving force behind m-learning and, as demand requires that more applications be re-authored for mobile formats, higher education institutions may find it necessary to overhaul data-sharing and content-delivery techniques to support the mobile platform (Educause, 2010a:2).

1.3 IMPORTANCE OF THE STUDY

Leaders and managers who work in the higher education environment face challenges common to all institutional leaders, such as rapidly changing technology, shrinking budgets, policy and legislative changes, globalisation, private sector competition, and a changing student population (Staley & Trinkle, 2011:16-30). Successful higher education leaders must be aware of emerging technologies and their potential value-added advantages for higher education institutions. The question is how higher education institutions will implement, utilise and manage mobile technologies and their rapid changes, and what impact these technologies will have on students, lecturers and administrators. Answering these questions will help higher education leaders to manage the resistance to change and optimise the effective implementation and usage of mobile technologies to gain a competitive advantage for their institutions.

The efficiency of higher education institutions will be a major factor in not only their own but also the country's competitiveness since a highly qualified workforce contributes substantially to a nation's economic competitiveness (Wagner, 2006:1). To create a sustainable competitive advantage in the present era of knowledge driven economy, the role of higher education becomes crucial in the overall socio-economic development of any country (Makkar, Ole Grabriel & Tripathi, 2008:3). Higher education institutions are the primary loci of knowledge production and the reproduction of knowledge for the country. The Department of Higher Education and Training proposes to achieve a 50% participation rate in all higher education institutions and for broader geographic access. To achieve this, the higher education system must focus on creating additional capacity over the next 20 to 30 years (Department of Higher Education and Training, 2009:22).

Mobile technology is helping to improve how faculty members teach, students learn, and institutions do business, and have vast potential for creating additional capacity for higher education institutions. Higher education institutions' success is measured according to how successful they are at retaining and graduating students and this should be their most important priority (Hrabowski & Suess, 2010:61). Since higher education institutions are subsidised by the government, there is the incentive to increase retention and graduation rates and to optimise capacity. As higher education globalises, its potential contributions are now seen as crucial components of cross-border economic competitiveness. Students will be competing with students around the world and the efficiency of the higher education institutions will be a major factor in not only their own but also their country's competitiveness.

1.4 CAUSAL FACTORS TO THIS STUDY

One of the main concerns when trying to introduce a new technology is who will be able to use it. This depends on what devices will be used and how many users' posses those types of devices (Al-Mushasha, 2010:2). An unpublished study done at the North-West University on the Potchefstroom campus revealed the following with regard to the technology ownership of students:

- Approximately 57.5% of respondents owned a personal computer
- 65.8% owned a laptop computer
- 23.1% of the computers that are less than one year old are laptops and 11.2% are personal computers
- Respondents indicated a preference for newer, more mobile and faster electronic devices, with 91.8% of respondents who indicated that they own an Internet capable handheld device (cell phone, PDA or smart phone) (le Roux & Olivier, 2011:2).

According to the Educause study (Smith & Caruso, 2010:22) into student technology adoption, there is little doubt that mobile technology will continue to expand as a consumer technology and will experience wide spread adoption and usage among higher education students.

Mobile technologies are potentially very valuable, especially in developing countries, because of their rapid adoption rate (Hodgkinson-Williams & Ng'ambi, 2009:6). Wireless cellular phone technologies offer new opportunities for open educational resource (OER) access, especially in the developing world (Atkins Seely-Brown & Hammond, 2007:35). The availability of mobile phones in South Africa has spurred interest in how this technology can be appropriated for learning (Hodgkinson-Williams & Ng'ambi, 2009:6).

The higher education sector in South Africa faces distinct challenges;

- Structural challenges include skills bottlenecks, especially in priority and scarce skills areas;
- low participation rates;
- distortions in the shape, size and distribution of access to education and training;
- as well as quality and inefficiency challenges in the system and its sub-systems and in institutions (Maharajh & Pogue, 2008:25).

If we are to meet the economic and social goals of participation in an inclusive economy and society, these challenges will have to be addressed so that we are equipped to compete in a more sustainable, diversified and knowledge-intensive international economy, which will meet the developmental goals of South Africa (Department of Higher Education and Training, 2009:17).

1.5 OBJECTIVES OF THE STUDY

This study comprises primary and secondary objectives. The primary objective is an indication of the purpose and intention of the study. The secondary objectives are an indication of the state of mobile technology's impact on higher education.

1.5.1 Primary objectives

The primary objective of this study is to develop a general framework to implement and manage mobile technologies in a higher education environment.

1.5.2 Secondary objectives

To achieve this primary objective of the study, the secondary objectives to be realised were as follows:

- Theory evaluation:
  - Perform a literature study to research the state of mobile technologies and why they are relevant to learning.
  - To investigate the implications of mobile technologies for students, lecturers and thus for the institution.
  - Provide an overview of frameworks found in literature with emphasis on the management of m-learning within the institution.
  - Explore the future developments in mobile technology in higher education.

- Empirical research:
  - Investigate the mobile technology assets of respondents with regard to the hardware and the software that they own.
  - Investigate the mobile technology actions of respondents in regards to what they do with the technology that they own.
  - Investigate the respondents' attitude towards mobile technologies.

From both the theory and the empirical research the final objective is to recommend a general framework for implementing mobile technologies which can be used to create a sustainable competitive advantage for the institution.

1.6 SCOPE AND LIMITATIONS OF THE STUDY

The study will achieve an understanding of the impact of mobile technologies on higher education. The study will determine which mobile technologies students and lecturers own, what they do with these mobile technologies, and their attitudes towards these mobile technologies. From the study, certain recommendations will be made to develop a general framework for the implementation and management of mobile technologies in a higher education environment. The developed general framework can be used to create a sustainable competitive advantage for the higher education institution.

This study is limited to mobile technologies and their impact on higher education institutions. The empirical study was limited to information gained from the North-West University in South Africa, with specific reference to the Potchefstroom campus. The literature study was limited to sources of information generally available.

1.7 RESEARCH METHODOLOGY

In order to answer the research questions, a literature study was executed followed by an empirical study.

1.7.1 Literature study

A literature study was undertaken to explore the state of mobile technologies and why they are relevant to learning; the implications of mobile technologies for students, lecturers and thus the institution; the competitive value added of mobile technologies within the institution; and the future of mobile technology in higher education.

In order to reach the objectives of the study extensive literature searches was conducted on: Google Scholar and the EBSCO host, ERIC, Academic Search Premier, Computers and Applied Sciences Complete and Google databases, catalogues of South African and international university libraries, Sabinet as well as accredited academic publications and text books.

1.7.2 Empirical study

Primary information was also gathered by means of an empirical study. A quantitative research approach was used to gather valid and reliable data in order to address the research question and the objectives. Questionnaires were distributed to the relevant students and lecturers from the North-West University, South Africa, Potchefstroom campus. Participants were selected by means of non-probability, convenience sampling.

1.8 DIVISION OF CHAPTERS

This dissertation is divided into four chapters. A brief description of each chapter is discussed in the section below:

Chapter One - This chapter briefly discusses the contents of and the nature and scope of the study. A brief overview is given on both mobile technologies and m-learning. The causal factors are discussed and the research objectives defined. The research methodology used as well as the target population is discussed.

Chapter Two - This chapter discusses the literature study. Mobile technologies are investigated, looking at mobile devices and hardware as well as mobile applications and software. M-learning is defined and investigated in three significant areas: mobility of the technology, mobility of the student and mobility of the lecturer. Models for framing the implementation of m-learning are studied, and lessons learned are identified. How digital competitiveness can contribute to a competitive advantage is reviewed under the implications of mobile technologies on students, lecturers and thus the institution.

Chapter Three - The research design is discussed outlining the methodology used during the empirical study. The design of the questionnaire is discussed, as well as the sample design and process of analysis and evaluation of the data. The results from the survey questionnaires are presented in relation to the literature study.

Chapter Four - Final recommendations are made to the development of a general framework for the implementation of mobile technologies in a higher education environment. A holistic approach is followed to present the recommendations for the study as emphasised in the nature of the study. Practical conclusions are made and a brief evaluation is done to confirm that objectives were met. The dissertation is concluded by indentifying opportunities for future research.

1.9 CONCLUSION

The main conclusion that can be drawn from chapter one is that the management of mobile technologies to support m-learning can create a sustainable competitive advantage for higher education institutions. Higher education institutions need to remain competitive by addressing the growing demand among students and lecturers for improved accessibility and convenience through emerging technologies such as m-learning. Higher education institutions should focus on providing value through innovative use of emerging technologies to all stakeholders. The research objectives were confirmed, as well as the research methods to be applied. An overview of the chapter division in the dissertation has been provided.

1.10 CHAPTER SUMMARY

In this chapter, we explored the background to the study into mobile technologies and how they impact learning in higher education environments. We propose to indentify best practices through the development of a general framework for the implementation and management of mobile technologies in a higher education environment. Our aim with this general framework for the implementation and management of mobile technologies is to create a sustainable competitive advantage for the higher education institution.

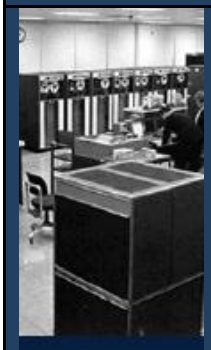
CHAPTER 2
LITERATURE STUDY

2.1 INTRODUCTION

Mobile learning (M-learning) can be defined as any educational interaction delivered through mobile technology and accessed at a student's convenience enabling students to learn at anytime and anywhere (El-Hussein & Cronje, 2010:14). M-learning is part of a new mobile conception of society driven by the mobile internet.

From mainframe to minicomputer, personal computer, desktop Internet, and now the mobile Internet, more and more people benefit from faster processing power, better user interfaces, smaller form factors, lower prices, and expanded services. Moore's law describes a long-term trend in the history of computing software. In 1965 Moore noted that components on silicon chips were doubling every two years (Karlgaard, 2005:1). Eighteen years ago, a cell phone was about the size and shape of a brick. Shrinkage and integration have led to phones with television tuners, 10-megapixel cameras and MP3 players. Declining costs have also put them in the hands of billions of people.

Figure 2.1: Technology cycles.

Mainframe Computing	Mini Computing	Personal Computing	Desktop Internet Computing	Mobile Internet Computing
				
1960s	1970s	1980s	1990s	2000s

Source: Adapted from Meeker (2010:16)

Metcalfe's law has been used to explain the growth of many technologies ranging from cell phones to web applications and social networks, especially online social networks. Metcalfe's Law is the law of the network. Metcalfe's law states that as the number of people in the

network grows, the connectivity increases, and if people can link to one another's content, the value grows at an exponential rate (Hendler & Golbeck, 2007:3). The mobile Internet is ramping faster than desktop Internet did, and it is believed that more users will connect to the Internet via mobile devices than desktop computers within five years (Meeker, 2010:16).

The primary objective of this study is to make recommendations based on the literature and empirical study, towards the development of a general framework to implement mobile technologies and manage m-learning in a higher education environment. The focus of the literature study is to research the state of mobile technologies and their relevance to learning. The literature study sets out to explore the future developments in mobile technology in higher education. The intent of the literature study is thus to investigate the implications of mobile technologies for students, lecturers and thus for the institution and to provide an overview of frameworks found in literature with an emphasis on the management of m-learning within the higher education institution.

2.2 MOBILE INFRASTRUCTURE IN SOUTH AFRICA

Telecommunications is one of the fastest growing sectors of South Africa's economy, with a network that is 99.9% digital and includes the latest in fixed-line, wireless and satellite communication, the country has the most developed telecoms network in Africa The mobile landscape is dominated by multinational companies Vodacom and MTN, with the smaller Cell C coming in third position (Jobodwana, 2009:289). South Africa is one of the fastest growing mobile communications markets in the world. In 2009, there were over 46.4-million mobile users in South Africa, ranking the country 26th in terms of subscriber numbers (Anon, 2008:1).

An increase in the number of undersea data cables linking South Africa to the rest of the world, as well as market liberalisation, has seen a shake-up in local internet access, with the number of South African internet users passing five million in January 2010, finally breaking through the 10% mark in internet penetration for the country (Goldstuck, 2010:2). According to Craig Holmes, the Middle East and Africa communication and industrial sectors executive at IMB, the key focus now is providing the infrastructure to deliver the performance, density and reliability needed to service the burgeoning data transmission needs of today’s smartphones and tablets (Mutheiwana, 2011:1). The Seacom submarine fibre-optic cable system linking south and east Africa to global networks via India and Europe was commissioned in July 2009, while the East African Submarine Cable System (EASSy) that links countries along the continent's eastern coast to the rest of the world, started service in

August 2010. The West African Cable System linking southern and western African countries with Europe is scheduled to be operational by the end of 2011 (Anon, 2008:1).

MTN, Vodacom and Neotel are jointly building a 5 000km fibre-optic cable network connecting several major centres across South Africa. The first phase of the cable, linking Gauteng with KwaZulu-Natal, was commissioned in June 2010 (Anon, 2008:1). Vodacom announced its 35.5% increase in data revenue and its investment in new infrastructure at the 2011 March preliminary results. According to Pieter Uys, CEO of Vodacom Group data, revenue has increased 33.9% to R6 180 million due to increased penetration of mobile personal computing connectivity and mobile internet usage, with active data bundle users increasing by 76.2% to 2.6 million and overall active data customers increasing 34.6% to 9.0 million (Mutheiwana, 2011:1). The Mobility 2011 research project, conducted by World Wide Worx and backed by First National Bank, reveals that 39% of urban South Africans and 27% of rural users are browsing the Internet on their phones in 2011. The study represents around 20-million South Africans aged 16 and above. This means that at least 6-million South Africans now have Internet access on their phones (Goldstuck, 2011:2). South Africa's data and voice costs are still among the highest in the world, but competition within the industry seems to have had some effect on data prices (Mutheiwana, 2011:1).

2.3 MOBILE WIRELESS COMMUNICATION

Today there are several communication technologies which are used in mobile devices. Their abilities vary vastly as well as their data transmission ranges.

Global System for Mobile Communications (GSM) is one of the leading digital cellular systems. GSM networks operate on 900 MHz and 1800 MHz. It (GSM) provides integrated voice mail, high-speed data, fax, paging and short message services capabilities, as well as secure communications. It offers the best voice quality of any current digital wireless standard (Georgiev, Georgieva & Smrikarov, 2004:3). Cellular networks have ubiquitous coverage with 90% global population coverage (Meeker, 2010:100). Cellular systems are described in multiple generations, with third- and fourth-generation (3G and 4G) systems just emerging. A family of wireless communication standards is 3G, which is supporting simultaneous voice and data connections and fast data transfer speeds over a large area up to 10 miles at a speed of 7.2Mbit per second. This 3G is key to the success of mobile internet with 485 million global users and mobile user penetration expected to rise to 44% by 2013. It (3G) increasingly adds Internet connectivity to ubiquitous coverage (Meeker, 2010:27). On

the horizon are 4G systems; while 3G is important in boosting the number of wireless calls, 4G will offer true high-speed data services.

Wireless local area networks (LANs) provide high-speed data within a small region such as a university campus, as users move from place to place. Wi-Fi are used to build wireless local area networks (LAN) that uses high frequency radio signals to transmit and receive data over distances of up to 500 feet at a speed of 108MBit per second (Goldsmith, 2005:12). Broadband Wireless Access provides high-rate wireless communications between a fixed access point and multiple terminals, extending to a few dozen kilometres. WiMax is an emerging broadband wireless technology that provides high speed data access to the Internet, the WWW, and to high speed data networks for both home and businesses (Goldsmith, 2005:14).

Microwave Radio Transmission frequencies are used to transmit data over relatively short distances. Bluetooth is a personal area wireless network that uses microwaves to transmit data over very short distances, up to 32 feet, at a speed of 1Mbit per second. Bluetooth is mainly used for short range communications, e.g. from laptop to a nearby printer or from a call phone to a wireless headset (Goldsmith, 2005:15). In 2008 1.3 billion Bluetooth-enabled units were shipped (Meeker, 2010:27).

Commercial satellite systems are another major component of the wireless communications infrastructure. Communications satellites are microwave relay stations in orbit around the earth. Global Positioning Systems (GPS) use satellite data to pinpoint locations nearly anywhere on the earth. There were 421 million GPS chipsets sold in 2008 with cell phones and PDAs making up 60% of GPS shipments (Meeker, 2010:27). Growth of wireless data is accelerating, a trend likely to persist for years as consumers demand more from their devices and as companies seize opportunities to serve them.

2.4 MOBILE DEVICES

*"The mobility paradigm involves a **consumer**-level and market-**driven** access to devices, to content; and as a result, it is everywhere"* (Futhey, 2011:48).

The realising of m-learning is impossible without the use of mobile devices. They vary significantly in ability, size and price. The key common characteristics which unite mobile devices are;

- **Made to be mobile.** Mobile devices like handheld computers or smartphones, are powerful technologies that are small and lightweight and can easily be carried around.
- **Made for connectivity.** On 3G and/or Wi-Fi connections give consumers Internet access anytime and anywhere.
- **Made for a personal experience.** Due to their small screen size mobile devices are made for a single user (Wessel & Mayr, 2007:33).

The main types of mobile devices as summarised by Georgiev *et al*. (2004:2) are:

- A **lightweight notebook/netbook computer** is highly mobile; it usually weighs less than one kilogram; its monitor is small (usually 25cm or less) and the keyboard is small and built in. Notebook/Netbook computers have the same abilities as a desktop personal computer and support wireless communications. Their prices remain high. A good example of Notebook/Netbook computers are the Apple MacBook Air, and the Acer Aspire one AOD 257 Netbook.
- A **tablet computer** is highly mobile, usually weighs less than one kilogram and its monitor is small (usually 25cm or less). Tablet personal computers also share the full range of abilities as personal computers. Some of them have touch screen keyboards and software to recognise handwritten text. Tablet computers are relatively expensive. Good examples of tablet computers are the Apple iPad and the Samsung, Galaxy Tab 10.1.
- A **Personal Digital Assistant (PDA)** usually has a small screen size and significant processor power. New models support more than 65000 colours, recognise handwritten text and can play different types of multimedia files. The main operating systems used are Palm and Microsoft Pocket PC.
- A **cellular phone** can mainly be used for voice communication and sending and receiving of text messages (SMS). Some of their disadvantages are low memory capacity and low data transfer rate. Cellular phones can be used to access the Internet via WAP or GPRS technologies. They can also be used to send and receive multimedia messages (MMS). Their prices continuously decrease.
- A **smartphone** can be defined as a mobile device that in addition to performing basic phone functions such as voice calls, SMS and contact database, also runs on an operating system; has Internet and/or email access; provides a standardised interface and platform for application developers; supports advanced digital functions like music, video, gaming, pictures, browsing, messaging, and some support navigation and mobile TV. Good examples of smartphones are the Apple iPhone 4S, Samsung Galaxy S, and BlackBerry Torch 9800.

Table 2.1: Traditional personal computing (PC) functions done on a mobile device.

Can traditional personal computing functions be done on a mobile device?	
Voice Calls via IP	Yes, and some mobile devices support voice over internet protocol (VoIP) and traditional voice calls.
E-Mail	Yes, and with push notification on mobile devices.
Social Networking	Yes, and can be done while mobile.
Acquiring News / Info	Yes, and with location awareness and real-time updates.
Watching Video	Yes, but lack of bandwidth and Flash support limits usage on some mobile device.
Playing Games	Yes, but mobile processing and battery life are still not powerful enough to compete with gaming on a PC.
Entertainment Hub	Yes, but mobile storage are still limited, and cloud service depends on internet connectivity.
Productivity Centre	Yes but, some mobile devices still cannot do serious word processing, spreadsheets, or presentations.

Source: Adapted from Meeker (2010:111)

In table 2.1 some of the traditional personal computing functions were compared with modern mobile device functions and in some areas mobile devices were out performing personal computers. Smartphone, notebook, netbook and other mobile devices will continue to evolve and the technology will continue to converge.

2.5 MOBILE PLATFORMS

Former Apple executive Jean-Louis Gassée recently commented that the operating system does not matter anymore. Gassée argued that the operating system is less about underlying structure and more about the user experience and development tools. What once was described as an operating system is now really more of a platform. As mobile development and adoption continue to surge and the capabilities of these devices grow as their component prices fall, the platform becomes the piece that drives innovation, adoption and use further (Warren, 2010:1).

The following platforms are showing especially strong momentum based on consumer usage and developer interest:

- **Mobile operating systems** such as Apples iOS, Google's Android, Microsoft's Windows Phone, and Research In Motion's (RIM) BlackBerry OS (Educause, 2011b:1).
- **The web** has clearly emerged as a platform. The introduction of asynchronous interactions into the Web environment has enabled developers to aspire to deliver user experiences that are more like those based on desktop operating systems (St. George, Bentley, Berman, Brown, Collins, Ganjalizadeh, Lewis, McMahon, Morales, Moses, Warner & Winston, 2007:3).
- **Social Network sites** such as Facebook, has the potential to serve as the communications overlay platform for the mobile Internet. Facebook is already taking significant share from other applications, and it could quite readily take a meaningful position in future online mobile search because of the enormous usage and user-generated content it stores. Like Twitter, Facebook is evolving to provide complete communications to its users, from emails and posts to online chats, voice, and video (Meeker, 2010:9).

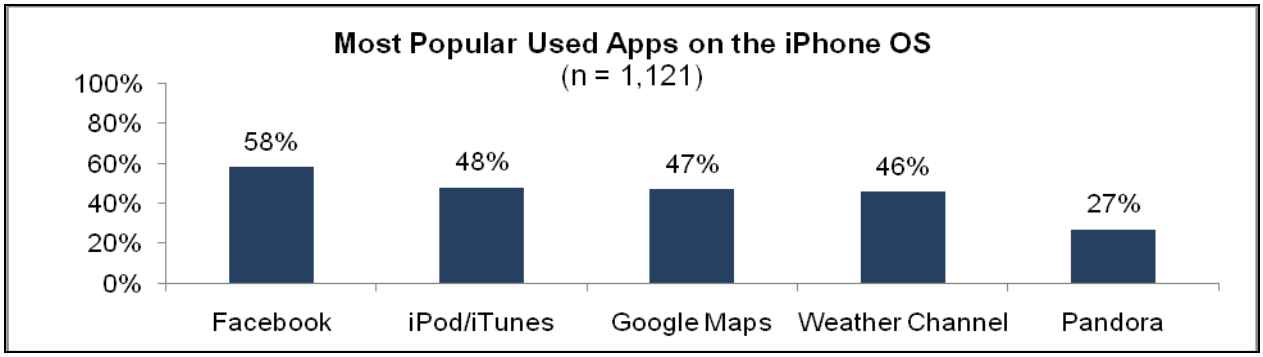
These next-generation platforms are already gaining material shares of global Internet traffic and are changing the way a generation communicates.

2.6 MOBILE APPLICATIONS

A mobile application is a computer program which runs on a mobile device. 'Apps' (short for applications), exist across many genres, including games, entertainment, utilities, education, travel and lifestyle.

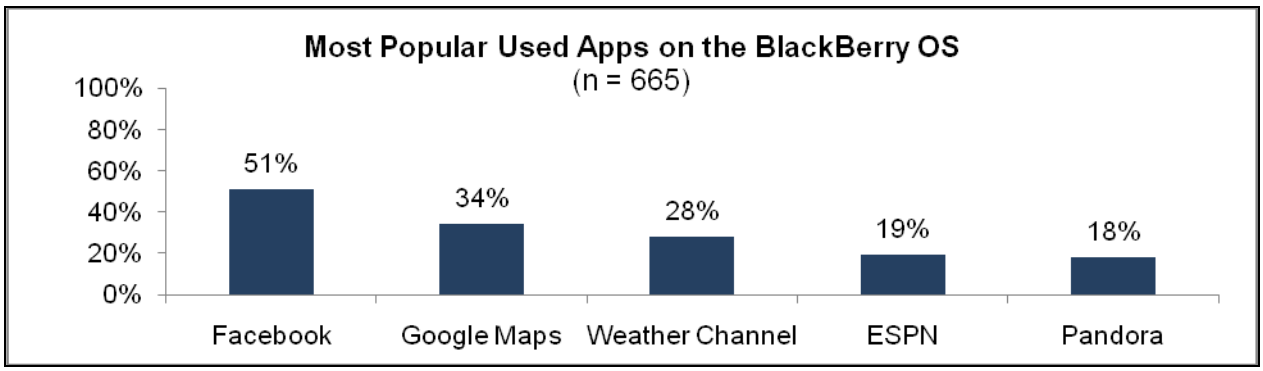
Native or computer based apps: Native or computer based apps are developed for a particular device and/or operating system, such as the iPhone, Android, BlackBerry, or others, whereas mobile web development pursues device agnostic applications that work on virtually any device with a mobile browser. Well-built native apps often provide a richer user experience, with greater control over the look and feel of the app, as well as access to device-specific features such as GPS, accelerometers, or cameras. In addition, native apps are more likely to work when the device is not connected to the Internet (Educause, 2011b:1).

Figure 2.2: Most popular used applications on the iPhone operating system (OS).



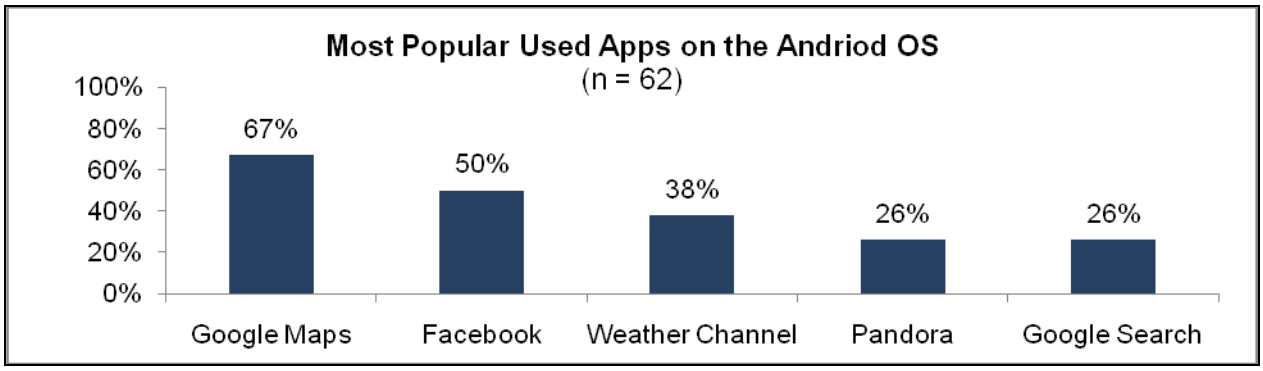
Source: Adapted from Nielsen (2010:3)

Figure 2.3: Most popular used applications on the BlackBerry operating system (OS).



Source: Adapted from Nielsen (2010:3)

Figure 2.4. Most popular used applications on the Android operating system (OS).



Source: Adapted from Nielsen (2010:3)

As illustrated in figures 2.2 to 2.4 native computer based apps allow one to access e-mail, schedule meetings, chat in real time, search maps, and collaborate on documents and spreadsheets.

Web based apps: The use of the Google suite of tools, commonly known as Google Apps, is causing quite a stir in the academic and corporate environments. Google Apps is free and accessible via the Web, so anyone can connect with others in an organisation anytime anywhere. And since it is hosted by Google, there is no hardware or software to install or maintain, meaning that a user can get Google Apps up and running quickly (St. George, 2007:3). Mobile consumers are embracing new, web-based software applications at perhaps the fastest pace in history. Also capturing incremental growth in the mobile Internet may be "traditional" Internet companies like Google in search, advertising, video, applications and systems; Amazon.com and Rakuten in commerce; MixIt in social networking; and Adobe in mobile content and delivery (Meeker, 2010:9).

Geolocation: When creating a native application, designers can take advantage of features that are often built into smartphones, such as geolocation. Geolocation software allows programs to utilise the user's physical location. This software uses embedded GPS chips or triangulates cell phone towers. Although many devices require a native application to take advantage of geolocation information, newer browser standards are changing this, so some mobile websites can detect location as well (Hu & Meyer, 2010:9). One use of geolocation is augmented reality (AR). AR refers to the addition of a computer-assisted contextual layer of information over the real world, creating a reality that is enhanced or augmented. The device's camera operates as a lens to the real world, and the device screen depicts the additional information. Sophisticated uses of augmented reality include object recognition, where the view of the object triggers recall of data (Johnson, Smith, Willis, Levine, & Haywood, 2011:16).

2.7 THE FUTURE OF MOBILE TECHNOLOGIES

We are in the early innings of the next major technology cycle, the mobile Internet. The drivers are adoption of 3G, social networking, video, VoIP, and mobile devices that are more powerful that personal computers (Meeker, 2010:9).

Some mobile technology trends, which have already been well documented, are continuing:

- The power of the processor, memory and battery is increasing and the physical size required is decreasing.
- The costs of screens, batteries and memory are going down.

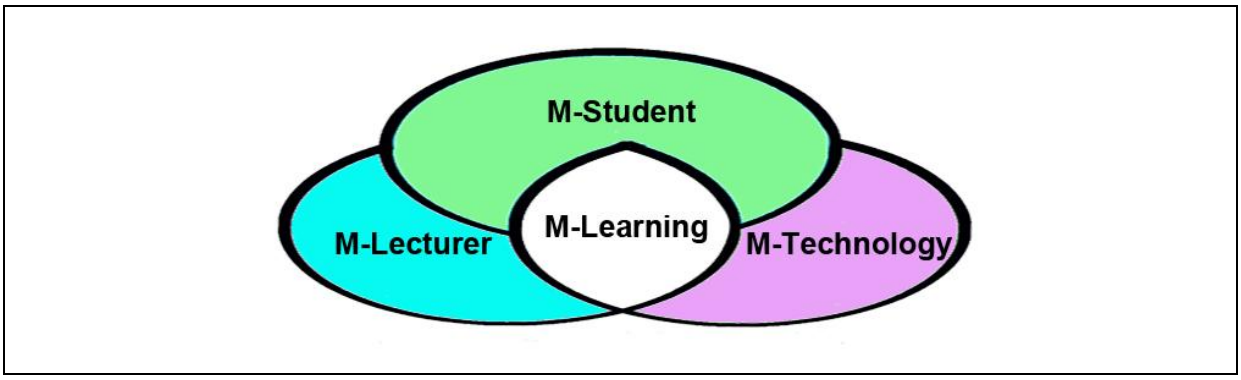
- Operating systems, as well as file formats and the media used for transferring them, are standardising.
- Mobile devices are getting better at communicating with one another in several different ways.
- Wireless networks and 3G give us fast data access wherever we are. The standards keep evolving, and future speeds are increasing for both short- and long-distance connections.

These different trends pull us towards the same place: smaller, faster, cheaper devices working together in a web of connectivity (Stead, Sharpe, Anderson, Cych & Philpott, 2006:7).

2.8 MOBILE LEARNING IN HIGHER EDUCATION

Mobile-learning (M-learning) can be defined as wireless and digital devices and technologies, generally produced for the public, used by students as they participate in higher education (El-Hussein & Cronje, 2010:17). The meaning of "mobile" in this context is not merely a new adjective qualifying the anytime and anywhere concept of "learning", rather, m-learning is emerging as an entirely new and distinct concept alongside the mobile workforce and the connected society (Taxler, 2007:14). M-learning is part of a new mobile conception of society. The concepts of m-learning can be divided into three significant areas: mobility of the technology, mobility of the student and mobility of the lecturer. According to El-Hussein and Cronje, (2010:17) the concept of the mobility of the higher education institution is also increasingly important in the new emerging higher education landscape.

Figure 2.5: The three significant areas defining m-learning.



Source: Adapted from El-Hussein and Cronje, (2010:17).

It is concerned with student mobility in the sense that students should be able to engage in educational activities without constraints of having to do so in a tightly delimited physical location. “Mobility” refers to the capabilities of the technology within the physical contexts and activities of the students as they participate in higher education, and on the other hand it refers to the mobility of the lecturer and the activities of the learning process, the behaviours of both the lecturer and the student as they use the technology to teach and learn. It also refers to the attitudes of lecturers and students who are themselves mobile as they use mobile technology for teaching and learning purposes (El-Hussein & Cronje, 2010:14).

2.8.1 Mobility of educational information technology

From a technological point of view, mobile devices are becoming more and more capable of performing all the functions necessary in educational learning and instructional design (El-Hussein & Cronje, 2010:7). The mobile internet’s potential impact on m-learning in a higher education institution will depend on the institutions mobile technology infrastructure, wireless communication network, mobile platform, and availability to mobile content and access to educational applications.

Mobile infrastructure in higher education: According to a recent report from mobile manufacturer Ericsson, studies show that by 2015, 80% of people accessing the Internet will be doing so from mobile devices. Perhaps more important for education, Internet capable mobile devices will outnumber computers within the next year. In Japan, over 75% of Internet users already use a mobile as their first choice for access. This shift in the means of connecting to the Internet is being enabled by the convergence of three trends: the growing number of Internet-capable mobile devices, increasingly flexible web content, and continued development of the networks that support connectivity (Johnson, *et al*., 2011:12). In developing countries where mobile devices are available at a fraction of the cost of other computing hardware, m-learning has extended the infrastructure of distance education to outlying areas that have previously been poorly served (Educause, 2010a:2).

Mobile wireless communication in higher education: The lack of infrastructure in the higher education in regard to wireless capacity in particular is a key issue contributing to the problems encountered and a less positive take-up of m-learning (McFarlane, Triggs & Yee, 2008:4). Where wireless networks are available, or where smartphones with data plans have access to cell networks, mobile lessons and exercises can leverage the ability to gather information from a variety of interdisciplinary sources in a wide array of formats while exploiting the value of location-based learning (Educause, 2010a:2).

Mobile devices in higher education: M-learning hardware may include mobile phones, handheld personal computers, tablets, and netbooks, as well as devices such as the iPod touch that are able to run mobile applications (Educause, 2010a:2). The portability of mobile devices and their ability to connect to the Internet almost anywhere makes them ideal as a store of reference materials and learning experiences, as well as general-use tools for fieldwork, where they can be used to record observations via voice, text, or multimedia, and access reference sources in real time. (Johnson, Smith, Willis, Levine, & Haywood, 2010:10). Because m-learning utilises a variety of devices, many of which are ubiquitous in the lives of students, it can foster student engagement and offer opportunities to make learning integral to daily life, thus facilitating authentic learning (Educause, 2010a:1).

The focus is on which mobile devices, in particular PDAs, tablets, note/netbooks and mobile phones, can be used for in an educational context for teaching and learning. The major advantages are seen as being portability, size, instantly on (no start-up time), cost (relative to laptop computers), battery life (relative to laptop computers), and outdoor use. However, the disadvantages are seen as being small screen, possibly not robust enough for education, lack of technical support, data loss due to battery problems and problems with linking to networks (McFarlane, Triggs & Yee, 2008:4).

Mobile platforms and applications in higher education: As learning management systems adapt to the mobile platform, m-learning may become a common tool for exploration by higher education faculty. The use of mobile devices seems a natural fit for distributed learning and field activities in that handheld technology can not only accompany the learner almost anywhere but also provide a platform that is rapidly evolving and always connected to data sources. Learning management systems may drive campuses to recognise the potential of this always-on, anyplace technology that lowers the physical boundaries to learning and extends the classroom (Educause 2010a:1).

Mobiles embody the convergence of several technologies that lend themselves to educational use, including electronic book readers, annotation tools, applications for creation and composition, and social networking tools. (Johnson, *et al*., 2011:13). The software that underlies m-learning does not only include mobile applications designed specifically for learning purposes, but also those designed for other uses such as geolocation, data access, readers, and maps, that can be adapted for educational purposes.

2.8.2 Mobility of the student

Instructional theory in this mobile age should be student-centric rather than technology- or lecturer-centric (El-Hussein & Cronje, 2010:8). This perspective moves away from the focus on the mobile device and looks at the mobility of the student.

Student accessibility to mobile technology: One of the main concerns when trying to introduce a new service or technology is who will be able to use it. This partially depends on what devices will be used, how many users posses those types of devices, and also the question of whether the users are prone to spend money for acquiring a device needed by a newly appeared service (Al-Mushasha, 2010:2). According to the Educause study into student technology adoption, nearly two-thirds of students responding to the survey are carrying Internet capable mobile devices and two-thirds of these owners use them to access the Internet weekly or more often (Smith & Caruso, 2010:24).

Widespread device ownership could translate into rapid adoption. The devices that are mainly relevant in the context of this study are mobile phones, smartphones, PDAs, note/netbooks and handheld tablet computers. Students were asked about the reasons for not having one of these devices. For tablets, the main reason was that such device is too expensive (49%), followed by the device is not useful (19%), costly wireless services (17%), devices' limited resources (8%), and devices not small enough (7%) (Al-Mushasha, 2010:2). The cost of smartphones and data plans is out of reach for some students, and adoption and ownership are uneven. While the screen size on many mobile devices enforces simplicity of design, the small screens and keys are difficult for some to use effectively, and the additional strain on battery life imposed by mobile apps can be frustrating (Educause, 2010a:1).

Ease of use offered by mobile devices supports lifelong learning, and because the devices themselves are integrated into everyday life, they facilitate authentic learning. Ultimately, it might be the ubiquity of these student-owned devices that ensures their use as teaching and learning tools (Educause, 2010a:1).

Student engagement in mobile technology: M-learning can be instrumental in helping students to learn in different contexts, especially in a social context where the exchange of information with other students using mobile technology assists in learning as knowledge is shared in this informal social context (Robinson & Kekwaletswe, 2007:300). The focus is more on the student and how the technology can support a lifetime of learning in collaboration with lecturers and other students, inside and out of the classroom.

Students using mobile technologies are not only remote from their instructors; they are also fully in control of the access to information on their mobile devices. The 2010 ECAR study found that the most frequent use (about 85%) of a handheld Internet device was to check for information on “news, weather, sports, specific facts, etc.” More than three-quarters of device owners use their devices to access e-mail and use social network system (SNS) (Smith & Caruso, 2010:22). Students are ready for greater use of 3G mobile phones and pocket personal computers and organisers, which are already being used for communication because of their flexibility and portability (Peters, 2007:12). The question is whether the divergence in mobile device usage for communication and entertainment, as compared with mobile device usage for learning and education-specific task, will widen or diminish (Smith & Caruso, 2010:22).

Mobile applications complement the short-burst, casual, multitasking style of today's "Digital Native" students. Given the opportunity, students will quickly embrace, use, and make the technology their own in various unexpected ways, just as they have been doing with all useful digital technology (Prensky, 2005:2).

Student skills in mobile technology: The digital divide is commonly understood as the socio-economic differences between communities when looking at their access to information and communication technologies like personal computers, telephones, and Internet related technology. This divide goes beyond access to new technologies, and includes the exclusion of people from effective use of the Internet as an information and communication resource, which divides people into the information rich and the information poor. The ability of higher education students to access information impacts on how they search and retrieve information and develop literacy and other key skills (Robinson & Kekwaletswe, 2007:3). Information and communication technology literacy continues its rise in importance as a key skill in every discipline and profession. This reality is exacerbated by the fact that as technology continues to evolve, information and communications technology literacy must necessarily be less about tools and more about of thinking and seeing, and of crafting narrative (Johnson, *et al*., 2010:5)

2.8.3 Mobility of the lecturer

Managing m-learning as a part of a suite of services that offers greater choice to students will have benefits for educators, because it can allow lecturers to move from delivery to the management of learning, and will help students gain specific skills of immediate value in the knowledge-based economy (Peters, 2007:16).

Lecturers accessibility to mobile technology: To most educators "computer" means a personal computer, or a laptop, mobile devices such as smarphones, on the other hand, are more often regarded as bothersome distractions to the learning process. However, it is time for lecturers to rethinking mobile devices as computers, even more powerful in some ways than personal computers (Prensky, 2008:1). These mobile devices will be wireless-enabled using Wi-Fi, and support WiMax and other protocols and it is crucial that higher education institutions make mobile technologies available to academic staff and support lecturers in the use thereof.

Lecturers engagement in mobile technology: The applications used in m-learning generally focus on brief interactions of perhaps five minutes or less, using simple navigation and graphics to accommodate multiple screen sizes. Such applications enable the quick review of information rather than prolonged or deep learning; as such, they are better suited for activities such as a status check, a request for just-in-time information, or as a student response tool in the classroom (Educause, 2010a:1). Some exercises contain collaborative elements or game play, employing a variety of tools like social networking, calendars, customized calculators, simulations, or augmented reality. In a study conducted by Faculty Focus, which focused on SNS usage of faculty, found that nearly 32 percent said they've friended a student on a SNS. In many instances, especially with regards to Twitter and Facebook, faculty said they create separate accounts: one for friends and family, and one for work-related applications, with limited information just for students (Bart, 2011:7).

The digital age has created a new relationship between lecturers and students, while mobile technologies provide convenient access; learning is about collaboration between lecturer and students, and between student and student, to process information to generate new knowledge that can be applied to real-life problems (Rajasingham, 2010:6). M-learning catalyses the process and organisation for teaching and learning on the go and foster instant communications and collaboration.

Lecturers expectations of mobile technology: There are new challenges facing educators who are steeped in traditional delivery styles when confronted with digitally literate students, where, rather than simply receiving and memorising the wisdom of their elders (which has been the tradition for millennia) students are now demanding training that meets their specific information needs; there is a divide between traditional teaching techniques and the learning attitudes of contemporary youth (Peters, 2007:5). The rushed initial training for lecturers is a

key issue contributing to the problems encountered and a less positive uptake of m-learning (McFarlane, *et al*., 2008:4).

In a study conducted by Faculty Focus, academic faculty was asked about the acceptance of mobile devices in the classroom. Nearly 83 percent would allow the use of laptops in the classroom. The use of smart phones is more of a challenge and, as a result, just 52 percent of faculty allow smartphones in the classroom and some admit to having to take phones away from students. Yet many noted that fighting the usage of smartphones in the classroom is a losing battle and they're looking for pedagogically sound approaches to incorporating them (Bart, 2011:4).

Students and faculty have different expectations and use technologies in different contexts, which can create tension and misunderstandings between the two groups. Nearly 60 percent of faculty in the Faculty Focus study said they have had problems with students getting on Facebook during class. Meanwhile using Twitter to cheat on exams (3.7%) and cyberbullying or mean-spirited comments (16.0%) are much less common in the classroom (Bart, 2011:15).

2.8.4 The mobile higher education institution.

Many education and training providers recognise the benefits of m-learning, but there appears to be limited adoption for educational use, which was attributed to the age and ability of lecturers, the cost of providing m-learning devices and infrastructure, the slow rate of change in large educational institutions, and the fact that mobile devices are not designed with the education market in mind (Peters, 2007:16).

The higher education institutions mobile piloting and evaluation: As an early m-learning adopter, Abilene Christian University has chosen to focus on Apple devices, distributing either an iPhone or iPod touch to each incoming first year student. Lecturers can leverage applications from the Apple iTunes store for learning purposes including field activities, while a dedicated portal offers campus news and calendars to keep students engaged in the learning community (Educause, 2010a:2). Also focusing on the Apple platform, Seton Hill University announced plans to offer an iPad to every full-time student in fall 2010, a technology chosen both for its mobility and the promise of easy future access to e-textbooks. At Ball State University, computer science students can study mobile applications programming, creating usable applications in a single semester. Recent examples include games, a reference tool for birdwatchers, and an English-Spanish tutoring program

(Johnson, *et al*., 2010:13). A joint outreach program undertaken by Carnegie Mellon University and the University of California, Berkeley, called Mobile and Immersive Learning for Literacy in Emerging Economies (MILLEE) seeks to support a group of English teachers in rural India with m-learning applications designed for grade-school students. The students access these activities via their mobile phones to work on English skills in the classroom as well as in the fields on days when they have to help with farm work (Educause, 2010a:2). An example of an m-learning project in South Africa is Dr Math, started in January 2007 by Meraka Institute of Mobi LED provides tutors to help with mathematics homework. Students use Mxit the mobile instant messaging service on their cell phones there is over 5,500 pupils that use the service. Students contact Dr Math from their homes, while on buses and on the sports field (Botha, Vosloo & Kuner, 2009:9).

The higher education institutions mobile infrastructure: The implementation of mobile learning requires careful planning and commitment from all stakeholders. This can be achieved if the government formulates policies and frameworks to guide the implementation of mobile learning at a national level; institutions of higher education should also consider adopting the use of ICT in enhancing student learning; and teachers need to explore various teaching methods for effective design of instruction using mobile technologies (Makoe, 2010:10). Hardware for mobile learning represents a wide range of platforms, screen sizes, and functionality, and no clear standards exist for development that address all of the tools available. As a result, universities can find infrastructure issues tricky to resolve. The cost of smartphones and data plans is out of reach for some students, and adoption and ownership is uneven (Educause, 2010a:2). While some m-learning applications may be provided by colleges and universities, mobile technology in the main provides an inexpensive layer of functionality to the institution, capitalising on an infrastructure that is increasingly supported by cloud services and by the technology that students bring to campus.

The higher education institutions mobile content: While students can use their handheld devices to access off-campus learning material and third-party study tools as well as to connect with fellow students in social networking websites, without the support of instructors and institutional information technology, a mobile device can't do much else to enhance their educational experience. M-learning and campus apps need to be supplied and integrated with existing campus services by campus employees using campus funds, a reality that may prove to be the pace-limiting step for education-related mobile adoption in the years to come (Smith & Caruso, 2010:25).

The higher education institutions academic and administrative staff: The South African White Paper on e-Education (2004) views "ICT development as a process that takes teachers and learners through learning about ICT, learning with ICT and learning through the use of ICT". This can only be possible if teachers are equipped with the necessary knowledge and skills that they require to integrate ICT into their curriculum to support the delivery of study material (Makoe, 2010:10). Resistance to the use of mobiles in the classroom continues to impede their adoption in many schools, but a growing number of institutions are finding ways to take advantage of a technology that nearly all students, faculties, and staff carry (Johnson *et al*., 2011:4).

The higher education institutions mobile resources: The rising tide of consumer information services will displace familiar campus-based tools, creating turbulence where the two domains meet and stimulating a competition between mature but declining enterprise systems on the one hand and raw but innovative consumer services on the other (Smith & Caruso, 2010:22). Mobile education, however innovative, technically feasible, and pedagogically sound, may have no chance on sustained, wide-scale institutional deployment in higher education if the strategic factors at work within educational institutions are not addressed. These strategic factors include resources (financial resources but also human resources, physical estates, institutional reputation, intellectual property, and expertise) and culture (institutions as social organisations, their practices, values and procedures, but also the expectations and standards of their staff, students, and their wider communities, including employers and professional bodies). Implementing wireless and mobile education within higher education must address these social, cultural, and organisational factors (Traxler, 2007:21).

2.9 THE FUTURE OF M-LEARNING

Mobiles enable ubiquitous access to information, social networks, tools for learning and productivity, and much more. Since most students already have access to a mobile device, higher education institutions are seizing the opportunity to turn these gadgets from distractions into learning tools by incorporating these devices into classroom lessons and projects (Abram, 2011:2). Mobile devices continue to evolve, but it is the increased access to affordable and reliable networks that is driving this technology now. Mobiles are capable computing devices in their own right, and they are increasingly a user's first choice for Internet access. The abundance of resources and relationships made easily accessible via the Internet is challenging educators to revisit their roles in sense-making, coaching, and credentialing (Johnson *et al*., 2011:3).

Students expect to be able to learn, and study whenever and wherever they want. The world of work is increasingly collaborative, giving rise to reflection about the way student projects are structured. While social media in education is still tricky territory, as sites like Twitter and Facebook evolve, the ways they're used in the classroom will likely become more refined and potentially more powerful in creating a better social educational experience (Johnson *et al*., 2011:5).

The technologies we use are cloud-based, and our notions of information and technology support are decentralised. Higher education institutions are increasingly looking to cloud computing as a way to provide access to information and to close budget gaps. An inexpensive solution, cloud computing is becoming the norm everywhere from grade schools to grad schools, perhaps because it is not only simple to use, but mobile as well. Information on the cloud, whether it is lesson plans or class projects, can be accessed from anywhere, any time and on any mobile device. In an increasingly mobile world and classroom, cloud computing is more than just a trend, and is likely to become the standard in information management over the next decade (Abram, 2011:2).

The next phase of m-learning is context sensitive location-based learning. M-learning has taken to the streets, with technologies that allow for seamless integration with a wide range of locations. One of the best uses of this technology has been within museums, where visitors can use a mobile device to listen to information about items in the museum's collection (Nix, 2008:23). Online learning management systems (LMS) like Sakai, Moodle and Blackboard have grown exponentially in their number of users in recent years. Part of the popularity stems from mobile devices like a phone or an iPad. Students and lecturers alike can easily check grades, upload assignments and check on homework through the assessment tools, making these not only more accessible, but more practical for anyone involved in the educational process.

Amazon.com is one of the biggest retailers of books, but in the past year, their sales of ebooks have outstripped that of traditional books. The ebook is steadily becoming a popular part of everyday life for numerous Americans, and the digital book is slowly making its way into the classroom as well. Not only could it be a big money saver, it may also help to eliminate the problem of student textbooks becoming quickly outdated as new discoveries are made, something every lecturer and student can appreciate (Abram, 2011:2).

Literature suggests that, while m-learning is proving to be innovative, the factors that most strongly impact on the ultimate success or failure of m-learning will depend on human

factors, the balancing of technological ideals and pedagogical imperatives, and the successful management of the interface between human educational systems and technology systems (Rajasingham, 2010:8). How we live, work, play, bank, shop, and learn is being profoundly affected by the increasing mobility of our society; consequently it is the responsibility of higher education institutions to address the needs of their changing lecturer and student corps.

2.10 A GENERAL FRAMEWORK FOR MANAGING MOBILE LEARNING

Technological innovation is changing the way that lecturers teach and students learn. For higher education institutions, charged with equipping graduates to compete in today's knowledge based economy, the possibilities are great. Distance education, sophisticated LMS and the opportunity to collaborate with research partners from around the world are just some of the transformational benefits that higher education are embracing. In fact, technology will become a core differentiator in attracting students and corporate partners (Glen, 2008:1). Tuition and research grants are the main sources of revenue for higher education institutions. As a result, institutions are under constant pressure to increase student enrolment and attract the best faculties and researchers to their institutions. One of the main differentiating factors between higher education institutions today is their ability to support m-learning, and to offer lecturers and students an interactive and collaborative learning environment (Alcatel-Lucent, 2010:3).

The proposed general framework is a tool to summarise the management of m-learning in higher education. The framework focuses on addressing key issues related to m- learning from the perspective of the student, the lecturer and thus the institution, as summarised in the preceding literature study.

The framework was adapted from a similar framework used by Lee (2006:8) and should include the following:

Impact. Measure the consequence of mobile learning upon the higher education environment.

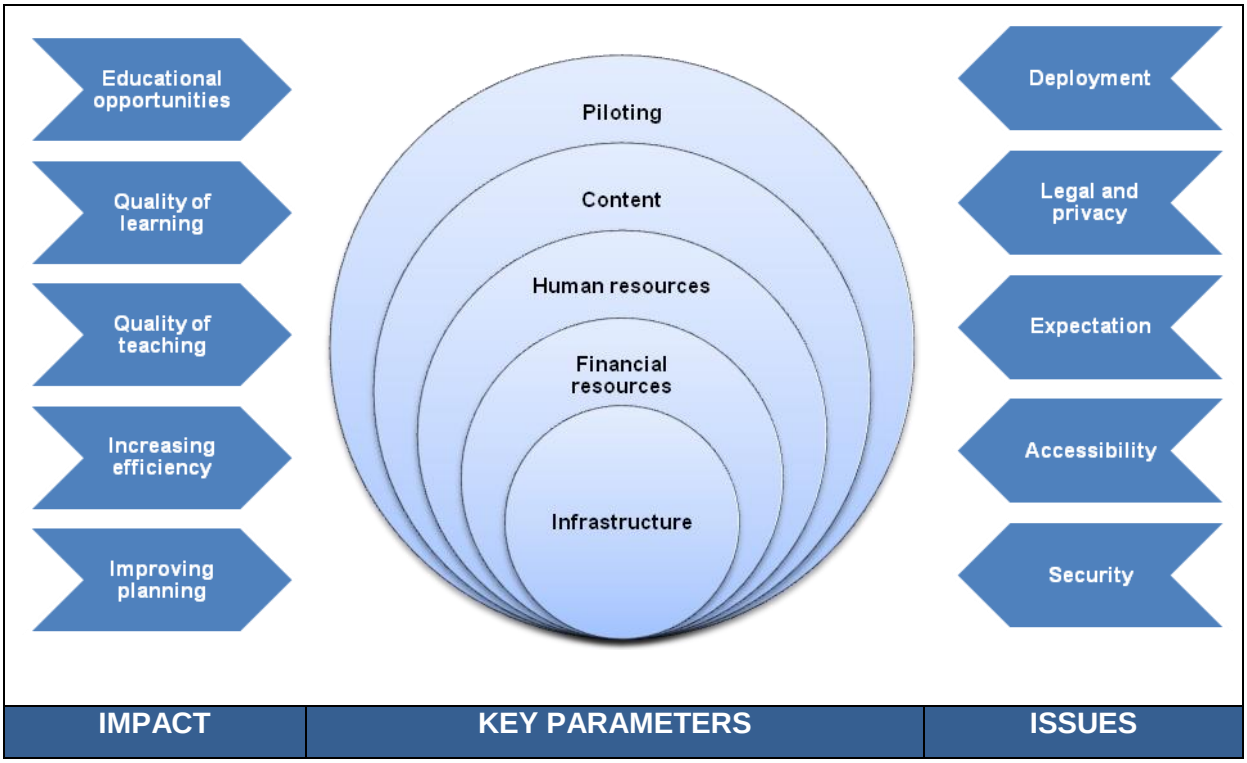
Key parameters. Definable and measurable characteristics, essential to understanding the impact of mobile learning on the higher education situation.

Institutional recommended responses. Tasks that must be undertaken to address the key parameters such as: establishing regulatory frameworks, putting in place mobile learning units, developing content, improving information networks, mobilising equipment and software and conducting lecturer training.

Issues. Primary issues deemed important by the literature study which may determine the implementation of mobile learning in the success of higher education.

Affecting factors. Circumstance or an influence that contributes to the issues related to mobile learning.

Figure 2.6. General framework for the management of m-learning.



2.11 THE IMPACT OF M-LEARNING ON HIGHER EDUCATION

When analysing areas for ICT intervention in higher education it is important to think about how m-learning could impact higher education's goals (Wachholz, 2005:11).

Expanding educational opportunities (access): Mobile learning has the potential to reach individuals and groups that are historically underserved, such as girls and women, rural populations, adult workers, and persons who cannot go to learning centres (due to distance, expense, and other obstacles) (Wachholz, 2005:11). Higher education must have the

capacity to reach beyond the brick and mortar classroom to students who cannot get there, and also to a wider world of knowledge. A blended learning environment that incorporates face-to-face instruction with electronic and m-learning resources can be the number one tool in addressing students' different needs (Alcatel-Lucent, 2010:3).

Increasing efficiency and productivity: By offering a dynamic learning environment, higher education institutions can be better prepared not only to attract faculty and students, but to retain them and help them be more productive and successful. Mobility is a competitive differentiator (Alcatel-Lucent, 2010:13). With the advantages of mobility, mobile wireless technologies help to improve efficiency and effectiveness in teaching and learning (Kim, Mims, & Holmes, 2006:78).

Enhancing the quality of teaching: M-learning could address challenges related to quality teaching such as continuous professional training, lifelong upgrading, and connecting with academics worldwide (Wachholz, 2005:11). The greatest benefit derived from wireless computing is communication, followed by student learning, faculty teaching, and collaboration among students and faculty. Communication may be more important because a good communication channel between lecturers and lecturers, students and students, and students and lecturers results in improvement of teaching and learning processes (Kim, Mims, & Holmes, 2006:78). Innovation is flourishing as lecturers weave the functionalities of technology into the design of their module content (Educause, 2011a:1).

Enhancing the quality of learning: M-learning has the potential to motivate and engage students, bring life to concepts and processes, foster inquiry, provide flexibility, allow application of information, bring the world into the classroom, offer collaborative opportunities and communication, and offer individualised learning (Wachholz, 2005:11). Higher education is discovering the potential of m-learning to promote student engagement and improve learning (Educause, 2011a:1). Collaborative learning and a more constructivist approach to education are, according to some educationalists, facilitated by the use of mobile devices. Increasingly, mobile devices are being used to facilitate field work and to support learning in professions where such devices are widespread (Anderson & Blackwood, 2004:19). Edith Cowan University in Western Australia has been using learning technologies in its learning programs for many years and has an extensive infrastructure for facilitating technology-supported learning. The University has an extensive wireless network providing all students with ready access to the University network and the Internet (Olivier, 2007:790).

Improving policy planning and management: Management of higher education institutions and systems, management of policymaking including storage and analysis of data, construction and assessment of policy scenarios, and tracer studies or tracking systems can be improved through the use of m-learning (Wachholz, 2005:11).

2.12 KEY PARAMETERS TO THE EFFICIENT MANAGEMENT OF M-LEARNING

Successful implementation must also take into account the following key parameters:

2.12.1 Infrastructure (hardware, maintenance).

Over the coming years increasing numbers of students will be presenting a variety of mobile devices and will expect to be able to use them within the higher education institutions' network infrastructure. These devices will be wireless-enabled using Wi-Fi, and support WiMax and other protocols. This will present campus ICT managers with many issues concerning the provision of additional hardware and software support (Anderson & Blackwood, 2004:19).

As mobile computing evolves, it places new strains on an institution's ICT infrastructure. Higher education needs to be diligent in maintaining the complex technology ecosystem that supports a thriving mobile culture. To make informed infrastructure decisions, higher education institutions must understand both the general mobile computing landscape and campus-specific aspects of infrastructure. Most of the principles and lessons of "computing" apply equally to mobile computing (Educause, 2011a:1). It may be necessary that there is a dedicated server to handle connection of mobile devices within a campus. This trend may also lead to a significant shift from supporting a lab-based personal computer infrastructure to supporting wireless access to the network from a student's own hardware. A fundamental problem is the potential lack of homogeneity as a multitude of devices is made available (Anderson & Blackwood, 2004:19). The student body could be persuaded to conform to a particular standard, or the institution could provide, on loan, the necessary hardware, or come up with a rent to own system.

Institutional responses recommended by relevant literature to these infrastructure challenges:

Higher education institutions need to plan for mobile architecture focusing on robust, reliable connections by firstly increasing technical infrastructure spending and then coordinating the purchasing of hardware and software (Smith, 2006:26). Higher education needs to introduce new positions such as Chief Information Officer (CIO) and Chief Knowledge Officer (CKO).

Today, relatively few university CIOs have a place at the table when it comes to strategy. Given ITC's expanding footprint in higher education, this will need to change. When Queens College in New York completed its "Five Presidential Goals" plan a few years ago, it identified technology as one of the critical elements in moving the college forward. Out of that initiative, Naveed Husain was appointed the College's first CIO. He stated: "Our president and executive committee recognised that technology was fundamental to creating an advanced learning environment and giving Queens a real market advantage" (Glenn, 2008:14).

2.12.2 Content (curriculum, software, assessment).

Educational institutions invest a lot of resources in the development of LMS, and it is important, when planning adoption of m-learning, to consider how this will be integrated into the existing LMS and lecturers' work practices, and also whether it makes economic sense (Tétard, Patokorpi & Carlsson, 2008:5). The issue is that of migration of materials to various device types and locations. The devices have smaller screens than conventional personal computers and the specific design of e-learning materials for mobile devices is likely to become an unsustainable practice on a larger scale. It may be that a more workable solution involves republishing material through an institution's LMS, which is more likely to be able to automatically repurpose content to mobile devices (Anderson & Blackwood, 2004:19).

The technology oriented economy of the 21st century focuses on sharing, organising, managing and creating information. This indicates that competition will be driven by a knowledge revolution in the future (Chen, & Huang, 2010:70). Higher education needs to teach students how to efficiently search and evaluate the quality of Internet material (Smith, 2006:27). New technology can create new learning and teaching environments as well as mechanisms for accessing resources.

Institutional responses recommended by relevant literature to these content challenges:

A quality m-learning system requires the higher education institution to deal with copyright and intellectual property issues, maintenance and upgrading of learning resources. Institutions also need to pay attention to issues related to evaluation of mobile-learning implementations, and development of content creators, and teaching and administrative staff's skills (Tétard, Patokorpi & Carlsson, 2008:5). Higher education institutions need to revisit traditional delivery methods and invest in research into current ICTs, learning styles, study patterns and habits of students (Smith, 2006:26).

2.12.3 Personnel (need to be committed and trained).

Entrenched organisational cultures may be another hurdle, as academic faculty members accustomed to traditional modes of instruction may be disinclined to change. In a study conducted by the Economist Intelligence Unit, more than one-third of those polled said that tenure and promotional requirements will need to be re-weighted to include technology-based teaching criteria. Adoption of m-learning by an educational institution needs to be considered, planned and implemented very carefully (Glenn, 2008:14). Support for technologies also necessitates increased investment in engaging and training staff, more robust technologies, and recognising that learning takes place 24 hours a day, 7 days a week, 365 days a year. Challenges that have arisen include: high expectations of students for immediate solutions; inappropriate uses of technology; and inconsistent levels of support (Smith, 2006:26).

Institutional responses recommended by relevant literature to these personnel challenges:

In order to resolve such challenges, higher education institutions can implement the following measures: Coordinated centralised approaches to ICT support and strategies; consider outsourcing options; and develop new organisational structures, policies, planning, and procedures for technology support (Smith, 2006:26). Organisations need to make time for training. Training needs analysis is important for first year students, as mobile literacy and confidence varies; most students need training in the use of the institution's LMS and more advanced mobile devices (Attewell, 2005:17). Longer training, ongoing access to advice and proactive support in the beginning are all helpful for lecturers. Fast response to lecturer and student problems is crucial to avoid disillusionment and stalling momentum. Proactive support, including contacting lecturers to ask if they have any problems or need any help, encourages lecturers to be more proactive too and identify issues before they become serious problems (Attewell, 2005:17).

2.12.4 Financial resources, and sustainability.

Various costs must be considered when implementing m-learning. In addition to the significant initial capital expenditure required to purchase devices and networking equipment, there is the ongoing cost of technical support and also various 'hidden' costs (Naismith, Lonsdale, Vavoula, & Sharples, 2004:34). Even if technologies require a heavy financial investment, more higher education institutions are allocating a larger part of their budget to

mobile wireless technologies because they realise that technologies play a crucial role in education. According to a report released by Gartner "Forecast: Enterprise IT Spending by Vertical Industry Market, Worldwide, 2008-2014, 2Q10 Update" worldwide, educational IT spending was up about 2.5 percent in 2010 compared with 2009, reaching $64.15 billion by the end of 2010 (Nagel, 2010:1). In South Africa the Department of Science and Technology (DST) has allocated just more than R55.4 million of its 2010/11 budget for broadband connectivity at rural universities (Rasool, 2010:1).

As the education marketplace becomes increasingly competitive, institutions can offer m-learning opportunities as a competitive edge over other institutions. M-learning can fit training niches, such as medical training, where significant costs are incurred for students who drop out or fail (Naismith, *et al*., 2004:34). Higher education institutions may also explore the opportunity to leverage technologies that students already own.

Institutional responses recommended by relevant literature to these financial challenges:

Different options for infrastructure and services imply different cost models. In general, institutions should try and make use of their existing facilities and services in order to keep costs down (Naismith, *et al*., 2004:34). Higher education institutions need to develop new business models that will increase revenue for the institution, selecting the best vendor partners and alliances to ensure multi-device (Internet, phone, PDA, note/netbook, tablet computers etc.) application access, differentiating the higher education institution to ensure competitiveness in the marketplace. The ECAR's research study conducted by Goldstein and Caruso (2004:2) formulated the following drivers that facilitate institutional IT funding:

- aligning funding and institutional priorities;
- creating fiscal flexibility to support innovation;
- constructing and facilitating a structured, transparent IT budget process; and
- making the CIO a member of the institution's cabinet and budget committee.

2.12.5 Piloting and evaluation.

The field of m-learning is at present characterised by an increase of pilots and trials that allow mobile technologies to be tested out in a variety of learning contexts. The sustained

deployment of m-learning will depend on the quality of these pilots and trials, which includes evaluation methodology and reporting (Taxler & Kukulska-Hulme, 2005:1).

Institutional responses recommended by relevant literature to these piloting and evaluation challenges:

The blog posted by the Mobi-learning made easy website recommends the following steps when implementing a mobile learning project.

STEP1: To begin any mobile learning project, identify the learning objectives.

STEP2: To measure the success of the pilot, measurable goals need to be put in place.

STEP3: Based on the learning objective, narrow down the features of mobile devices to the top three to five critical requirements and make a selection that best suits the learning need.

STEP4: Define a budget for the pilot; expenditures will include devices, wireless connectivity plans, training, and the technology support and solution.

STEP5: For an m-learning project to be accepted and successful, lecturers have to be involved and on board. Identify key stakeholders and champions.

STEP6: A few rounds of discussion with key decision makers will be required to finalise the technology implementation plan.

2.13 ISSUES INFLUENCING THE MANAGEMENT OF M-LEARNING

Compared to desktop technology, learning and teaching with mobile technology presents significant new issues, including:

2.13.1 Security related issues.

Higher education institutions have a responsibility to educate their students about cyber security and privacy. It is part of the educational mission, and security breaches can jeopardise enterprise data. The variability of threats and student attitudes makes teaching cyber security through best practices difficult. Mobile computing presents all the same security threats as desktop computing and many more, which vary by device, function, and

application (Educause, 2011b:1). The deployment of a wireless infrastructure can provide an unregulated 'back door' into an internal network. As a minimum, it is generally recommended that data transmitted over wireless connections are encrypted using the Wired Equivalent Privacy (WEP) security protocol, although this requires additional resources at the client and server ends of a system, and has some weaknesses. Other security mechanisms such as password protection, use of virtual private networks (VPNs), and authentication should also be considered (Anderson & Blackwood, 2004:19).

Affecting factors:

Higher education institutions must perform a balancing act between deploying networking technology that enhances teaching, learning, collaboration and access to information, while providing advanced network security. The nature of the higher education environment is that it is open and allows students the freedom to explore. This openness can be a communication network's greatest vulnerability. With more students arriving on campus with their own computers, higher education institutions need to ensure that students do not plug unprotected devices into their dorm or classroom connections and infect the entire campus network. Campus ITC staff must have flexible technology to screen users and monitor network traffic, so they can proactively protect the institution (Alcatel-Lucent, 2010:4).

2.13.2 Legal and privacy issues.

Undoubtedly, there are copyright issues with regard to the use of these devices as media players and, increasingly, digital rights management is a key issue within ICT. New ethical frameworks for ICT usage will need to be developed (Anderson & Blackwood, 2004:19). The majority of existing educational content is protected under traditional copyright with terms and conditions that must be honoured within the "open" paradigm. The formally defined faculty, staff, and student communities of a higher education institution generally have access to site licensed digital materials through the library, and have access to most of the literature that would be cited in course material. But in opening up course material to the world, institutions must invest the time and expense to scrub the material to be sure that materials licensed for use in their formal community are not available to the world. The citation or link can be there, but the target cannot. Outsiders generally have access to abridged versions of the material although they may find the material elsewhere. As earlier described in Section 2.2.5, the Hewlett Foundation has wisely supported Creative Commons to help mitigate the constraints of "all rights reserved" copyright (Atkins, Brown & Hammond, 2007:13).

Affecting factors:

The large numbers of mobile devices and their wireless capability is likely to present legal issues for ICT departments. If the devices are actually owned by students themselves, the higher education institution is limited in the levels of control that can be implemented with regard to security options and privacy issues. These devices are relatively easy to lose and are likely to attract attention from thieves. A recent survey found that two thirds of PDA users do not use any kind of encryption to protect data, and use them to store valuable personal information such as bank account passwords, PIN numbers and access codes for secure buildings (Anderson & Blackwood, 2004:20).

2.13.3 User accessibility issues.

A recurring theme in online conversations is the concern that embracing mobility will reopen the "digital divide," since not all students can afford mobile devices. Good mobile ITC solutions for the disabled don't exist yet, and some regions lack telecommunications support for mobile devices (Educause, 2011b:1). It should be noted that it is generally less costly to equip each student with a handheld computer than with a desktop or laptop computer. Indeed, mobile technology can be used to address the 'digital divide', as mobile devices are the cheapest way of providing pupils with a computing device that can be taken home and through which they can connect to the Internet. The personal and collaborative nature of mobile devices can encourage participation and build social capital, which can be used to motivate disengaged or at-risk students (Naismith, *et al*., 2004:34).

Affecting factors:

Small screens, awkward keypads and handwriting recognition all present issues of universal accessibility. The developers of software applications for learning will need to consider these issues in depth during the development process (Anderson & Blackwood, 2004:19). Learning is most effectively supported when each student has access to a device. The ownership of the devices is thus a key consideration. Ownership is stated as a prerequisite for engagement, where students have the potential to go "beyond the necessary and play with it to explore its potential". Personal ownership does, however, present a challenge to the institutional control of the technology (Savill-Smith & Kent, 2003:15).

2.13.4 User expectation issues.

The current generation grew up in the digital millennium, so they have fundamentally different learning styles and expectations from previous generations. Today's students enter campus with laptop computers, smartphones and other mobile devices. Attracting the best students means meeting and exceeding their expectations for a more interactive, multimedia experience (Anderson & Blackwood, 2004:22).

The Technology Acceptance Model (TAM) was developed by Davis (1989), based on the Theory of Reasoned Action. In the TAM there are two beliefs focused on information system acceptance "perceived usefulness" (PU) and "perceived ease of use" (PEOU). Perceived usefulness is defined as the degree to which a user believes a specific system could increase his/her abilities in undertaking a particular task, and the main point of PU is the expectations a user has when faced with a piece of technology. As long as he/she thinks the system might help in some way, the attitudes he/she expresses will be positive. Perceived ease of use is defined as the degree to which a user thinks a specific system is easy to operate, and the point of PEOU is the functionality of the system. As long as users think that it is easy to use the system, they will have a positive attitude towards it, and this will affect their behaviour (Cheng, Hwang, Wu, Shadiev, & Xie, 2010:12).

Affecting factors:

The key is to establish a framework in which technology expectations can be met through a consistent approach. Managing technology expectations requires the institution to constantly revise policies and processes, and provide various orientation programmes in which to communicate expectations to students. Usability relates to the ease of understanding, remembering and learning to use the device itself and its varied tools. Devices should be easy to carry and have an easy to use interface for their functions (Kadle, 2009:12). The rapid development of seamless networks connected to a range of mobile devices, which one may even be wearing, presents new challenges with regard to work and life structures. The 'always on' nature of these technologies will present consequences for society in general, but education, with its younger user-base, may face such challenges sooner rather than later (Anderson & Blackwood, 2004:22).

2.13.5 Development and deployment issues

There is a wide range of development and deployment issues with regard to the introduction of new e-learning and administrative applications using mobile technologies. The availability of this technology makes new ways of administering higher education institutions an option. As with the introduction of other forms of information technology, such changes may require a review of the processes themselves. For example, using the push nature of SMS to issue SMS reminders of library loans will require some rethinking on the lending process in general (Anderson & Blackwood, 2004:19),

Affecting factors:

The deployment of such mobile systems can be expensive, technically difficult, and fraught with difficulties related to connectivity and ergonomics. Such systems cannot be designed in a vacuum divorced from 'mainstream' business and educational systems, and must pay particular attention to the usability issues inherent in designing for smaller devices. There is also a range of issues regarding network infrastructure, such as the use of firewalls and the encryption of data between applications and database servers (Anderson & Blackwood, 2004:21).

Although delivering materials in a browser helps, it does not offer full platform independence and there are still standards issues. An iterative approach to development is best and developing learning materials specifically for m-learning is better than re-using materials developed for delivery to a personal computer. It is important to be aware that, when delivering learning or offering support services to someone's mobile phone, we are encroaching on their personal space. A flexible, collaborative and pragmatic approach to development works well in an environment where the technologies are new and standards are evolving (Attewell, 2005:16).

The lessons on m-learning that have been learned at the University of Southern Queensland can be summarised as follows: Develop a framework for m-learning appropriate for your own context. Don't be seduced or consumed by new developments in technology. Collaborate, and learn from the successes and failures of others. Use mentors and consultants as catalysts. E-learning and m-learning have changed, and will continue to change traditional approaches to teaching, learning, student support, and administration. It is important to remember that technology is only a means to an end. It must be used wisely to develop systems and approaches which promote quality education provision (Smith, 2006:26).

2.14 CONCLUSION

Mobile technologies have propelled higher education into the next major technology cycle, the mobile Internet with drivers such as the rapid adoption of 3G, social networking, video, VoIP, and mobile devices that are more powerful that personal computers (Meeker, 2009:9). M-learning is part of a new mobile conception of society, with the mobility of the technologies impacting on the mobility of the students, the lecturers and ultimately on the mobility of higher education. Literature suggests that, while m-learning is proving to be innovative, the factors that most strongly impact on the ultimate success or failure of m-learning will depend on human factors, the balancing of technological ideals and pedagogical imperatives, and the successful management of the interface between human educational systems and technology systems (Rajasingham, 2010:8). When analysing areas for ICT innovation in higher education it is important to think about how m-learning could impact students, lecturers and higher education institutions.

2.15 CHAPTER SUMMARY

The mobile Internet is ramping faster than desktop Internet did, and it is believed that more users will connect to the Internet via mobile devices than desktop personal computers within five years (Meeker, 2010:16). Innovative new mobile technologies pull higher education towards smaller, faster, cheaper devices working together in a web of connectivity (Stead, *et al*., 2006:7). Traxler (2007:11) and other advocates of mobile education define m-learning as wireless and digital devices and technologies, generally produced for the public, used by a student as he or she participates in higher education. The proposed general framework focuses on addressing key issues related to mobile learning from the perspective of the student, the lecturer and thus the institution. In order to remain competitive higher education needs to be diligent in maintaining the complex technology infrastructure that supports a thriving mobile culture that will meet and exceed the expectations of both lecturers and students.

CHAPTER 3
EMPIRICAL STUDY

3.1 INTRODUCTION

This chapter deals with the empirical research study conducted within the North West University (NWU) in South Africa, specifically on the Potchefstroom Campus (PC), to explore the implication of mobile technologies on the way students learn and lecturers teach, and thus also explore how to manage m-learning in higher education institutions. The main objective was to develop a general framework to implement and manage mobile technologies in a higher education environment. To achieve this primary objective of the study, the secondary objectives of the empirical research needed to be investigated. The empirical research objectives were to investigate the mobile technology assets of respondents with regard to the hardware and the software that they own, the mobile technology actions of respondents in regard to what they do with the mobile technology that they own and to investigate the respondents' attitude towards mobile technologies. This chapter sets out the scope of the research, the research design, data collection, data analysis, and discussion of the results of the study.

3.2 SCOPE OF THE EMPIRICAL RESEARCH

The empirical study, to research the management of m-learning in higher education will focus on the following:

- Investigating the implications of mobile technologies for students, lecturers and thus for the institution.
- Identifying the mobile technology assets of respondents with regard to the hardware and the software that they own.
- Identifying the mobile technology actions of respondents in regard to what they do with the technology that they own.
- Identifying the respondents' attitude towards mobile technologies.

3.3 RESEARCH DESIGN

3.3.1 Population

The population can be seen as the entire personnel and student corps of the North-West University (NWU) in South Africa and specifically of the Potchefstroom Campus. The NWU is a multi-campus university with a footprint across two provinces. The Mafikeng and Potchefstroom Campuses are situated in the North-West Province and the Vaal Triangle Campus is in Gauteng. The head office, known as the Institutional Office, is in Potchefstroom, situated near the Potchefstroom Campus. The NWU is recognised as one of the best-managed and most innovative universities in South Africa. As conveyed in the NWU's pay-off line, Innovation through diversity, the NWU inspires to be the leading institution that has moved away from E-learning to I-learning by exploring the modalities of Innovative learning as a new future concept. The total population contact students at the NWU Potchefstroom Campus in 2011 was N = 19,409 (Koekemoer, 2011:1) and lecturers were N = 767 (Koekemoer, 2011:1). This study is limited to the NWU Potchefstroom Campus and also limited to the part of the sample population that could be reached.

3.3.2 Sample type and size

It is impractical and uneconomic to involve all the members of the population in a research project, consequently we have to rely on the data obtained for a sample of the population (Welman, Kruger & Mitchell, 2005:55). Due to budget and time constrains student respondents were selected by means of a non-probability, convenience sampling. Convenience sampling involves selecting those participants that are easiest to obtain, the sample selection process is continued until the required sample size is reached (Welman *et al.,* 2005:69). Lecture respondents were selected by means of a non-probability, self-selection sampling. Self-selection sampling occurs when participants identify their desire to take part in the research. Participants that self-select often do so due to their feelings or opinions about the research objectives (Welman et al., 2005:69). The data were analysed as if obtained from a probability random sample.

In the business world, sample sizes are determined prior to data collection to ensure that the confidence interval is narrow enough to be statistically significant and useful in making decisions. The optimum sample size is determined from the desired confidence level and the acceptable sampling error and can be calculated by means of Equation 1 below. (Levine, Stephan, Krehbiel & Berenson, 2008:299-304).

The sample size, n, is equal to the Z value squared, times the population proportion, π, times 1 minus the population proportion, π, divided by the square of the sample error, e.

Equation 3.1. Sample size. Source: Levine *et al*. (2008:303)

$$n = \frac{Z^2\pi(1-\pi)}{e^2} \qquad 196 = \frac{(1.96)^2(0.5)(0.5)}{0.07^2}$$

The three factors to determine the sample size;

- The desired confidence level, which determines the value of Z, the critical value from the standard normal distribution. A 95% confidence interval (z = 1.96) were used.
- The acceptable sampling error, e to within ± 0.07.
- The population proportion, π used was 0.5 which maximizes the sample size)

The number of NWU (PC) Lecturers in the population is 767 the number of NWU (PC) contact Students in the population is 19,409. For these set values it was calculated that 169 questionnaires were required. In total 252 responses were received from Lecturers and 350 responses were received from students, which is greater than the minimum required, and thus it can be assumed that the survey results are representative of the opinion of the population.

3.3.3 Survey design

Two schools of thought can be grouped into distinguishing between the various instruments that can be used by researchers for capturing the information needed, namely qualitative and quantitative research approaches. Qualitative research can be described as a subjective approach to research that attempts to collect rich descriptive data in respect of a particular context with the intention of developing an understanding of what is being observed (Welman et al., 2005:8-9). Quantitative research is a process that is objective in its approach of using numerical data from only a selected sample of the population to generalize the findings to the population that is being studied (Welman et al., 2005:8-9). This method seeks precise measurement and analysis of target concepts. To objectively meet the research objectives, a quantitative approach was selected.

A questionnaire was used as the survey instrument. Using the literature study in chapter One, the Educause ECAR questionnaire (2010) in the undergraduate students' use of information technology, and an unpublished study on the NWU, PC, in the information technology use of students, a new questionnaire was developed as an exploratory study in the use of mobile technologies by both students and lecturers. The questionnaire was structured into four sections namely Section A: Demographics with four questions: Section B: Mobile device ownership with three questions: Section C: Mobile technologies usage with twelve questions: Section D: Mobile technology and information literacy skills with two questions, and Section E: Attitude toward mobile technology with one question. A four point Liker scale was utilise depending on the question. Refer to Appendix A for the questionnaire developed for the research survey.

3.4 DATA COLLECTION

3.4.1 Proof of concept

The questionnaire was subjected to a pilot test to identify weaknesses in the construction and formulation of the questions. Feedback on the content was carefully considered and after suggestions had been incorporated, the final questionnaire was distributed. A draft questionnaire was sent to Statistical Consultation Services of the North West University Potchefstroom Campus to get their views and recommendations, as a proof of concept.

3.4.2 Selection method

The final version of the questionnaire was distributed through e-mail and hard copy, using the network of colleagues within the university, to gather data. The questionnaire to the university lecturers was electronically deployed to the target population via an e-mail containing the background to the study and a hyper-link to the survey created in SurveyMonkey- online survey software and questionnaire tool. The e-mail was sent to 767 colleagues (only 604 colleagues opened their mail the rest were automated out of office replies, stating that lecturers were either on study leave or abroad. The survey remained active for a period of one week; after the week only 79 lecturers had responded. An e-mail was again sent to lecturers; as an extra incentive the executive summary of the study done at the NWU to research the use and ownership of information technology by students on the Potchefstroom Campus was added. The survey was again reopened for another week and the response increased to 252 lecturers and was used in the empirical study. The questionnaire for the university students were printed in hard copy and 350 questionnaires

were given out to lecturers to give to their students to complete. If any blank questionnaires were received, those questionnaires were again given out. Thus all 350 questionnaires were completed.

3.5 DATA ANALYSIS

3.5.1 Frequency analysis and descriptive statistics

The data collected from both the responding student and lecturers questionnaires were processed using Excel spreadsheets, where standard Excel functions and the programme SPSS version 18 were used to analyse data. Using SPSS, a frequency analysis and descriptive statistics were performed on both student and lecturer response datasets by Statistical Consultation Services of the North West University.

The arithmetic mean, or mean, denoted $\bar{X}$, is the most commonly used measure of central tendency indicating the balance point in a set of data (Levine *et al.*, 2008:97) It is the average of the set of data. Standard deviation is the primary measure of variation in a frequency distribution. A large standard deviation will indicate that the data are spread out, where concentrated data will have a small standard deviation (Levine *et al*., 2005:116-118). Refer to Appendix B for the summary of the descriptive statistics.

Equation 3.2. Calculation of the arithmetic mean. Source: Levine *et al.* (2008:97)

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

Equation 3.3. Calculation of the standard deviation. Source: Levine *et al.* (2008:117)

$$S = \sqrt{\frac{\sum_{i=1}^{n} (X_i - \overline{X})^2}{n-1}}$$

Where:

$\bar{X}$ = Arithmetic mean

n = Sample size

$\sum_{i=1}^{n} X_i$ = The sum of all the observed values in the data set.

S = Standard deviation

Statistical significance tests were conducted to validate the data. In many cases it is important to know whether a relationship between two variables is practically significant, e.g. between lecturer or student and preference for internet activities conducted over a mobile device. For random samples, the statistically significance of such relationships are determined with Chi-square tests (Ellis & Steyn, 2003:54). Although non-probability convenient sampling was used for this study, for the sake of completeness, p-values will be reported as if probability sampling was done. Statistical significance does not necessarily imply that the result is important in practice as these tests have a tendency to yield small *p*-values (indicating significance) as the sizes of the data sets increase. Practical significance can be understood as a large enough difference to have an effect in practice, with the effect size independent of sample size (Ellis & Steyn, 2003:53). To determine the effect size for the relationship in contingency tables the Phi coefficient was used. Phi measures strength of association between two categorical variables.

Equation 3.4. Calculation of Phi. Source: Ellis & Steyn (2003:54)

$$w = \sqrt{\frac{X^2}{n}}$$

Where:

X^2= is the usual Chi-square statistic for the contingency table

n= is the sample size

w = is the effect size given by the phi (ϕ) coefficient.

The following are given as guidelines for the interpretation of the effect size:

- small effect: w=0.1,
- medium effect: w=0.3 and
- large effect: w=0.5.

Therefore when w is calculated to be greater than 0.5, the effect size is large and considered to be practically significant and thus of practical importance (Ellis & Steyn, 2003:54).

3.5.2 Validity and reliability

The validity of a questionnaire relies first and foremost on reliability. If the questionnaire cannot be shown to be reliable, there is no discussion of validity. If the content of a instrument matches an actual situation that is being studied, then the questionnaire has content validity. Validity is the extent to which the research findings accurately represent what is happening in the situation (Welman, Kruger & Mitchell, 2005:242). To ensure the data collected with the instrument was valid the questionnaire was reviewed by both subject experts and Statistical Consultation Services of the North West University to determine internal validity.

Reliability is concerned with the findings of the research and relates to the credibility of the findings. Cronbach's alpha coefficient was used to test the internal consistency method utilised to estimate reliability. Cronbach's alpha coefficient is stated as a number between 0 and 1; a generally acceptable value of Cronbach's alpha of greater than 0.7 is ideal however. According to Field (2009:675), even lower values can be realistically accepted due to diversity of the constructs. The questionnaire was developed as an explorative study into the ownership and activities of mobile technologies; the question to investigate respondents' attitude and opinion towards mobile technology was also handled as a construct. A construct, intentionally developed, is an abstract concept used to represent a divergent collection of responded opinion and attitude towards issues identified in the literature study. The question in totality did not score a high relevancy score with a Cronbach's alpha of less than 0.5, but by eliminating questions a high Cronbach's alpha score above 0.8 was achieved testing four questions relevant to the opinion of both lecturer and student respondents towards mobile technology increasing efficiency and productivity. The Cronbach's alpha of the construct on the efficiency and productivity of lecturers and students will be discussed further at point 3.5.5.

3.6 RESULTS AND DISCUSSIONS

Responses assessing the ownership, activities, and attitude towards mobile technology were analysed in the dataset observed. To simplify the process during data analysis, two different Likert scales were used, distinguished with an A (1-4), and B (1-4) during the data analysis:

1. A -rated the response according to the perception of how often they used the technology (example: 1 = Almost always, 2 = Often, 3 = Seldom, 4 = almost never)

2. B -rated the response according to the perception to what extent the respondent agreed or disagreed with the statements (example: 1 = Strongly agree, 2 = Agree, 3 = Disagree, 4 = Strongly disagree)

To investigate the ownership, usage and attitude of respondents towards mobile technology the responses were grouped under: positive response (1) and (2) and negative response (3) and (4).

3.6.1 Results of Section A

Section A consists of biographical information of respondents. The respondents populated the table with their demographic information, i.e. age and gender. This was done to see if there are any major differences or correlation between demographic groups within the university.

3.6.1.1 Age

The respondents align well with and are representative of the target population with the majority of students falling in the traditional age demographic of university students and the average age of responding lecturers being 41.

Table 3.1: Biographical profile of respondents by age.

Responding lecturers			**Responding students**		
Age	**Number of respondents**	**% of Respondents**	**Age**	**Number of respondents**	**% of Respondents**
			17-19	51	14.6
			20-24	203	58
29 <	35	14.2	**25-29**	27	7.7
30-39	90	36.4	**30-39**	44	12.6
40-49	62	25.1	**40-49**	21	6
50 >	60	24.3	**50 >**	4	1.1
Total	247	100	**Total**	350	100
Missing	5		**Missing**	0	

Source: Annexure B

As illustrated in table 3.1 close to 61.5% of responding lecturers were between the age group of 30 - 50. Most responding students were under 25 years old (72.6%) and 62.8% reside off campus.

3.6.1.2 Gender

The respondent's gender distributions were approximately equal with almost 50% male and 50% female respondents for both lecturers and students.

Table 3.2: Biographical profile of respondents by gender.

Responding lecturers			Responding students		
Gender	**Number of respondents**	**% of Respondents**	**Gender**	**Number of respondents**	**% of Respondents**
Male	118	46.6	**Male**	183	52.4
Female	134	53.4	**Female**	166	47.6
Total	252	100	**Total**	349	100
Missing	0		**Missing**	1	

Source: Annexure B

As illustrated in table 3.2 the responding lecturers were 46.6% male and 53.4% female. The responding students were 52.4% male and 47.6% female.

3.6.1.3 Historical year at the university

The respondents align well with and are representative of the target population with approximately 70% undergraduate students and approximately 30% post graduate students.

Table 3.3: Biographical profile of respondents by historical year at the university.

Responding lecturers			Responding students		
Years of lecturing	**Number of respondents**	**% of Respondents**	**Year of study**	**Number of respondents**	**% of Respondents**
First yr.	32	12.9	**First yr**	54	15.5
Second yr.	30	12	**Second yr**	66	18.9
Five yrs >	89	35.7	**Third/fourth**	99	28.4
Ten yrs >	39	15.7	**Post grad.**	55	15.8
Fifteen yrs >	59	23.7	**MBA**	65	18.6
			Other	10	2.9
Total	249	100	**Total**	349	100.0
Missing	3		**Missing**	1	

Source: Annexure B

As illustrated in table 3.3 the majority (75.1%) of the responding lecturers have been lecturing at the university for more than 5years. Out of the 349 responding students that answered the question, 15.5% were first year, 18.9% were second year, 28.4 were third or fourth year, 15.8 were post graduate, 18.6% were MBA students and 2.9% choose "other".

3.6.2 Results of Section B

The questions in section B were directed in such a way as to get an understanding of which mobile devices respondents owned. An open question was asked to determine the main reasons for respondents owning or not owning a specific device. Students were asked about their preference for reading study material on hard copy, desk top computers or on a mobile device.

3.6.2.1 Mobile devices

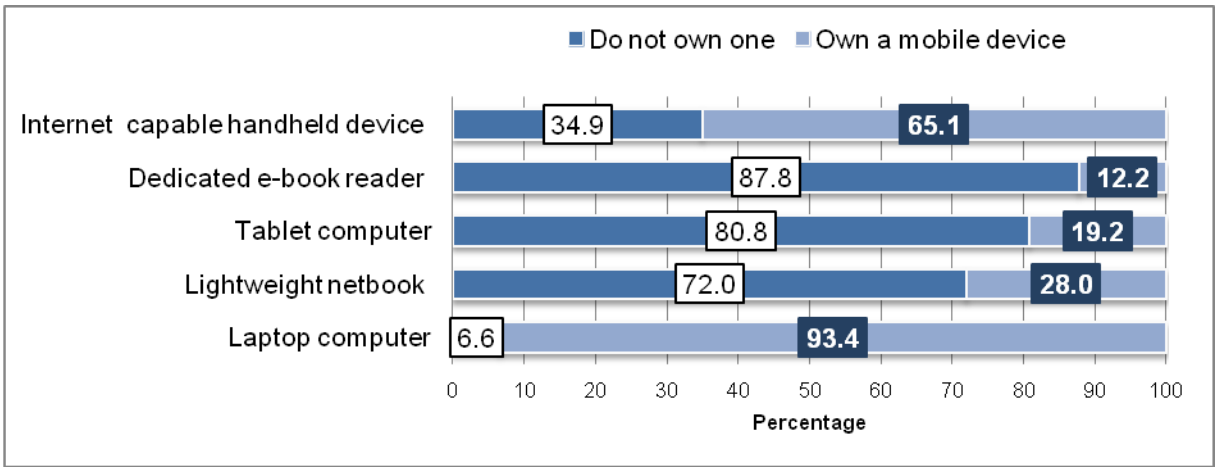
In the literature study laptops were excluded in the definition of mobile devices, but for the purposes of the empirical study laptops were included since a laptop computer is designed to be mobile.

In the questionnaire devices mentioned in the questions were defined as such:

• A desktop computer is one that was not designed to be portable; the keyboard and monitor are usually separate units.
• A full-sized laptop computer is one that is designed to be portable; it usually weighs more than one kilogram; the keyboard and monitor are usually attached to each other.
• A lightweight netbook computer is highly portable; it usually weighs less than one kilogram; its monitor is small (usually 25cm or less) and the keyboard is small and built in.
• A tablet computer is highly portable; it usually weighs less than one kilogram; its monitor is small (usually 25cm or less) and the keyboard may be small and built in or the keys may be displayed in video on a touch screen. Apple iPad and the Samsung, Galaxy Tab 10.1. is included here.
• A dedicated e-book reader is a portable device with the sole function of being a platform for reading electronic books and certain other electronic publications. Examples include the Amazon Kindle, NOOK, and the like; Apple iPad and similar tablet devices have many other functions and are therefore not included here.
• A handheld device is usually about the size of a cellular telephone and often includes one; it has a screen that can display e-mail messages, web pages, video, etc.; and its keyboard is at most a few centimetres wide, or the keys may be displayed in video on a touch screen. Included in this group are Personal Digital Assistants (PDA), Cellular phones, and Smart Phones.

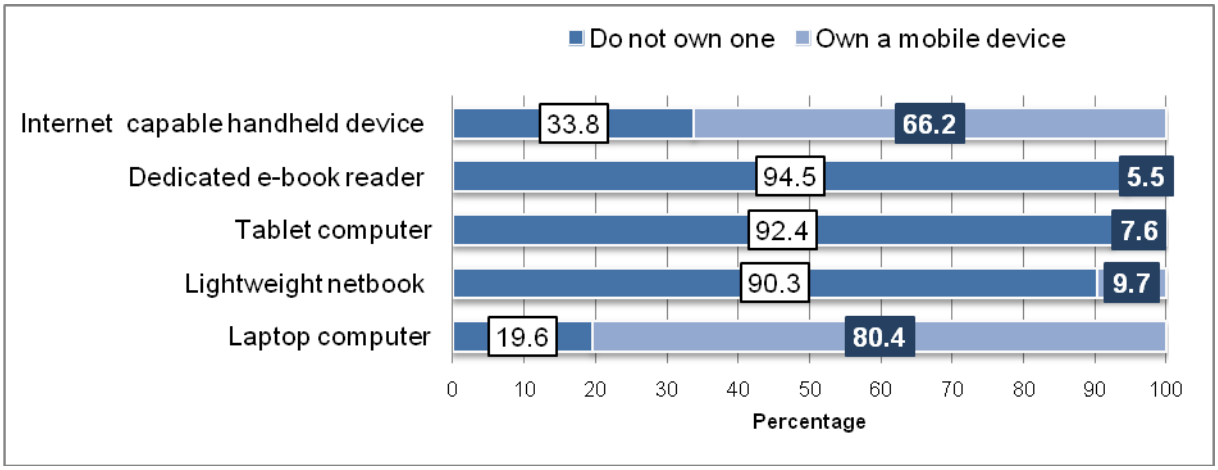
It is evident from the responding lecturers' results (figure 3.1) that laptop computers (93.4%) are the most used mobile devices, followed by the internet capable handheld devices such as cell phones, smart phones and PDAs (65.1%).

Figure. 3.1: Percentage of mobile devices owned by responding lecturers



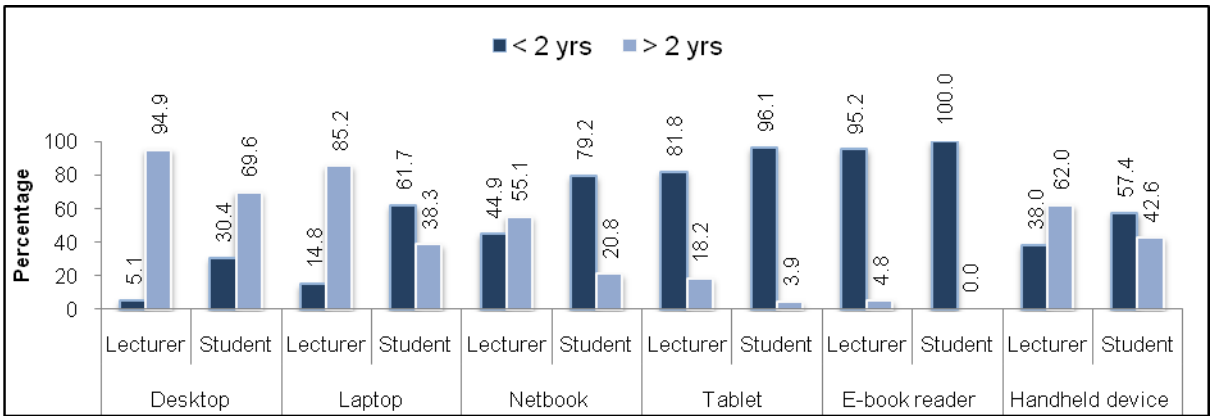
It is evident from the responding students' results (figure 3.2) that laptop computers (80.4%) are the most used mobile devices, followed by the internet capable handheld devices such as cell phones, smart phones and PDAs (66.2%).

Figure. 3.2: Percentage of mobile devices owned by responding students



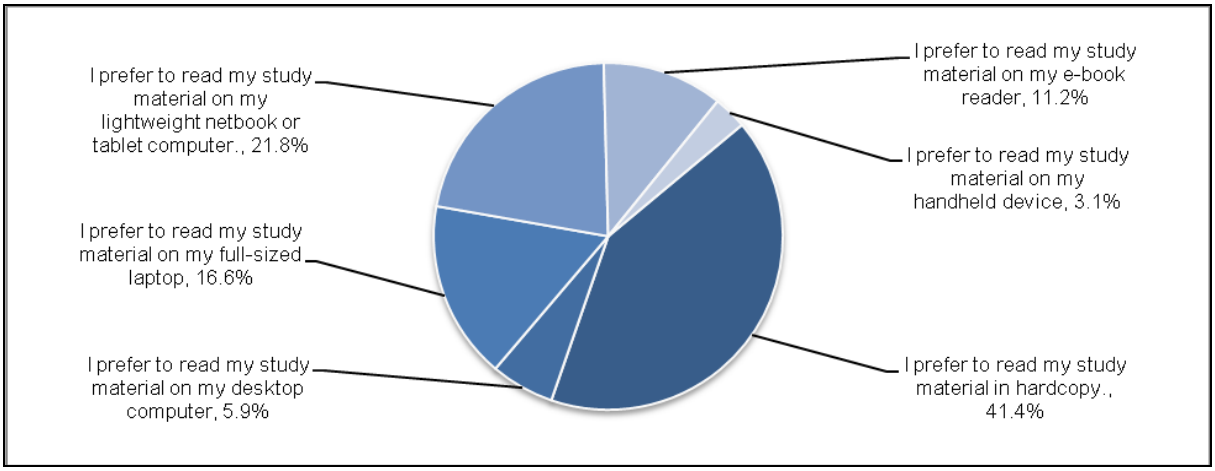
The majority of both lecturers' and students' desktop computers are more than two years old, whereas the majority of lecturers' laptops and handheld devices are more than two years old, and more than half of the students' laptops and handheld devices are less than two years old. The majority of the netbooks, tablets and e-book readers for both lecturers and student respondents are less than two years old.

Figure. 3.3: Percentage of mobile devices owned by responding students and lecturers by number of years owned.



Only 41.4% of student respondents still prefer to read their study material in hard copy, only 5.9% prefer to read their study material on their desktop and the rest (52.7%) prefer to read their material on some kind of mobile device. The mobile devices that are preferred for reading study material by the majority (21.8%) of responding students are lightweight netbook or tablet computers

Figure. 3.4: Percentage responding student's preference for reading study material.



Responding lecturers felt that the main reason for owning mobile devices is their mobility and convenience to travel with. Some respondents felt that laptop computers are easy to use; some reasons for not owning a laptop computer were that laptop computers are "too big and lumpy" making them difficult to carry around. Some respondents commented that netbook computers are too expensive while others responded that they were thinking of purchasing a netbook computer soon. Respondents agreed that tablet computers are versatile and portable which makes them "the best device for documents/meetings" as well as for news and social networking applications, others felt that they don't own a tablet computer because

tablet computers are expensive and that they are unfamiliar with the technology. Some respondents prefer reading in hard copy and stated that as the main reason why they do not own an e-book reader, others felt that e-book readers have limited capabilities and are expensive. Other respondents felt that e-book readers save space by having all their books in one place when they travel, and that is why they own e-book readers. Personal Internet capable handheld devices give respondents access to information anytime, anywhere and are convenient for reading e-mail and for social networking. Although some respondents still find Internet capable handheld devices expensive, the major reason why responding lecturers do not own a type of mobile device seems to be because of the expense and the relative computing power that mobile devices provide.

Responding students felt that the main reason for owning mobile devices is their mobility and convenience. Some respondents felt that laptop computers were, affordable and practical because of their portability, ease of use and access to Internet. Some respondents felt that cost is still the reason for not owning a laptop computer. Some student respondents felt that they have no need for a netbook and that netbook computers are expensive and can easily be stolen because they are so small. Other respondents felt that their light weight and mobility make netbooks convenient and portable. Respondents felt that tablet computers are “small and very capable of doing anything from social networking, music, movies, work, and university slides” Some are planning on getting a tablet computer, while other responding students find no need for tablet computers and feel that tablet computers are too expensive and have compatibility issues with other devices as well as other hardware limitations. Some respondents felt that e-book readers are a luxury item and are too expensive because e-book readers are not multi-functional. Other respondents prefer hard copy books, while some like to have all their books in one place. One respondent stated “I'm lost without it” when asked why they owned an Internet capable handheld device. Others stated that they use handheld devices such as PDAs, cell phones and smart phones for everything that they do in their lives, from studies, social and personal interaction. Respondents feel that handheld devices are mobile, convenient, easy to use and always with them. Although some respondents feel that Internet capable handheld devices are affordable, others feel that the technology is too expensive. The reasons stated by the majority of student respondents in answer to the question why they do not own a particular mobile device were most commonly that the device was too expensive.

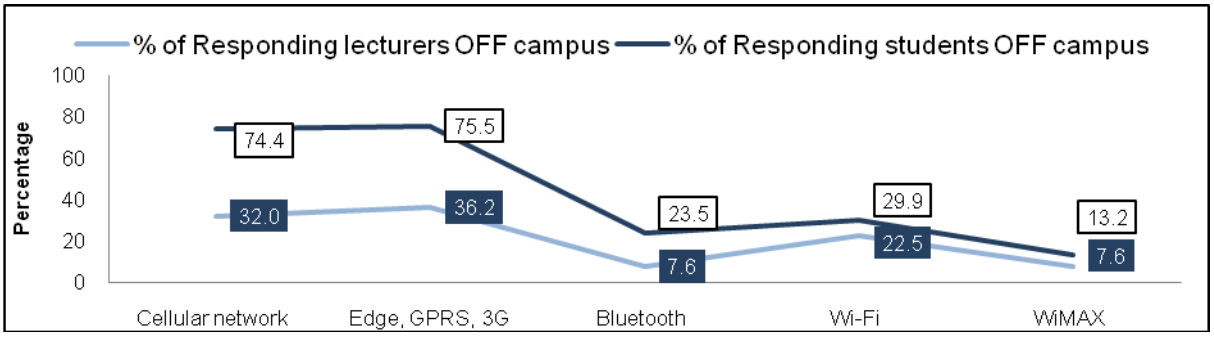
3.6.3 Results of Section C

The questions in section C were directed in such a way as to get an understanding of which wireless technologies respondents use on and off campus, how many hours a day respondents spend online on the internet for recreation and for work or study purposes, and about the collaborations and activities they do over their mobile devices. Respondents were also asked about their use of computer or network based applications, their adoption of technology and their preference for mobile and other information technology in modules.

3.6.3.1 Wireless technologies

The cellular network usage includes the percentage of Edge, GPRS and 3G, as these are cellular technologies utilising the cell phone network. The high usage can be explained because of the high number of cell phone and laptop users. Wi-Fi is steadily gaining some ground among students and lecturers and is bound to increase in popularity as costs decrease. WiMAX is still relatively new and not used by both lecturers and students for gaining access to the Internet off campus. Bluetooth and infrared technology scored the lowest for both lecturer and student respondents.

Figure. 3.5: Percentage of wireless devices used off campus

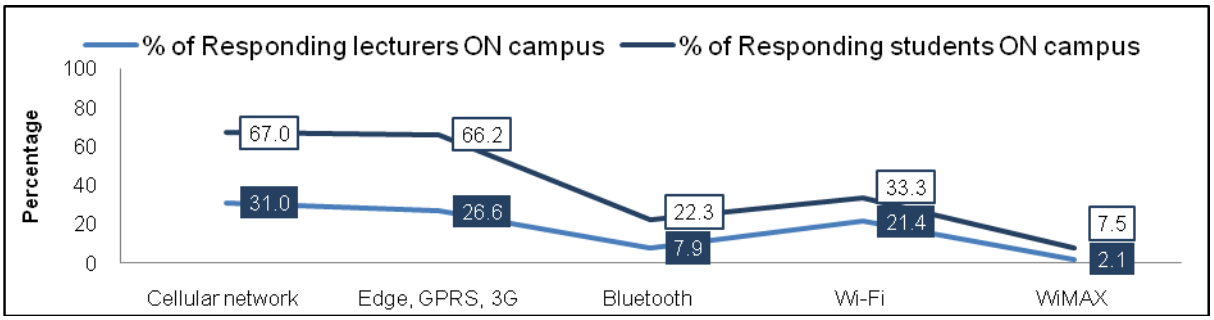


The number of users that utilise the cellular network off campus (Figure 3.5) as a wireless technology scored the highest from both lecturer and student respondents.

However, student usage of cellular network, Edge, GPRS, and 3G is significantly higher than the usage of lecturers on campus. This can be due to the fact that lecturers gain access to the Internet on campus through the university's broadband ADSL connection. The university's Wi-Fi connection is still under -utilised by both students and lecturers. WiMAX is the next generation (4G) of wireless, and is not available on campus. This type of signal has

much broader access than the Wi-Fi signal, meaning that you can connect to the university's network from more places off campus than ever before.

Figure. 3.6: Percentage of wireless devices used on campus.



The number of users that utilise the cellular network on campus (Figure 3.6) as a wireless technology scored the highest from both lecturer and student respondents.

3.6.3.2 Activities on mobile devices

In an April 2010 report on Internet trends, Morgan Stanley analysts developed a forecast of future Internet use showing a dramatic shift towards mobile web use. Based on current exponential growth of the mobile web, the report concludes that the mobile web will be bigger than desktop Internet use by 2015. Five converging technologies are driving this growth: 3G, social networking, video, VOIP, and remarkable mobile devices (Meeker, 2010:9)

Table 3.4: Percentage of respondents accessing the Internet from their mobile device.

Descriptive Statistics					
% of Responding lecturers					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Work purposes	232	0	60	7.9	11.5
Recreation	230	0	35	3.6	5.2
% of Responding students					
Study purposes	276	0	56	5.6	7.2
Recreation	274	0	80	6.5	8.9

Source: Annexure B

Responding lecturers access the Internet from a mobile device an average of 7.9 hours per week for work purposes, and an average of 3.6 hours for recreation. Student respondents access the internet on a mobile device on average 5.6 hours per week for study purposes and for recreation an average of 6.5 hours per week. Much of this growth is driven by increasing mobile access to social networking.

Table 3.5: Respondents' access to Internet activities over their mobile device.

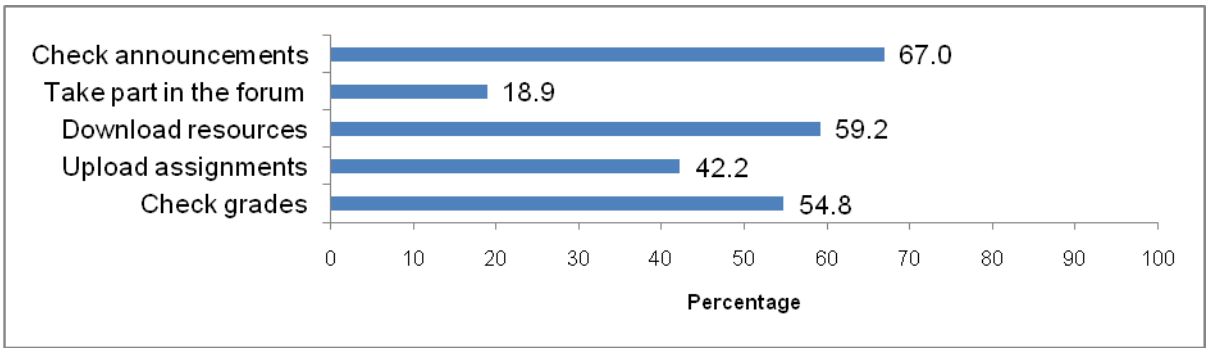
Internet activities		Almost always	Often	Seldom	Almost never	N	Chi-Square Tests: Effect sizes >0.5	Chi-Square Tests: P values <0.05
Text messaging.	Lecturer	9.0%	33.2%	37.7%	20.1%		**.691**	**.000**
	Student	71.5%	24.2%	2.8%	1.4%	281		
Place and receive telephone calls.	Lecturer	11.0%	34.5%	36.0%	18.5%	199	**.590**	**.000**
	Student	65.8%	24.2%	6.0%	3.9%	281		
Instant messaging.	Lecturer	3.8%	11.3%	28.3%	56.5%	186	**.640**	**.000**
	Student	60.9%	16.7%	9.3%	13.2%	281		
Social networking websites	Lecturer	4.1%	9.1%	11.7%	75.1%	200	**.640**	**.000**
	Student	46.5%	25.2%	13.8%	14.5%	282		
E-mail.	Lecturer	57.0%	31.5%	8.5%	3.0%	193	.259	.000
	Student	42.3%	24.6%	17.1%	16.0%	281		
Check information online	Lecturer	3.5%	7.6%	23.2%	65.7%	195	**.568**	**.000**
	Student	34.5%	32.4%	13.9%	19.2%	281		
eFundi.	Lecturer	48.2%	24.1%	6.2%	21.5%	193	.285	.000
	Student	23.8%	22.8%	14.9%	38.4%	281		
Twitter	Lecturer	1.0%	2.6%	3.6%	92.7%	197	.384	.000
	Student	15.9%	12.3%	13.7%	58.1%	277		
The university library website.	Lecturer	6.7%	18.1%	21.8%	53.4%	198	.144	.021
	Student	13.6%	20.4%	25.1%	40.9%	279		
Post or contribute to blogs.	Lecturer	1.0%	2.5%	14.6%	81.8%	198	.234	.000
	Student	8.3%	7.6%	21.6%	62.6%	278		
Download or watch videos	Lecturer	0.5%	14.9%	24.1%	60.5%	197	.182	.001
	Student	7.9%	15.8%	17.2%	59.1%	279		
Photo-sharing websites	Lecturer	0.5%	2.5%	9.1%	87.8%	198	.239	.000
	Student	5.4%	6.5%	20.4%	67.7%	279		
watch mobile TV in class.	Lecturer	0.0%	2.0%	5.6%	92.4%	195	.138	.029
	Student	3.6%	2.2%	8.3%	85.9%	276		
educational games online.	Lecturer	0.0%	1.5%	8.6%	89.8%	197	.193	.001
	Student	2.9%	6.8%	13.7%	76.6%	278		

Source: Annexure B

Responding students were asked what Internet and communication activities they do from their mobile devices and found that some of the activities mentioned in the literature review are showing up as popular activities in the results of the questionnaire. The most popular activity among students is text messaging with 95.7% of students using the technology almost always and often, second is placing and receiving telephone calls with 90.0% of students using the technology almost always and often; in third place is instant messaging with 77.6% of students using the technology almost always and often, and fourth is social networking websites with 71.7% of students using the technology almost always and often. Internet activities done least by responding students are educational games, watching mobile TV, and photo-sharing websites. Activities associated with the university such as eFundi (the universities course management system, CMS) and the university library website scored low, with respectively 46.6% and 34% of students using the technology almost always and often over their mobile device.

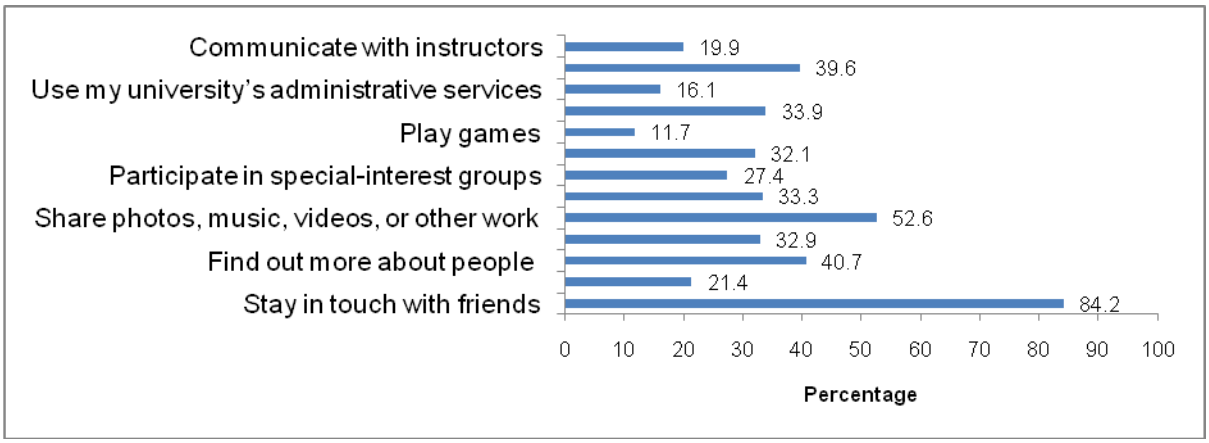
Responding lecturers were asked how often they use Internet activities to communicate with or provide information to their students. The most popular activity among lecturers is to send students email with 88.5% of lecturers using the technology almost always and often, and in second place lecturers use eFundi to provide students with information, with 72.3% of lecturers using the technology almost always and often. These statistics indicate statistically significant association between variables with a p-value of less than 0.05, but more interesting is the effect size with values of 0.1 indicating a small effect, thus no practically significant association; values of 0.3 indicating a medium effect, thus some practically visible association and values of 0.5 indicating a large effect; thus a practically significant association.

Figure. 3.7: Percentage responding students' eFundi activities over a mobile device.



Responding students, who answered that they access eFundi on a mobile device on a regular basis, were asked about the activities they do on eFundi over a mobile device. Respondents answered that they read announcements (67.0%), download resources (59.2%) and check grades (54.8%) using the technology almost always and often.

Figure. 3.8: Percentage responding students' SNS activities on their mobile device.



Responding students, who answered that they access Social Networking Websites on a mobile device on a regular basis, were asked about the activities they do on Social

Networking Websites over a mobile device. More than half of respondents answered that they use SNS over mobile devices to stay in touch with friends (84.2%), and share photos, music, videos, or other work (52.6%) using the technology almost always and often.

In February 2010, chief information officers, chief business officers, and industry leaders gathered in Tempe, Arizona, for an EDUCAUSE/NACUBO Cloud Computing Workshop to explore what shape a higher education cloud might take and to identify opportunities and risks. The resulting white paper noted that cloud computing could offer institutions the flexibility for some institutional activities to move above campus to providers that are faster, cheaper, or safer, and for activities to move off the institution's responsibility list to the "consumer" cloud, while still other activities can remain in house, including those that differentiate and provide competitive advantage to an institution (Hignite, Katz, & Yanosky, 2010:2).

Table 3.6: Web-based tools used by respondents.

Web-based tools		Almost always	Often	Seldom	Almost never	N	Chi-Square Tests	
							Effect sizes >0.5	Effect sizes >0.5
Social networking websites	Lecturer	5.8%	7.3%	12.6%	74.3%	191	.399	.000
	Student	18.8%	27.1%	18.8%	35.3%	266		
Web-based applications	Lecturer	7.8%	10.9%	18.8%	62.5%	192	.228	.000
	Student	18.4%	19.5%	20.3%	41.7%	266		
Wikis (Wikipedia, module wiki, etc.)	Lecturer	6.3%	15.8%	17.4%	60.5%	190	.175	.003
	Student	11.5%	24.0%	21.0%	43.5%	262		
Video-sharing websites	Lecturer	3.2%	12.1%	15.8%	68.9%	190	.164	.007
	Student	8.6%	15.4%	21.8%	54.1%	266		
Textbook publisher websites	Lecturer	3.1%	13.6%	23.0%	60.2%	191	.078	.425
	Student	6.1%	11.4%	20.5%	62.0%	263		
Photo-sharing websites	Lecturer		2.6%	11.1%	86.2%	189	.210	.000
	Student	4.5%	6.8%	18.6%	70.1%	264		
Micro-blogs	Lecturer	2.6%	4.8%	6.3%	86.2%	189	.196	.001
	Student	3.8%	5.7%	19.4%	71.1%	263		
Web-based citation tools	Lecturer	2.1%	11.6%	16.4%	69.8%	189	.071	.518
	Student	3.4%	8.0%	17.1%	71.5%	263		
Blogs	Lecturer	.5%	6.5%	11.4%	81.5%	184	.132	.051
	Student	3.0%	6.4%	18.2%	72.3%	264		
Social bookmarking	Lecturer		3.7%	6.4%	89.9%	188	.214	.000
	Student	3.0%	4.2%	18.3%	74.5%	263		
Online virtual worlds	Lecturer	.0%	1.6%	5.4%	93.0%	186	.161	.009
	Student	2.7%	3.1%	11.5%	82.8%	262		

Source: Annexure B

Responding students were asked whether they were working with other students using any off the following web-based tools for any of their modules this quarter/semester. The most popular collaborative web-based tools under students are social networking websites with

45.9% of students using the technology almost always and often; in second place are Web-based word processor, spreadsheets, presentation, and form applications (Google Docs, iWork, Microsoft Office Live, etc.) with 37.9% of students using the technology almost always and often; in third place are Wiki's (Wikipedia, module wiki, etc.) with 35.5% of students using the technology almost always and often.

Responding lecturers were asked how often their students collaborate or work with other students using any web-based tools in any of their modules this semester. According to the results of the questionnaire lecturers are not aware of the collaborative web-based tools used by students. Not all of these statistics indicate statistically significant association between variables with a p-value of less than 0.05 and the effect sizes indicate a small to medium effect; thus there is none to some practically visible association between variables.

Table 3.7: Computer and Network-based applications used by respondents.

	% of Responding lecturers		% of Responding students	
Applications	**Computer based**	**Network based**	**Computer based**	**Network based**
Word processors	85.1	31.3	95.3	60.8
Spreadsheets	67.8	17.9	69.3	38.5
Presentation software	86.6	28.6	77.8	40.1
Total	**201**	**201**	**275**	**273**
Missing	**51**	**51**	**75**	**77**

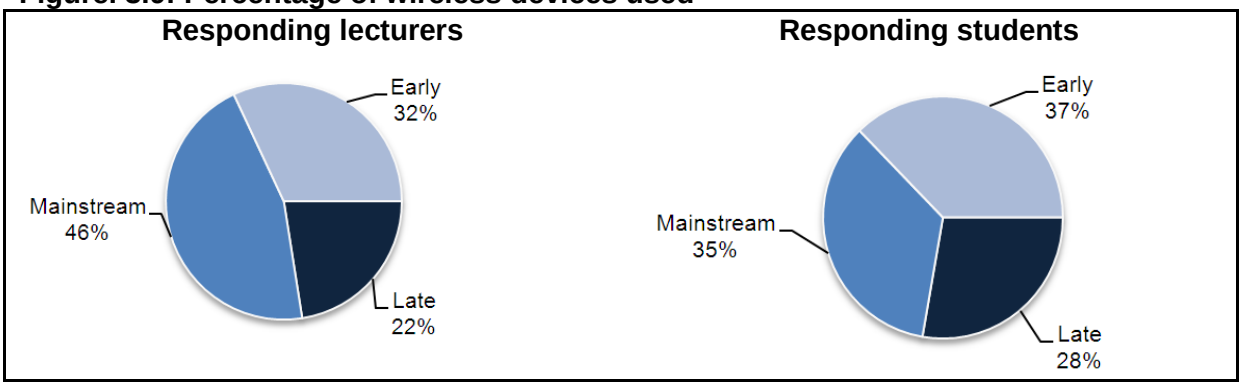
Source: Annexure B

Some of the applications lecturers and students use on their desktops, laptops, netbooks, or tablet computers are computer-based; that is, they run on a computer whether it is connected to the network or not. Other applications are network-based; they run only when a computer is connected to the Internet. The majority of applications used by lecturers are computer based. The majority of students are also using computer based applications but more than half (60.8%) of student respondents are also using network based applications for word processing.

3.6.3.3 Technology adoption

Research employing innovator-to-laggard models developed by Rodgers in 1962 has found that adopting and engaging with new technology is associated with many factors, including cultural influences, financial capability, perceived difficulty versus perceived benefits, past experience with technology, and gender (Smith & Caruso, 2010:38). Respondents were given a set of statements about technology adoption and asked to choose the one that best described them. The responses are mapped out in a simplified Rogers's technology adoption model.

Figure. 3.9: Percentage of wireless devices used

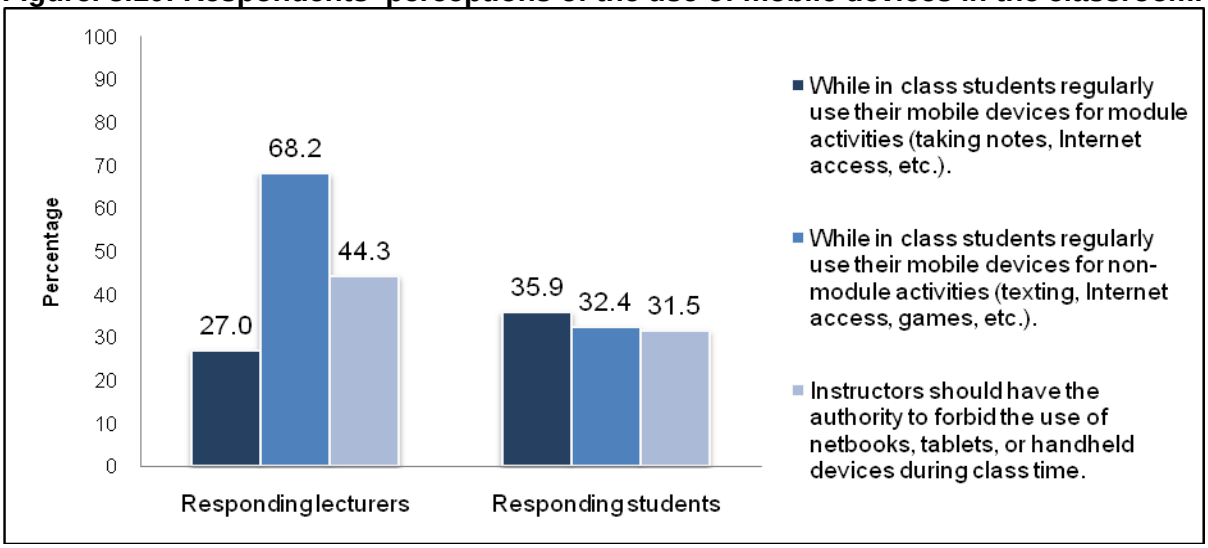


Responding lecturers perceive themselves to be mainly mainstream adopters (46%) with early adopters less than a third (32%) and a quarter of respondents late adopters of technology (22%). Responding students perceive themselves as mainly early adopters (37%) with almost a third mainstream adopters (37%) and more than a quarter of respondents late adopters of technology (28%).

3.6.3.5 Preference and opinions of mobile technologies in the classroom

Information and communication technologies have become integral to teaching, from using electronic resources in the library to conducting Internet research to delivering grades and other content through a course management system. ICT enables students to participate more actively in the learning process, and technologies that support this interaction are at the core of the changing face of higher education (Smith & Caruso, 2010:77).

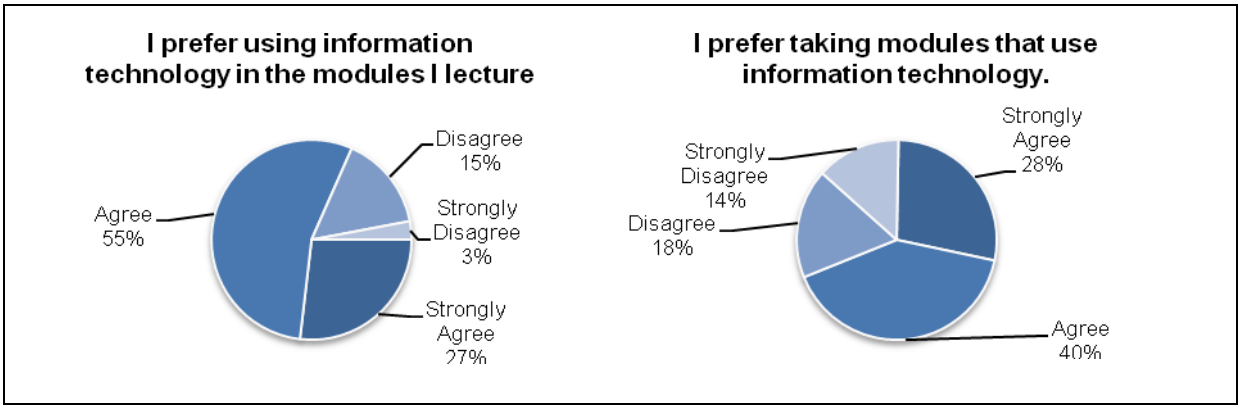
Figure. 3.10: Respondents' perceptions of the use of mobile devices in the classroom.



More than half (68.2%) of responding lecturers strongly agreed and agreed that while students are in class they regularly use their mobile devices for non-module activities, whereas less than half (27.0%) of lecturers strongly agreed and agreed that while in class

students regularly use their mobile devices for module activities, and less than a quarter (44.3%) of lecturers strongly agreed and agreed that instructors should have the authority to forbid the use of mobile devices during class time. Less than a third of responding students strongly agreed and agreed with the statements involving the use of mobile devices in the classroom.

Figure. 3.11: Respondents' preference for the use of ICT in modules



Lecturers were asked whether they prefer using information and communication technology (ICT) in the modules that they lecture. The majority of responding lecturers agreed (55%), 27% strongly agreed, 15% disagreed and 3% strongly disagreed. Students were asked whether they prefer taking modules that use ICT. The majority of responding students agreed (40%), 28% strongly agreed, 18% disagreed and 14% strongly disagreed.

3.6.4 Results of section D

The questions in section D were directed in such a way as to get an understanding of the skills of respondents in the use of mobile devices.

3.6.4.1 Skills of respondents in the use of mobile devices

The effectiveness of IT used to convey learning is only as successful as the instructor's ability to use it. Respondents were asked about their perception of the skill level of lecturers. Responding lecturers strongly agreed and agreed (75.6%) with the statement that lecturers have adequate ICT skills for carrying out module instruction; student respondents strongly agreed and agreed with 73.4%. Responding lecturers strongly agreed and agreed (76.7%) that lecturers are using ICT effectively in their modules, student respondents strongly agreed and agreed with 79.4%.

Responding lecturers strongly agreed and agreed (62.0%) that lecturers are providing students with adequate training for the ICT they use in their modules; student respondents strongly agreed and agreed with 60.9%.

Table 3.8: Skills of respondents in the use of mobile devices

Perceived skill level of lecturers		Strongly agree	Agree	Disagree	Strongly Disagree	N	Chi-Square Tests	
							Effect sizes >0.5	Effect sizes >0.5
Having adequate ICT skills	Lecturer	32.5%	44.5%	19.4%	3.7%	191	.094	.263
	Student	52.5%	36.6%	6.6%	4.3%	257		
Using ICT effectively in your modules	Lecturer	8.0%	19.1%	55.3%	17.6%	188	.096	.246
	Student	37.3%	41.6%	12.2%	9.0%	255		
Providing students with adequate training for the ICT in modules	Lecturer	9.0%	22.8%	54.0%	14.3%	189	.065	.594
	Student	30.6%	42.7%	16.5%	10.2%	255		
Creating an environment where students can use their mobile devices for learning purposes.	Lecturer	26.8%	50.0%	20.0%	3.2%	190	.157	.011
	Student	28.4%	35.4%	20.2%	16.0%	257		

Responding lecturers strongly agreed and agreed (49.5%) that lecturers are creating an environment where students can use their mobile devices for learning purposes; student respondents strongly agreed and agreed with 47.3%. None of these statistics indicate statistically significant association between variables with a p-value of less than 0.05 and the effect sizes indicate a small effect; thus there is no practically visible association between variables.

Table 3.9: Perceived skill level of responding students.

Perceived skill level of students		Strongly agree	Agree	Disagree	Strongly Disagree	N	Chi-Square Tests	
							Effect sizes >0.5	Effect sizes >0.5
Using the Internet to search for information	Lecturer	18.1%	57.5%	22.3%	2.1%	193	.244	.000
	Student	16.8%	56.6%	20.7%	5.9%	256		
Understanding the ethical/legal issues	Lecturer	17.1%	59.6%	21.2%	2.1%	193	.535	.000
	Student	22.6%	56.8%	16.7%	3.9%	257		
Evaluating the reliability of information	Lecturer	10.9%	51.0%	31.3%	6.8%	192	.437	.000
	Student	14.8%	46.1%	31.6%	7.4%	256		
Accessing eFundi	Lecturer	9.3%	40.2%	39.7%	10.8%	194	.225	.000
	Student	13.3%	34.0%	32.0%	20.7%	256		
NWU library website	Lecturer	18.1%	57.5%	22.3%	2.1%	193	.213	.000
	Student	16.8%	56.6%	20.7%	5.9%	256		
Mobile device maintenance	Lecturer	17.1%	59.6%	21.2%	2.1%	193	.207	.000
	Student	22.6%	56.8%	16.7%	3.9%	257		

Students were asked to assess their skills at a set of mobile technologies and information literacy practices providing insight into student's perceptions of their ITC skills. Students perceive themselves to be skilled at information literacy with more than half strongly agreeing and agreeing to statements related to information literacy. Responding lecturers strongly agreed and agreed (77.0%) with students' perceived skill at using the Internet to effectively and efficiently search for information. Lecturers strongly disagreed to disagreed (72.9%) with the statement that student' exhibit excellent skills at understanding the ethical/legal issues surrounding the access to and use of digital information. Lecturers strongly disagreed to disagreed (68.3%) with the statement that students are skilled at evaluating the reliability and credibility of online sources of information.

Students perceive themselves as being skilled at accessing eFundi and the university library website over a mobile device with 63.8% and 64.5% strongly agreeing and agreeing with the statement respectively. Generally responding lecturers perceive students' skills to be better than students perceive themselves, with 76.8% strongly agreeing and agreeing that students are skilled at accessing eFundi over a mobile device, and with 68.4% strongly agreeing and agreeing that students are skilled at accessing the universities website over mobile devices. The majority of students perceive themselves to be skilled at mobile device maintenance with 61.7% who strongly agreed and agreed. Lecturers strongly agreed and agreed with 72.0%.

Most of these statistics indicate statistically significant association between variables with a p-value of less than 0.05, effect size with values of 0.1 to 0.5 indicating a small to large effect, thus no to medium practically significant association.

3.6.5 Results of section E

The question to investigate respondents' attitude and opinion towards mobile technology was handled as a construct. The question in totality did not score a high relevancy score with a Cronbach's alpha of less than 0.5, but by eliminating questions a high Cronbach's alpha score above 0.8 was achieved testing four questions relevant to the opinion of both lecturer and student respondents towards mobile technology increasing efficiency and productivity. Constructs are the hypothetical variables that are being measured by a specific factor. Cronbach's alpha measures the reliability of the factors, and the closer the measurement to 1 the more reliable the measure, and the closer the score to 0 the less reliable the factor. All factors scored a high Cronbach's alpha score indicating a high measure of reliability (Table 3.10). The calculation for Cronbach's alpha coefficient is given in Equation 2.

Equation 3.5. Cronbach's alpha coefficient

$$\alpha = \frac{k}{k-1}\left[1 - \frac{\sum_1^k S_i^2}{S_T^2}\right]$$

Where:

α = Cronbach's alpha coefficient

k = number of items in the analysis

S_i = item standard deviation

S_T = total standard deviation of all items in the construct.

Table 3.10: Reliability measurement on all questions within the construct.

Reliability Statistics	Summary Item Statistics				
Cronbach's Alpha	Mean	Range	Maximum / Minimum	Variance	N of Items
Lecturers' opinion of the impact of their use of mobile devices.					
.554	2.33	.801	1.405	.045	15
Students' opinion of the impact of their use of mobile devices.					
.754	.156	.998	-2.630	.031	17

In table 3.12 the question to investigate respondent's attitude and opinion towards mobile technology in totality did not score a high relevancy score with a Cronbach's alpha of less than 0.5.

Table 3.11: Reliability measurement on only the questions related to efficiency and productivity.

Reliability Statistics	Summary Item Statistics				
Cronbach's Alpha	Mean	Range	Maximum / Minimum	Variance	N of Items
Lecturers' opinion of the impact of their use of mobile devices on their efficiency and productivity.					
.864	.558	.281	1.649	.009	5
Students' opinion of the impact of their use of mobile devices on their efficiency and productivity.					
.852	.487	.437	2.534	.018	6

Table 3.11 indicated that the construct testing four questions relevance to the opinion of both lecturer and student respondents towards mobile technology increasing efficiency and productivity scored a high Cronbach's alpha score above 0.8.

The questions in the questionnaire were directed in such a way as to get an understanding of the impact of mobile technologies on respondents, and their attitude towards common mobile technology issues researched in the literature study in chapter two.

3.6.5.1 Security related issues

Lecturers and students were asked if they are concerned about possible security risks when they use their mobile device, such as exposure to files with viruses, etc. Both lecturers and students are moderately concerned with 62.2% of lecturers and 61.8% of students strongly agreeing and agreeing with the statement about security.

Table 3.12: Respondents view off security related issues.

Security	Responding lecturers		Responding students	
	%	(n)	%	(n)
I am concerned about possible security risks when I use my mobile device (exposure to files with viruses)	62.2	188	61.8	233

In table 3.12 both lecturers and students are moderately concerned with 62.2% of lecturers and 61.8% of students strongly agreeing and agreeing with the statement about security.

3.4.5.2 Ethical issues

Lecturers and students were asked if they are concerned about the possible misuse of their personal information if another person gains access to their mobile device.

Table 3.13: Respondents view of ethically related issues.

Ethical	Responding lecturers		Responding students	
	%	(n)	%	(n)
I am concerned about the misuse of my personal information if another person gains access to my mobile device.	62.0	187	71.7	233

In table 3.13 both lecturers and students are concerned with lecturers slightly less concerned than students 62.0% of lecturers and 71.7% of students strongly agreeing and agreeing with the statement about ethical concerns.

3.6.5.3 User accessibility issues.

Lecturers and students were asked about accessibility issues. Students (76.4%) more than lecturers (71.1%) strongly agreed and agreed with the statement that if they don't have access to the Internet, it is really hard for them to get the information they need. Students (63.2%) in contrast also strongly agreed and agreed with the statement that it is good to occasionally take a break from going online and just NOT use the Internet from time to time, slightly less lecturers strongly agreed and agreed with 60.4%.

Table 3.14: Respondents view of accessibility related issues.

Accessibility	Responding lecturers		Responding students	
	%	(n)	%	(n)
When I don't have access to the Internet, it is really hard to get the information I need.	71.7	187	76.4	233
The university's network services are available when I need them for work purposes.	81.8	187	73.4	233
The university's Wi-Fi services are available when I need them for work purposes.	41.3	179	56.1	230
When I get a new electronic device, I usually need someone else to set it up or show me how to use it.	45.5	187	31.2	231
When I don't have my mobile device with me, it is really hard to get the information I need.	52.7	186	60.9	233
It is good to occasionally take a break from going online and just NOT use the Internet from time to time.	60.4	187	63.2	234

Lecturers (81.8%) strongly agreed and agreed that the universities' network services are available to them when they need them for work purposes; students (73.4%) strongly agreed and agreed to a slightly lesser degree. More students (56.1%) than lecturers (41.3%) are satisfied with the availability of the universities' Wi-Fi services; this correlates with more students using Wi-Fi on campus than lecturers. These percentages are still very low, leaving room for improving access to Wi-Fi on campus.

Lecturers (45.5%) strongly agreed and agreed slightly more with the statement that they need help with new electronic devices than students (31.2%). Students (60.9%) strongly agreed and agreed 10% more than lecturers (52.7%) with the statement that when they do not have their mobile devices with them, it is harder to get the information they need.

3.6.5.3 User expectation issues.

Lecturers and students were asked about expectation issues. Lecturers were asked whether they were adequately prepared to use ICT as needed in the teaching of their modules when they started working at the university, and 56.7% of lecturers strongly agreed and agreed. Students were also asked about their preparedness for the use of ITC in university modules, 70.8% of students strongly agreed and agreed.

Table 3.15: Respondents view off user expectation related issues.

User expectations	Responding lecturers		Responding students	
	%	(n)	%	(n)
When I started working at the university, I was adequately prepared to use ICT as needed in the teaching of my modules.	56.7	187		
When I entered University, I was adequately prepared to use ICT as needed in my modules.			70.8	234
By the time I graduate, the ICT I have used in my modules will have adequately prepared me for the workplace.			76.4	233
The university's IT support services are available when I need them for work purposes.	80.1	186	60.9	230
I like that mobile devices allow me to be more available.	64.4	180	82.8	232
In the design of mobile devices, companies do not pay enough attention to the needs of the academic environment.	61.0	182	51.9	233

Students also felt that the ICT that they used in their modules prepared them for the workplace with 76.4% of students strongly agreeing and agreeing. More lecturers (80.1%) than students (60.9%) strongly agreed and agreed with the statement that the universities support services are available when support are needed. The majority of students (82.8%) strongly agreed and agreed with the statement that they like it that mobile devices allow them to be more available to others while more than half (64.4%) of lecturers strongly agreed and agreed with the statement. Lecturers more than students strongly agree and agree with the statement that in the design of mobile devices, companies do not pay enough attention to the needs of the academic environment.

3.6.5.3 Development and deployment issues

Lecturers and students were asked about development and deployment issues. Lecturers were asked whether they get more actively involved in the teaching of modules where they can incorporate the ICT students can access on their mobile devices; only 44.0% of lecturers strongly agreed and agreed.

Table 3.16: Respondents view of development and deployment issues.

Development & deployment	Responding lecturers		Responding students	
	%	(n)	%	(n)
I get more actively involved in the teaching of modules where I can incorporate the ICT students' access on their mobile devices.	44.0	184		
I get more actively involved in modules where I can use my mobile device for learning purposes.			56.7	233
The ICT that students can access on their mobile devices improves my teaching.	53.0	183		
The use of mobile devices in my modules improves my learning.			54.5	233
Mobile devices make doing my module activities more convenient.			70.3	232
I believe I am more productive in my work as a lecturer as a result of the use of my mobile devices.	55.7	185		
I believe I am more productive because of the use of my mobile devices			75.4	232

Students were asked if they get more actively involved in modules where they can use their mobile device for learning purposes, and more than half (56.7%) of the responding students strongly agreed and agreed. Half (53.0%) of lecturers strongly agreed and agreed with the statement that the ICT that students can access on their mobile devices improved their teaching, while more than half (54.5%) of the responding students strongly agreed and agreed with the statement that the use of mobile devices in their modules improves their learning. Just more than half (55.7%) of lecturers strongly agreed and agreed that they believe themselves to be more productive in their work as a lecturer as a result of the use of their mobile devices, while 75.4% of students strongly agreed and agreed that they believe themselves to be more productive because of the use of their mobile devices, and 70.3% of students strongly agreed and agreed that mobile devices make doing their module activities more convenient.

3.7 CONCLUSION

Responding lecturers and students were asked about the kind of mobile devices that they own, in order to **identify the mobile technology assets** of respondents with regards to the hardware and the software that they own. It is evident from the research that laptop computers are the mobile device used most, followed by the internet capable handheld devices such as cell phones, smart phones and PDAs. Responding lecturers and students were asked about the mobile technologies that they are using, in order to **identify the**

mobile technology actions of respondents in regard to what they do with the technology that they own. The number of users that utilise the cellular network off campus as a wireless technology scored the highest from both lecturer and student respondents. Wi-Fi is steadily gaining some ground among students and lecturers and is bound to increase in popularity as costs decrease. The universities Wi-Fi connection is still under utilised by both students and lectures. Responding lecturers and students were asked about common ITC and mobile technology issues mentioned in the literature study in chapter two, in order to **identify the respondents' attitude towards mobile technologies**. Both lecturers and students are moderately concerned about possible security risks and the possible misuse of their personal information if another person gains access to their mobile device. Both lecturers and students agreed that the universities network and Wi-Fi services are available to them when they need it for work purposes. Lecturers and student respondents feel adequately prepared to use ICT as needed in university modules. Lecturers do not feel that the ICT accessible over mobile devices improves their teaching or increases student involvement in learning, while more than half of students agreed that the ICT they can access over their mobile device improves their learning and increases their involvement. Only just more than half of lecturers agreed that they believe themselves to be more productive in their work as a lecturer as a result of the use of their mobile devices, while the majority of students agreed that they believe themselves to be more productive because of the use of their mobile devices and that mobile devices make doing their module activities more convenient.

There is ample proof from the empirical study that there is a gap with regard to the level of accessibility, usage, and attitude with regards to the different interest groups in a higher education environment. Higher education institutions should invest in investigating these gaps further and in leveraging off the benefits of the effective management of these technologies to improve teaching and learning.

3.8 CHAPTER SUMMARY

The empirical research conducted had as objectives to investigate the impact of mobile technology on students, lecturers and thus the institution. The empirical research investigated the mobile technology assets of respondents with regard to the hardware and the software that they own, the mobile technology actions of respondents in regard to what they do with the mobile technology that they own and investigate the respondent's attitude towards mobile technologies. To meet the research objectives a quantitative approach was selected. Using SPSS, a frequency analysis and descriptive statistics were performed on both student and lecturer response datasets by Statistical Consultation Services of the North

West University. Statistical significance tests were also conducted to validate the data. To determine the effect size for the relationship in contingency tables the Phi coefficient was used. Phi measures strength of association between two categorical variables. Cronbach's alpha coefficient was used to test the internal consistency method utilised to estimate reliability. The question in totality did not score a high relevancy score with a Cronbach's alpha of less than 0.5, but by eliminating questions a high Cronbach's alpha score above 0.8 was achieved testing five questions relevant to the opinion of both lecturer and student respondents towards mobile technology increasing efficiency and productivity. There is ample proof from the empirical study that there is a gap with regard to the level of accessibility, usage, and attitude with regards to the different interest groups in a higher education environment that needs to be managed in order to implement m-learning successfully into a higher education environment.

CHAPTER 4
CONCLUSIONS AND RECOMMENDATIONS

4.1 INTRODUCTION

This final chapter concludes with a summary of the secondary objectives researched in the literature (Chapter two) and empirical research (Chapter three) chapters in order to support recommendations towards the primary objective of this study. The primary objective of the study was to develop a general framework to implement and manage mobile technologies in a higher education environment. To achieve this primary objective of the study, the secondary objectives realised were a thorough theoretical evaluation of the state of mobile technologies and why they are relevant to teaching and learning. The literature study in chapter two also investigated the implications of mobile technologies for students, lecturers and thus for the institution, and explored the future developments in mobile technology in higher education. The empirical research in chapter three investigated the mobile technology assets of respondents with regard to the hardware and the software that they own, the mobile technology actions of respondents regarding what they do with the technology that they own and the respondents' attitude towards mobile technologies. From both the theory and empirical research the final objective is to make recommendations towards a general framework for implementing mobile technologies which can be used to create a sustainable competitive advantage for the higher education institution. A brief evaluation will be made to confirm that the study objectives are achieved, and recommendations for further study are made.

4.2 CONCLUSIONS

In order to draw conclusions towards the implementation and management of m-learning at a higher education institution, the information gathered with the empirical research conducted at the NWU (PC) was used to analyse the NWU (PC) in regards to strengths, opportunities, weaknesses and threats regarding the ownership, usage and attitude of students and lecturers at the higher education institution. The SWOT analysis is summarised in Table 4.1.

Table 4.1 SWOT analysis: NWU (PC) in regards to m-learning

SWOT analysis: NWU (PC) in regards to m-learning	
STRENGTHS • 84.3% of students own a mobile device. • Both students and lecturers agree that lecturers have adequate ICT skills for carrying out module instruction. • Lecturers and students agree that the universities network services are available to them when they need it for work, or study purposes, students and lecturers agreed that if they don't have access to the Internet, it is really hard for them to get the information they need. • Students felt that the ICT that they have used in their modules have prepared them for the workplace. • Lecturers agree to the statement that the universities support services are available when support is needed. • Approximately half of both lecturers and students agree that the ICT that students can access on their mobile devices improved their teaching and learning. • Just more than half (55.7%) of lecturers and 75.4% of students agree that they believe themselves to be more productive because of the use of their mobile devices, students believe that mobile devices make doing their module activities more convenient. • With 52.7% of students preferring to read their study material on some kind of mobile device.	**WEAKNESSES** • The universities Wi-Fi connection is underutilised, both students and lecturers are dissatisfied with the availability of the universities Wi-Fi services. • The NWU CMS and the library website scored respectively 46.6% and 34% of students using the technology regularly over their mobile device. • The most popular collaborative web-based tools under students were social networking websites, and web-based applications, lecturers are not utilising collaborative web-based tools used by students. • Responding lecturers agree that while students are in class they regularly use their mobile devices for non-module activities, students disagree that lecturers are creating an environment where students can use their mobile devices for learning purposes. • Lecturers disagree that students are skilled at understanding the ethical/legal issues surrounding the access to and use of digital information, and that students are not skilled at evaluating the reliability and credibility of online sources of information. • Responding students disagree (39.1%) that lecturers are providing students with adequate training for the ICT they use in their modules, this can be because generally responding lecturers perceive students skills to be better than students perceive themselves • Students (39.1%) disagree to the statement that the universities support services are available when support is needed.
OPPERTUNITIES • Given students' ownership of mobile devices, institutions and instructors may have an opportunity to make more effective use of mobile technologies to communicate with, educate, and support students. • Institutions may have an opportunity to differentiate themselves in terms of how effectively they support both standard and specialised devices, applications, and services. • Given that students believe that mobile devices impacts positively on their productivity, learning efficiency and learning convenience, institutions may have an opportunity to examine and improve not just their technology infrastructure, but their instructional practices. • Given that more than halve of responding students prefer to read their study material on some kind of mobile device, institutions may have an opportunity to explore digital study material moving to a less paper based system and minimising the institution's carbon-footprint.	**THREATS** • The limitation in using technology to improve students' academic experiences is not due to students. Rather, institutional and instructor use of technology seems more limited than students want and need. • Given that many students are not fully confident in the technology skills they believe they need, and given that many students report that instructors do not provide sufficient technology training to students, institutions may have to offer training that improves technology skills. • Given that understanding the ethical/legal issues surrounding the access to and use of digital information, and evaluating the reliability and credibility of online sources of information is critical skills of the new knowledge based economy, institutions may have to focus on teaching information literacy skills to students. • Student's expectations towards support services are often unrealistic in terms of the availability of institutional resources. • Given that only 56.7% of lecturers believed that they were adequately prepared to use ICT as needed in the teaching of their modules when they started working at the university, institutions may have to add ICT training to new academic staff's induction training.

Higher education finds itself in the early innings of the next major technology cycle, the mobile Internet. The drivers are adoption of 3G, social networking, video, VoIP, and mobile devices that are more powerful than pc's (Meeker, 2010:9). These different trends pull us towards the same place: smaller, faster, cheaper devices working together in a web of connectivity (Stead, *et al*., 2006:7), with m-learning as a part of a new mobile conception of society. M-learning could impact higher education's goals of expanding educational access,

by increasing efficiency and productivity, in order to enhance the quality of teaching and learning (Wachholz, 2005:11).

The empirical data investigated the mobile technology assets of respondents with regards to the hardware and the software that they own, the mobile technology actions of respondents in regard to what they do with the technology that they own, and the respondents' attitude towards mobile technologies, and how this impacts on learning, teaching and on the institution.

4.2.1 Biographical information of respondents.

The population can be seen as the entire personnel and student corps of the North-West University (NWU) in South Africa, specifically from the Potchefstroom Campus. Due to budget and time constraints student respondents were selected by means of a non-probability convenience sampling and lecturer respondents were selected by means of a non-probability, self-selection sampling. The response to the survey was 252 lecturers and 350 students. Close to 61.5% of responding lecturers were between the age group of 30 - 50 and the average age of responding lecturers were 41. Most responding students were typical traditional students under 25 years old (72.6%) and 62.8% resided off campus. The responding lecturers were 46.6% male and 53.4% female. The responding students were 52.4% male and 47.6% female.

4.2.2 Ownership of mobile devices

According to the literature study it is impossible to realise m-learning without the use of mobile devices. Mobile devices vary significantly in their abilities, sizes and prices. Responding lecturers prefer laptop computers (93.4%), followed by the internet capable handheld devices such as cell phones, smart phones and PDA's (65.1%). Responding students also prefer laptop computers (80.4%) followed by the internet capable handheld devices (66.2%). More than half of students (52.7%) prefer to read their material on some kind of mobile device. Smartphone, notebook, netbook and other mobile devices will continue to evolve and blur. Over the coming years increasing numbers of students will be presenting a variety of mobile devices and will expect to be able to use them within the higher education institutions network infrastructure (Anderson & Blackwood, 2004:19).

4.2.3 Usage of mobile technologies

Nowadays several communication technologies exist which are used in mobile devices. Their abilities vary vastly, as well as their data transmission ranges. The number of users that utilise the cellular network on and off campus as a wireless technology scored the highest from both lecturer and student respondents. Wi-Fi is steadily gaining some ground among students and lecturers and is bound to increase in popularity as costs decrease. The university's Wi-Fi connection is still under- utilised by both students and lecturers.

M-learning is part of a new mobile conception of society. It is evident from the data gathered in the empirical study that students and lecturers are spending considerable time on the mobile internet doing both module activities and interacting: interaction takes place between students and students, lecturers and lecturers and lecturers and students. Responding lecturers access the Internet from a mobile device an average of 7.9 hours per week for work purposes and an average of 3.6 hours for recreation. Student respondents access the internet on a mobile device on average 5.6 hours per week for study purposes and for recreation an average of 6.5 hours per week.

The most popular activities among students were text messaging with 95.7% of students using the technology almost always and often. Activities associated with the university such as eFundi (the universities learning management system, LMS) and the university library website scored respectively 46.6% and 34% for students using the technology almost always and often over their mobile device. We asked responding lecturers how often they used Internet activities to communicate with or provide information to their students.

The most popular activities among lecturers were to send students email with 88.5% of lecturers using the technology almost always and often, and second lecturers use eFundi to provide students with information with 72.3% of lecturers using the technology almost always and often. Responding students were asked whether they were working with other students using any off the following web-based tools for any of their modules this quarter/semester. The most popular collaborative web-based tools among students were social networking websites with 45.9% of students using the technology almost always and often.

Responding lecturers were asked how often their students collaborate or work with other students using any web-based tools in any of their modules this semester. According to the results of the questionnaire lecturers are not aware of the collaborative web-based tools used

by students. The issue is that of migration of traditional learning materials to various mobile device and web-based locations (Tétard, Patokorpi & Carlsson, 2008:5).

4.2.5 Technology adoption

Responding lecturers perceive themselves to be mainly mainstream adopters (46%) with responding students perceiving themselves as mainly early adopters (37%) of technology

4.2.6 Preference and opinions of mobile technologies in the classroom

Lecturers were asked whether they prefer using information, communication technology (ICT) in the modules that they lecture. The majority of responding lecturers confirmed that they do (82%). Students were asked whether they prefer taking modules that use ICT and the majority of responding students confirmed that they do (68%).

4.2.7 Skills of respondents in the use of mobile devices

Responding lecturers strongly agreed and agreed to the statement that lecturers have adequate ICT skills, and most students agreed. Students were asked to assess their skills at a set of mobile technologies and information literacy practices providing insight into students' perceptions of their ITC skills. Students perceive themselves to be skilled at information literacy but responding lecturers do not. Lecturers strongly disagreed to disagreed (72.9%) to the statement that student's skill at understanding the ethical/legal issues surrounding the access to and use of digital information. Lecturers strongly disagreed to disagreed (68.3%) to the statement that students are skilled at evaluating the reliability and credibility of online sources of information. The literature study also indicated that higher education institutions need to teach students how to efficiently search and evaluate the quality of Internet material (Smith, 2006:27). Students perceive themselves as being skilled at accessing eFundi and the university library website over a mobile device with 63.8% and 64.5% strongly agreeing and agreeing to the statement respectively. Generally responding lecturers perceive students' skills to be better than students perceive themselves.

4.2.7 The impact of mobile technologies on respondents.

The literature indicated that m-learning has the potential to increase accessibility, productivity, efficiency, quality of teaching and learning, and thus increase the quality of service delivery, for higher education institutions. Lecturers and students were asked about

their attitude and opinions regarding mobile technology issues mentioned in the literature study, and whether both lecturers and students perceived these issues as challenges or advantages of m-learning. Lecturers and students were asked if they are concerned about possible security risks such as exposure to files with viruses, etc. when they use their mobile devices. Both lecturers and students are moderately concerned with 62.2% of lecturers and 61.8% of students strongly agreeing and agreeing with the statement about security.

Lecturers and students were asked if they are concerned about the possible misuse of their personal information if another person gains access to their mobile device. Both lecturers and students are concerned, with lecturers slightly less concerned than students: 62.0% of lecturers and 71.7% of students strongly agreeing and agreeing with the statement about ethical concerns. The nature of the higher education environment is that it is open and allows students the freedom to explore. This openness can be a communication network's greatest vulnerability (Alcatel-Lucent, 2010:1).

Lecturers and students were asked about accessibility issues. Students (76.4%) more than lecturers (71.1%) strongly agreed and agreed with the statement that if they don't have access to the Internet, it is really hard for them to get the information they need. Students (63.2%) in contrast also strongly agreed and agreed to the statement that it is good to occasionally take a break from going online and just NOT use the Internet from time to time. Slightly fewer lecturers strongly agreed and agreed (60.4%). Lecturers (81.8%) strongly agreed and agreed that the universities network services are available to them when they need them for work purposes. Students (73.4%) strongly agreed and agreed to a slightly lesser degree. Students (56.1%) are more satisfied than lecturers (41.3%) with the availability of the universities Wi-Fi services. This correlates with more students using Wi-Fi on campus than lecturers. These percentages are still very low, leaving room for improving access to Wi-Fi on campus. Lecturers (45.5%) strongly agree and agree slightly to the statement that they need help with new electronic devices, compared to 31.2% of students. Students (60.9%) strongly agreed and agreed about 10% more than lecturers (52.7%) to the statement that when they do not have their mobile devices with them, it is harder to get the information they need. According to the literature study learning is most effectively supported when each student has access to a device. The ownership of the devices is thus a key consideration. Ownership is stated as a prerequisite for engagement, where students have the potential to go "beyond the necessary and play with it to explore its potential" (Savill-Smith & Kent, 2003).

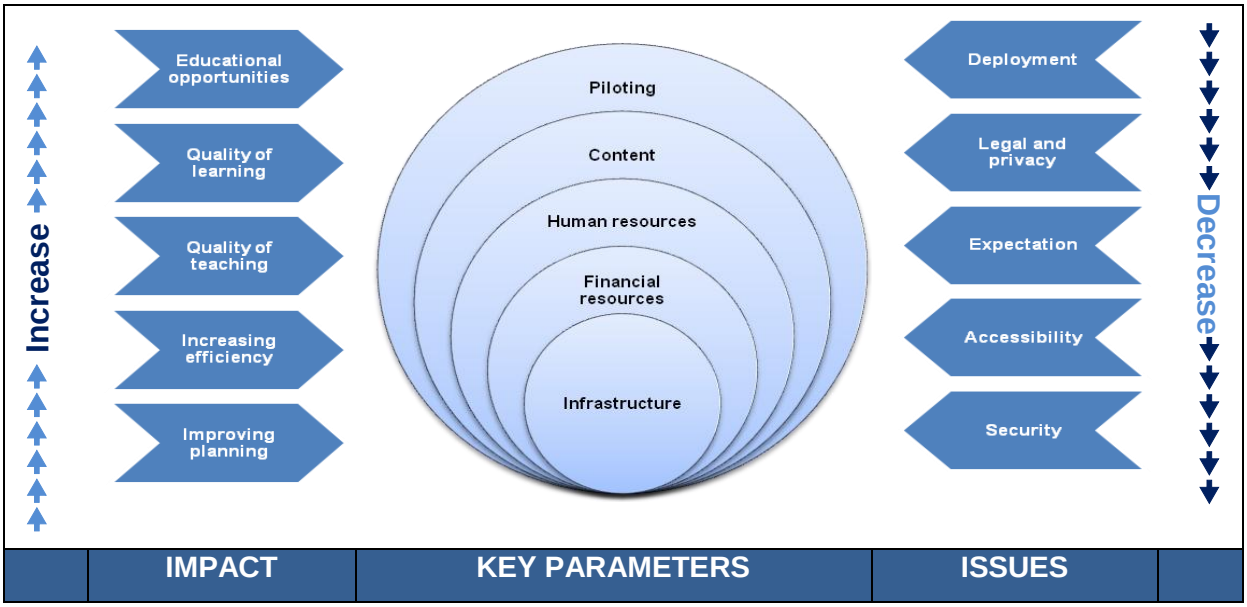
Lecturers and students were asked about expectation issues. Lecturers were asked whether they were adequately prepared to use ICT as needed in the teaching of their modules when they started working at the university, and 56.7% of lecturers strongly agreed and agreed. Students were also asked about their preparedness for the use of ITC in university modules, and 70.8% of students strongly agreed and agreed. Students also felt that the ICT that they used in their modules has prepared them for the workplace with 76.4% of students strongly agreeing and agreeing. Lecturers (80.1%) more than students (60.9%) strongly agreed and agreed with the statement that the universities support services are available when support is needed. The majority of students (82.8%) strongly agreed and agreed to the statement that they like it that mobile devices allow them to be more available to others while more than half (64.4%) of lecturers strongly agreed and agreed to the statement. Managing technology expectations requires the institution to constantly revise policies and processes, and provide various orientation programmes in which to communicate expectations with students (Kadle, 2009:12).

Lecturers and students were asked about development and deployment issues. Lecturers were asked whether they get more actively involved in the teaching of modules where they can incorporate the ICT students can access on their mobile devices, and only 44.0% of lecturers strongly agreed and agreed. Students were asked if they get more actively involved in modules where they can use their mobile device for learning purposes, and more than half (56.7%) off the responding students strongly agreed and agreed. Half (53.0%) of lecturers strongly agreed and agreed to the statement that the ICT that students can access on their mobile devices improved their teaching, while more than half (54.5%) of the responding students strongly agreed and agreed to the statement that the use of mobile devices in their modules improves their learning. Just more than half (55.7%) of lecturers strongly agreed and agreed that they believe themselves to be more productive in their work as a lecturer as a result of the use of their mobile devices, while 75.4% of students strongly agreed and agreed that they believe themselves to be more productive because of the use of their mobile devices, and 70.3% of students strongly agreed and agreed that mobile devices makes their module activities more convenient.

4.3 RECOMMENDATIONS

It is evident from the research that mobile technology has many possible benefits for learning, teaching and the higher education institution. How can higher education institutions leverage the benefits of the effective management of these technologies to improve teaching and learning?

Figure 4.1. General framework for the management of m-learning.



The literature study in chapter two proposed a general framework as a tool to summarise the management of m-learning in higher education. The framework focuses on addressing key issues related to m-learning from the perspective of the student, the lecturer and thus the institution these issues were researched in the empirical study to determine their negative impact on implementing and managing m-learning. It is recommended that higher education institutions research the impact of these issues before implementing m-learning. Based on the framework recommendations are made towards increasing the positive impact of m-learning on higher education and decreasing the issues related to mobile technology through the empirical research conducted in chapter three.

4.3.1 Expanding educational opportunities (accessibility).

M-learning has the potential to increase the capacity of higher education to reach beyond the brick and mortar classroom to a wider world of knowledge, and must be further explored by higher education institutions. The utilisation of m-learning to expand educational opportunities and the accessibility to information must be made readily available to all students and lecturers (Wachholz, 2005:11).

This can be achieved through:

Increasing availability to mobile technology. Higher education institutions can reduce the price of these technologies to increase usage and fast track adoption through negotiating special deals with hardware companies, and arrangements for licences with software

companies who are keen to have their products trialled, and then offering students “rent to own deals” to make mobile devices more affordable. The real costs to institutions in terms of hardware and especially software should be assessed as elements of institutional budgets (McFarlane, Triggs & Yee, 2008:25-28). Legislation plays a major role in the current SA Telecoms and ICT industries. Legislation can decrease the price of these technologies and thus increase the usage and acceptance levels.

Increasing awareness of mobile technology. Higher education institutions should invest in the marketing of mobile technology products and the support services. They should educate both lecturers and students concerning the benefits and features of mobile technologies for teaching and learning.

Increasing the synergy of mobile technology. Synergies between wireless and mobile technology's benefits and features to achieve optimal usage and benefits should be enhanced. This also implies that care must be taken not to use these technologies in isolation.

Given students’ ownership of mobile devices, institutions and lecturers may have an opportunity to make more effective use of mobile technologies to communicate with, educate, and support students. Higher Education institutions need to take cognisance of the tangible and intangible benefits of wireless and mobile technologies. A clear understanding of the benefits will improve acceptance and investment of such technologies. Higher education institutions should *increase the availability* of mobile technologies to their lecturers and students to increase and leverage the benefits of m-learning. This implies that higher education institutions will have to *increase their financial investment* in mobile technologies.

4.3.2 Increasing efficiency and productivity.

The advantages of m-learning through mobile technologies help improve efficiency and effectiveness in teaching and learning making mobility a competitive differentiator (Alcatel-Lucent, 2010:1).

This can be achieved through:

Increasing training and support in mobile technology. Given that both lecturers and students are not fully confident in the technology skills students believe they need and given that both lecturers and students report that lecturers experience difficulty in the effective use

of mobile technology in modules. Institutions may have an opportunity to offer training that improves technology skills campus-wide This applies both to core skills for academic productivity and access to learning resources and to specialized skills in more advanced applications, based on their needs or interests. Institutions need to commit to providing and supporting technology that students want and that faculty can use; faculty need to commit to using the technology students want and institutions support (Dahlstrom, de Boor, Grunwald & Vockley, 2011:29-32).

Increasing anytime, everywhere access to information through mobile technology. Higher education institutions need to meet lecturers and students' expectations for anytime, everywhere, Wi-Fi access on the devices they prefer to use.

Increasing productivity through mobile technology. Higher education institutions need to help faculty and administrators to excel at supporting students' use of core productivity software and applications for academic use, including, accessing e-mail, module content on the LMS, and library sites, through mobile devices.

Higher education institutions need to make more and better use of mobile technologies that are easily integrated into learning and teaching experiences in the shared environments in higher education (e.g., tablets, smartphones, student response systems or clickers). In many cases, these are the technologies that distinguish highly rated from less highly rated institutions regarding the effective use of technology today.

4.3.3 Enhancing the quality of teaching.

M-learning could address challenges related to quality teaching such as continuous professional training, lifelong upgrading, connecting with academics worldwide and communicating effectively with students (Wachholz, 2005:11).

This can be achieved through:

Increasing mobile technology in modules. Given that students prefer their modules to have an online component, institutions may have an opportunity to provide more blended learning environments improving the quality of teaching.

Increasing mobile technology initiatives. Encouraging lecturers to undertake small-scale initiatives which they then review, evaluate and share with other lecturers will be valuable.

Increasing communities of practice. The development of communities of self-supporting lecturers using mobile technologies in modules within the institution and between institutions should be actively encouraged and facilitated as an aspect of sustainability (Dahlstrom, de Boor, Grunwald & Vockley, 2011:29-32).

Increasing professional development. Higher education institutions need to increase investment in professional development opportunities and incentives so that lecturers can make better use of mobile technologies students find engaging and relevant. Higher education institutions need to meet students' expectations for joining the consumer migration to mobile content.

At the most basic level of pedagogical effectiveness, students value instructional uses of technology that go beyond the basics of access and efficiency and beyond the classroom, lecture hall, or lab. They value the connections to lecturers, and to experts in their field, that technology makes possible outside the classroom. And they value a number of more profound instructional benefits of technology, including its potential to make learning more creative, enable students to reach their true academic potential, and elevate the quality of teaching.

4.3.4 Enhancing the quality of learning.

Higher education is discovering the potential of m-learning to promote student engagement and improve learning (Educause, 2011a:1).

This can be achieved through:

Increasing communication. Many students seem eager to communicate more with their lecturers online, to use their mobile devices for module work, and to reach out for help when they need it. Multiple communications channels are useful and necessary to communicate and interact with students.

Increasing social learning. Given that students are not of one mind when it comes to their preferences for using social networking as a tool for academic purposes. Institutions and lecturers may need to walk a fine line to satisfy students' different expectations about online social learning and academic relationships. Given many students' use of, interest in, social

studying sites, there seem to be an opening for institutions and lecturers to explore online social learning tools (Dahlstrom, de Boor, Grunwald & Vockley, 2011:29-32).

Increasing students' involvement in technology planning and decision making. Expand or enhance students' involvement in technology planning and decision making.

Increasing collaboration through the use of mobile technologies. Use technology in more transformative ways, such as participatory and collaborative interactions, and for higher-level teaching and learning that is engaging and relevant to students' lives and future plans. Use technology more to extend learning beyond the classroom (McFarlane, Triggs & Yee, 2008:25-28).

M-learning has the potential to motivate and engage students, bring life to concepts and processes, foster inquiry, provide flexibility, allow application of information, bring the world into the classroom, offer collaborative opportunities and communication, offer individualised learning.

4.3.5 Improving policy planning and management.

Management of higher education institutions and systems, management of policymaking including storage and analysis of data, construction and assessment of policy scenarios, and tracer studies or tracking systems can be improved through the use of m-learning (Wachholz, 2005:11).

This can be achieved through:

Increasing scalability. The main policy issues to be addressed are of sustainability and scalability. Schools strategically committed to sustaining a one to one ownership of mobile devices are already facing the challenge of balancing budget priorities. The question of which funding models are scalable is urgent.

Increasing technology infrastructure. Given that lecturers' effective, frequent, and seamless integration of technology into coursework is associated with student perceptions of institutional technology effectiveness, institutions may have an opportunity to examine and improve not just their technology infrastructure, but their instructional practices.

Increasing sustainability. There is a powerful symbiotic relationship between the industry (in terms of design, supply, cost of devices), providers (of software, content, wireless access), schools, Local authorities and other agencies (as consumers, users, commissioners). This needs to be articulated and interrogated in relation to sustainability of the use and potential of handheld mobile devices in learning.

Increasing research and consultations into mobile technologies. Higher education institutions should invest in research and development departments and technology specialists tasked to assist the institution with the understanding; investment choice and implementation of wireless and mobile technology, and get experts in the technology field to assist with the choice and implementation of such technologies. Best practices and case study information were available to assist with choice, understanding and optimizations of such technologies.

Increasing institutional learning cultures. Mobile technologies can act as a trigger to generate an institutional learning culture through the increased interest in learning more than any other form of delivery. Mobile technologies can utilise a database focused on capturing institutional knowledge and allow synchronous communication and information sharing (McFarlane, Triggs & Yee, 2008:25-28).

There must be agreement between technology functionality and institutional requirement through the integration mobile technology into the institutions value chain; this will save time and money through the increase in productivity; efficiency; effectiveness; quality and availability.

4.4 ACHIEVEMENT OF THE STUDY OBJECTIVES

The success of the study can be measured in terms of the objectives formulated in chapter one.

4.4.1 Primary objectives of the study

The primary objective of this study is to make recommendations towards the development of a general framework to implement and manage mobile technologies in a higher education environment. This was achieved through the literature study in chapter two and the empirical study in chapter three that researched the implications of mobile technologies for students, lecturers and thus for the institution. The primary impacts on higher education are expanding

educational opportunities, increased efficiency and productivity, improved quality teaching and learning and improving policy planning and management. The recommendation made in this final chapter will guide the higher education institution towards making the right decisions in the implementation and management of mobile technologies to support m-learning.

4.4.2 Secondary objectives of the study

The literature study in chapter two set out to investigate the state of mobile technologies, researching the current mobile infrastructure in South Africa, defining the different mobile wireless communication technologies, summarising the common characteristics which unite mobile devices, commenting on the changing nature of mobile operating systems into mobile platforms, defining the many mobile applications into web-based and computer-based applications and making predictions on the future of mobile technologies. The literature study in chapter two set out to investigate why mobile technologies where relevant to teaching and learning, defining m-learning in relation to the mobility of the technology, the mobility of the student, the mobility of the lecturer and thus the mobility of the higher education institution, making predictions on the future of m-learning in the higher education environment.

The literature study in chapter two set out to investigate the implications of mobile technologies for students, lecturers and thus for the institution, making recommendations towards the development of a general framework for the implementation and management of mobile technologies in higher education institutions to effectively support m-learning. The literature indicated that m-learning has the potential to increase accessibility, productivity, efficiency, quality of teaching and learning, and thus to increase the quality of service delivery for higher education institutions. According to the literature the successful implementation of m-learning must take into account the higher education institutions' mobile technology infrastructure, the available learning content and content delivery platform, the commitment and the training of academic as well as administrative personnel, financial resources and sustainability, as well as piloting and evaluation of m-learning projects. The mobile technology issues influencing the management of m-learning as identified in the literature study were: security, legal and privacy issues, user accessibility issues, user expectation issues and development and deployment issues. The literature study achieved the desired objectives set out in chapter one.

The empirical research in chapter three investigated the mobile technology assets of respondents with regard to the hardware and the software that they own, the mobile technology actions of respondents in regard to what they do with the technology that they

own and the respondents' attitude towards mobile technologies. The question to investigate respondents' attitude and opinion towards mobile technology was handled as a construct. The question in totality did not score a high relevancy score with a Cronbach's alpha of just more than 0.5, but by eliminating questions a high Cronbach's alpha score above 0.8 was achieved testing five questions relevant to the opinion of both lecturer and student respondents towards mobile technology increasing efficiency and productivity. Both the lecturer and student factors scored a high Cronbach's alpha score indicating a high measure of reliability (Table 3.10). The empirical research in chapter three achieved the research objectives as set out in chapter one.

4.5 RECOMMENDATIONS FOR FURTHER STUDY

Mobile technologies are on the increase and the management thereof will become increasingly important to higher education. The effective use and implementation of these technologies will become a necessity for higher education institutions in order to build sustainable competitive advantages, especially in an ever increasing competitive global market place with higher education facing changes to how lecturers teach and students learn in a new global knowledge based economy. Mobile technologies will continue to increasingly become an integral part of students' and lecturers' private and day to day lives, and m-learning will be integral in educational content delivery. Additional research is required to study the effective and optimal implementation of m-learning. A better understanding of the benefits and leverage thereof is also required and additional research should be able to answer these questions. The increase of environmental accountability by moving to a paperless system should also be investigated, and awareness of the social impact, of how m-learning can contribute to the community at large, other ethical considerations such as the impact of RICA or the Regulation of Interception of Communication Act on m-learning, should also be investigated. RICA is a new government law that makes it compulsory for everyone to register all new and existing cellphone numbers. RICA is one of government's key crime prevention initiatives towards making South Africa a safer place to live and work.

4.6 CONCLUSION

The primary objective of the study was to develop a general framework to implement and manage mobile technologies in a higher education environment. This final chapter concludes with a summary of the secondary objectives researched in the literature (Chapter two) and empirical research (Chapter three) chapters in order to support recommendations towards the primary objective of this study. M-learning is part of a new mobile conception of society and the strategic importance of mobile technology cannot be underestimated. The rapid pace of adoption and advancement of mobile technologies creates opportunities for new and innovative services provided through such mobile devices. Higher education finds itself in the early innings of the mobile Internet pulling both lecturers and students towards the same place: smaller, faster, cheaper devices working together in a web of connectivity (Stead, *et al*., 2006:7). There has been a shift over the past few years from a need for processing power and hard drive space to a need for connectivity anywhere and anytime, especially to the Internet. The availability and accessibility of information has become the power and enabler for both teaching and learning. It is evident from the research that mobile technology has many possible benefits to learning, teaching and the higher education institution. Recommendations were made in this final chapter on how higher education institutions can leverage the benefits of the effective management of these technologies to improve teaching and learning. The success of the study can be measured in terms of the objectives formulated in chapter one, the primary objective of the study was achieved through the secondary objectives as set out in chapter one. The theoretical objectives as researched in the literature study in chapter two and the empirical objectives as researched in chapter three were achieved and summarised in the final chapter. Recommendations for further studies into mobile technologies and the impact of m-learning were to research environmental impact of mobile technologies, the awareness of the social impact of how m-learning can contribute to the community at large, and other ethical considerations such as the impact of RICA.

4.7 CHAPTER SUMMARY

In this final chapter recommendations and conclusions were presented based on the literature study in chapter two and the empirical study in chapter three. The empirical data investigated the mobile technology assets of respondents with regard to the hardware and the software that they own, the mobile technology actions of respondents in regard to what they do with the technology that they own, the respondents' attitude towards mobile technologies, and how all of this impact on learning, teaching and on the institution. It is evident from the research that mobile technology has many possible benefits to learning,

teaching and the higher education institution. M-learning has the potential to increase the capacity of higher education; this can be achieved through increasing availability of mobile technology; increasing awareness of mobile technology; and increasing the synergy of mobile technology. The advantages of m-learning through mobile technologies help to improve efficiency and effectiveness in teaching and learning, making mobility a competitive differentiator. This can be achieved through increasing training and support in mobile technology, increasing anytime, everywhere access to information through mobile technology; and increasing productivity through mobile technology. M-learning could address challenges related to quality teaching such as continuous professional training, lifelong upgrading, connecting with academics worldwide and communicating effectively with students. This can be achieved through increasing mobile technology in modules; increasing mobile technology initiatives: increasing communities of practice; and increasing professional development. Higher education is discovering the potential of m-learning to promote student engagement and improve learning. This can be achieved through increasing communication through the use of mobile technology, increasing social learning, increasing students' involvement in institutional technology planning and decision making, and increasing collaboration through the use of mobile technologies. Management of higher education institutions and systems, management of policymaking including storage and analysis of data, construction and assessment of policy scenarios, and tracer studies or tracking systems can be improved through the use of m-learning. This can be achieved through increasing mobile technology scalability, increasing mobile technology infrastructure, increasing sustainability, increasing research and consultations into mobile technologies, and increasing institutional learning cultures. There must be agreement between technology functionality and institutional requirement through the integration mobile technology into the institution's value chain. This will save time and money through the increase in productivity, efficiency, effectiveness, quality and availability. The success of the study can be measured in terms of the objectives formulated in chapter one. The primary objective of this study is to develop a general framework to implement and manage mobile technologies in a higher education environment. This was achieved through the literature and empirical study that indicated the impact of m-learning on students, lecturers and thus the institution. Mobile technologies are on the increase and the management thereof will become increasingly important to higher education. Mobile technologies will continue to increasingly become an integral part of students' and lecturers' private and day to day lives and m-learning will be integral in educational content delivery. Additional research is required to study the effective and optimal implementation of m-learning.

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ANNEXURE A (a)

Managing mobile learning in a Higher Education environment.

Survey Questionnaire to Lecturers.
September 2011

Aim of the study

The advances made with the development of new technologies present Higher Education with many opportunities to improve on the way we teach.

The challenge we now face is how to make the most of these opportunities presented by the development of new technologies and how to support students in the use thereof. An understanding of lecturers' expectations of and experiences with information technology may provide insight into this challenge.

Instructions
This questionnaire measures your personal expectations of and experiences with the use of mobile technology. Please answer the questionnaire by making a cross (X) in the space provided next to each item. In most questions you need only select ONE of the items, unless specifically stated otherwise.

Thank you for your participation in this project.

Section A: Biographical details.

1. What is your gender?

1	Male
2	Female

2. How old are you?_____

3. How many years have you been lecturing at the university?

1	First year.
2	Second year.
3	Five years and more.
4	Ten years and more.
5	Fifteen years and more.

Section B: What kind of mobile devices do lecturers own?

We are interested in some of the network-capable technology devices you own. Here's how we define the devices mentioned in the questions below:

- A desktop computer is one that was not designed to be portable; the keyboard and monitor are usually separate units.
- A full-sized laptop computer is one that is designed to be portable; it usually weighs more than one kilogram; the keyboard and monitor are usually attached to each other.
- A lightweight netbook computer is highly portable; it usually weighs less than one kilogram; its monitor is small (usually 25cm or less) and the keyboard is small and built in.
- A tablet computer is highly portable; it usually weighs less than one kilogram; its monitor is small (usually 25cm or less) and the keyboard may be small and built in or the keys may be displayed in video on a touch screen. iPad is included here.
- A dedicated e-book reader is a portable device with the sole function of being a platform for reading electronic books and certain other electronic publications. Examples include the Kindle, NOOK, and the like; iPad and similar tablet devices have many other functions and are therefore not included here.
- A handheld device is usually about the size of a cellular telephone and often includes one; it has a screen that can display e-mail messages, web pages, video, etc.; and its keyboard is at most a few centimetres wide, or the keys may be displayed in video on a touch screen. Included in this group are Personal Digital Assistants (PDA), Cellular phones, and Smart Phones.

4. How long have you been using your personal.....:

	Do not own one	**Own a mobile device**					
		Less than 1 year	**1 year**	**2 years**	**3 years**	**4 years**	**More than 4 years**
5.1. Desktop computer	0	1	2	3	4	5	6
5.2. Laptop computer	0	1	2	3	4	5	6
5.3. Lightweight netbook	0	1	2	3	4	5	6
5.4. Tablet computer	0	1	2	3	4	5	6
5.5. Dedicated e-book reader	0	1	2	3	4	5	6
5.6. Internet capable handheld device	0	1	2	3	4	5	6

(Please refer to technology device definitions on page 1)

5. What is your main reason for owning or not owning a specific device?

5.1 Personal laptop computer:
5.2 Personal lightweight netbook:
5.3 Personal tablet computer:
5.4 Personal dedicated e-book reader:
5.5 Personal Internet capable handheld device:

Section C: Which mobile technologies are lecturers using?

6. How often do you use the following *wireless mediums* to gain access to the Internet on campus?

	Almost always	Often	Seldom	Almost never
6.1 Cellular network - voice/cell phone (Cell C, Vodacom, MTN)	1	2	3	4
6.2 Edge, GPRS, 3G	1	2	3	4
6.3 Bluetooth or Infra Red on your laptop or cell phone	1	2	3	4
6.4 Wi-Fi (e.g. Hotspots, Wireless LAN)	1	2	3	4
6.5 WiMAX (Wireless broadband network spanning up to 50km)	1	2	3	4

7. How often do you use the following *wireless mediums* to gain access to the Internet off campus?

	Almost always	Often	Seldom	Almost never
7.1 Cellular network - voice/cell phone (Cell C, Vodacom, MTN)	1	2	3	4
7.2 Edge, GPRS, 3G	1	2	3	4
7.3 Bluetooth or Infra Red on your laptop or cell phone	1	2	3	4
7.4 Wi-Fi (e.g. Hotspots, Wireless LAN)	1	2	3	4
7.5 WiMAX (Wireless broadband network spanning up to 50km)	1	2	3	4

8. **Approximately how many hours each week do you actively spend on Internet activities on your mobile device for work purposes?**

_____

9. **Approximately how many hours each week do you actively spend on Internet activities on your mobile device for recreation?**

_____

10. How often do you use any of these activities to communicate with or provide information to students?

	Almost always	Often	Seldom	Almost never
10.1 Place and receive telephone calls.	1	2	3	4
10.2 Text messaging.	1	2	3	4
10.3 Instant messaging.	1	2	3	4
10.4 E-mail.	1	2	3	4
10.5 The university library website.	1	2	3	4
10.6 eFundi.	1	2	3	4
10.7 Twitter or a similar application.	1	2	3	4
10.8 Social networking websites (Facebook, LinkedIn, etc.).	1	2	3	4
10.9 Ask students to check information (news, weather, sports, specific facts, etc.) online using a mobile device.	1	2	3	4
10.10 Post or contribute to blogs.	1	2	3	4
10.11 Photo-sharing websites (Flickr, Snapfish, Picasa, etc.)	1	2	3	4
10.12 Ask students to watch mobile TV in class.	1	2	3	4
10.13 Ask students to Download or watch videos online.	1	2	3	4
10.14 Ask students to play educational games online.	1	2	3	4

Some of the applications you use on your desktop, laptop, netbook, or tablet computer are computer-based; that is, they run on your computer whether it is connected to the network or not. Other applications are network-based; they run only when your computer is connected to the Internet.

11. In modules this semester, are you using <u>computer-based</u> applications for…?

	Almost always	Often	Seldom	Almost never
11.1 Word processors (Word, Pages, etc.)	1	2	3	4
11.2 Spreadsheets (Excel, Numbers, etc.)	1	2	3	4
11.3 Presentation software (PowerPoint, etc.)	1	2	3	4

12. In modules this semester, are you using <u>network-based</u> applications for…?

	Almost always	Often	Seldom	Almost never
12.1 Word processors (Google Documents, etc.)	1	2	3	4
12.2 Spreadsheets (Google Spreadsheets, etc.)	1	2	3	4
12.3 Presentation software (Google Presentations, etc.)	1	2	3	4

13. How often are your students <u>collaborating or working with other students</u> using any of the following web-based tools in any of your modules this semester?

	Almost always	Often	Seldom	Almost never
13.1 Web-based word processor, spreadsheets, presentation, and form applications (Google Docs, iWork, Microsoft Office Live, etc.)	1	2	3	4
13.2 Video-sharing websites (YouTube, etc.)	1	2	3	4
13.3 Photo-sharing websites (Flikr, Snapfish, Picasa, etc.)	1	2	3	4
13.4 Web-based citation/bibliography tools (CiteULike, etc.)	1	2	3	4
13.5 Textbook publisher resource websites (McGraw-Hill, etc.)	1	2	3	4
13.6 Micro-blogs (Twitter, etc.)	1	2	3	4
13.7 Social bookmarking/tagging (Delicious, Newsvine , etc.)	1	2	3	4
13.8 Social networking websites (Facebook, LinkedIn, etc.)	1	2	3	4
13.9 Wikis (Wikipedia, module wiki, etc.)	1	2	3	4
13.10 Blogs	1	2	3	4
13.11 Online virtual worlds (Second Life, etc.)	1	2	3	4

14. To what extent do you agree/disagree with the following statements?

	Strongly Agree	Agree	Disagree	Strongly Disagree
14.1 While in class students regularly use their mobile devices for module activities (taking notes, Internet access, etc.).	1	2	3	4
14.2 While in class students regularly use their mobile devices for non-module activities (texting, Internet access, games, etc.).	1	2	3	4
14.3 Instructors should have the authority to forbid the use of netbooks, tablets, or handheld devices during class time.	1	2	3	4
14.3 I prefer using information technology in the modules I lecture.	1	2	3	4

15. Which of the following best describes you? (Choose only one)

15.1 I am sceptical of new technologies and use them only when I have to.	1
15.2 In my circle of friends and acquaintances, I am usually one of the last people to use new technologies.	2
15.3 In my circle of friends and acquaintances, I usually start using new technologies when most of them start doing so.	3
15.4 In my circle of friends and acquaintances, since I like new technologies, I am usually the first to start using them.	4
15.5 I love new technologies and am usually amongst the first to experiment with and use them	5

Section D: What is your perceived skill level in the use of mobile technologies?

16. Do you perceive your students to be skilled at using the following?

	Strongly Agree	Agree	Disagree	Strongly Disagree
16.1 Using the NWU library website on a mobile device?	1	2	3	4
16.2 Accessing eFundi on a mobile device?	1	2	3	4
16.3 Mobile device maintenance (software updates, security, etc.)?	1	2	3	4
16.4 Using the Internet to effectively and efficiently search for information	1	2	3	4
16.5 Evaluating the reliability and credibility of online sources of information	1	2	3	4
16.6 Understanding the ethical/legal issues surrounding the access to and use of digital information	1	2	3	4

17. Do you perceive yourself to be skilled at the following?

	Strongly Agree	Agree	Disagree	Strongly Disagree
17.1 Using information and communication technology effectively in your modules	1	2	3	4
17.2 Providing students with adequate training for the information and communication technology you use in your modules	1	2	3	4
17.3 Having adequate information and communication technology skills for carrying out module instruction	1	2	3	4
17.4 Creating an environment where students can use their mobile devices for learning purposes.	1	2	3	4

Section E: What do lecturers believe to be the advantages of and challenges to the use of mobile technologies?

In the following questions, the term "information and communication technology (ICT)" refer to computers, networks, software, classroom display systems, learning management systems, and the like.

18. To what extent do you agree/disagree to the following statements?

	Strongly Agree	Agree	Disagree	Strongly Disagree
18.1 When I started working at the university, I was adequately prepared to use ICT as needed in the teaching of my modules.	1	2	3	4
18.2 It is good to occasionally take a break from going online and just NOT use the Internet from time to time.	1	2	3	4
18.3 When I don't have access to the Internet, it is really hard to get the information I need.	1	2	3	4
18.4 I get more actively involved in the teaching of modules where I can incorporate the ICT students can access on their mobile devices.	1	2	3	4
18.5 The ICT that students can access on their mobile devices improves my teaching.	1	2	3	4
18.6 I am concerned about possible security risks when I use my mobile device (exposure to files with viruses, etc.)	1	2	3	4
18.7 I am concerned about the misuse of my intellectual property if another person gains access to my mobile device.	1	2	3	4
18.8 The university's network services are available when I need them for work purposes.	1	2	3	4
18.9 The university's Wi-Fi services are available when I need them for work purposes.	1	2	3	4
18.10 The university's IT support services are available when I need them for work purposes.	1	2	3	4
18.11 I like that mobile devices allow me to be more available to my students.	1	2	3	4
18.12 When I get a new electronic device, I usually need someone else to set it up or show me how to use it.	1	2	3	4
18.13 I believe I am more productive in my work as a lecturer as a result of the use of my mobile devices.	1	2	3	4
18.14 When I don't have my mobile device with me, it is really hard to get the information I need.	1	2	3	4
18.15 In the design of mobile devices, companies do not pay enough attention to the needs of lecturers and the academic environment.	1	2	3	4

Thank you! You have come to the end of this survey. If you have any questions or concerns, please e-mail me at Vanessa.Olivier@nwu.ac.za

ANNEXURE A (b)

Managing mobile learning in a Higher Education environment.

Survey Questionnaire to Students
September 2011

Aim of the study

The advances made with the development of new technologies present Higher Education with many opportunities to improve on the way we learn.

The challenge we now face is how to make the most of these opportunities presented by the development of new technologies and how to support students in the use thereof. An understanding of student's expectations of and experiences with information technology may provide insight into this challenge.

Instructions
This questionnaire measures your personal expectations of and experiences with the use of mobile technology. Please answer the questionnaire by making a cross (X) in the space provided next to each item. In most questions you need only select ONE of the items, unless specifically stated otherwise.

Thank you for your participation in this project.

Section A: Biographical details.

1. How old are you?

1	17-19
2	20-24
3	25-29
4	30-39
5	40-49
6	50 and older

2. What is your gender?

1	Male
2	Female

3. What is your historical year of study?

1	First year
2	Second year
3	Third or fourth year
4	Post graduate studies
5	Other

4. Do you reside on campus or off campus?

1	On campus
2	Off campus

Section B: What kind of mobile devices do you own?

We are interested in some of the network-capable technology devices you own. Here's how we define the devices mentioned in the questions below:

- A desktop computer is one that was not designed to be portable; the keyboard and monitor are usually separate units.
- A full-sized laptop computer is one that is designed to be portable; it usually weighs more than one kilogram; the keyboard and monitor are usually attached to each other.
- A lightweight netbook computer is highly portable; it usually weighs less than one kilogram; its monitor is small (usually 25cm or less) and the keyboard is small and built in.
- A tablet computer is highly portable; it usually weighs less than one kilogram; its monitor is small (usually 25cm or less) and the keyboard may be small and built in or the keys may be displayed in video on a touch screen. iPad is included here.
- A dedicated e-book reader is a portable device with the sole function of being a platform for reading electronic books and certain other electronic publications. Examples include the Kindle, NOOK, and the like; iPad and similar tablet devices have many other functions and are therefore not included here.
- A handheld device is usually about the size of a cellular telephone and often includes one; it has a screen that can display e-mail messages, web pages, video, etc.; and its keyboard is at most a few centimetres wide, or the keys may be displayed in video on a touch screen. Included in this group are Personal Digital Assistants (PDA), Cellular phones, and Smart Phones.

5. How old is your personal:

	Do not own one	Own a mobile device					
		Less than 1 year old	1 year old	2 years old	3 years old	4 years old	More than 4 years old
5.1. Desktop computer	0	1	2	3	4	5	6
5.2. Laptop computer	0	1	2	3	4	5	6
5.3. Lightweight netbook	0	1	2	3	4	5	6
5.4. Tablet computer	0	1	2	3	4	5	6
5.5. Dedicated e-book reader	0	1	2	3	4	5	6
5.6. Internet capable handheld device	0	1	2	3	4	5	6

(Please refer to technology device definitions on page 1)

6. Which of the following devices would you prefer for interacting with your study material (such as study guides, study notes, and/or textbooks)?

	Strongly Agree	Agree	Disagree	Strongly Disagree
6.1. I prefer to read my study material in **hardcopy**.	1	2	3	4
6.2. I prefer to read my study material on my **desktop computer**	1	2	3	4
6.3. I prefer to read my study material on my full-sized **laptop**	1	2	3	4
6.4. I prefer to read my study material on my **netbook.**	1	2	3	4
6.5. I prefer to read my study material on my **tablet computer.**	1	2	3	4
6.6. I prefer to read my study material on my **e-book reader**	1	2	3	4
6.7. I prefer to read my study material on my **handheld device**	1	2	3	4

7. What is the major reason you do own or do not own a specific device?

7.1 Personal laptop computer:
7.2 Personal lightweight netbook:
7.3 Personal tablet computer:
7.4 Personal dedicated e-book reader:
7.5 Personal Internet capable handheld device:

Section C: What mobile technologies are students using?

8. Do you use the following *wireless mediums* to gain access to the Internet on campus?

	Almost always	Often	Seldom	Almost never
8.1 Cellular network - voice/cell phone (Cell C, Vodacom, MTN)	1	2	3	4
8.2 Edge, GPRS, 3G	1	2	3	4
8.3 Bluetooth or Infra Red on your laptop or cell phone	1	2	3	4
8.4 Wi-Fi (e.g. Hotspots, Wireless LAN)	1	2	3	4
8.5 WiMAX (Wireless broadband network spanning up to 50km)	1	2	3	4

9. Do you use the following *wireless mediums* to gain access to the Internet off campus?

	Almost always	Often	Seldom	Almost never
9.1 Cellular network - voice/cell phone (Cell C, Vodacom, MTN)	1	2	3	4
9.2 Edge, GPRS, 3G	1	2	3	4
9.3 Bluetooth or Infra Red on your laptop or cell phone	1	2	3	4
9.4 Wi-Fi (e.g. Hotspots, Wireless LAN)	1	2	3	4
9.5 WiMAX (Wireless broadband network spanning up to 50km)	1	2	3	4

10. **Approximately how many hours a week do you spend actively doing Internet activities on your mobile device for study purposes?**

_____

11. **Approximately how many hours a week do you spend actively doing Internet activities on your mobile device for recreation?**

_____

12. Do you take part in any of these Internet activities from your mobile device?

	Almost always	Often	Seldom	Almost never
12.1 Place and receive telephone calls	1	2	3	4
12.2 Text messaging	1	2	3	4
12.3 Instant messaging	1	2	3	4
12.4 E-mail	1	2	3	4
12.5 Use the university library website	1	2	3	4
12.6 Access eFundi	1	2	3	4
12.7 Use Twitter or a similar application	1	2	3	4
12.8 Use social networking websites (Facebook, LinkedIn, etc.)	1	2	3	4
12.9 Check information (news, weather, sports, facts, etc.)	1	2	3	4
12.10 Read or contribute to blogs	1	2	3	4
12.11 Use maps (find places, get direction, or plan routes.)	1	2	3	4
12.12 Conduct personal business (banking, shopping, etc.)	1	2	3	4
12.13 Use photo-sharing websites (Flickr, Snapfish, Picasa, etc.)	1	2	3	4
12.14 Watch mobile TV	1	2	3	4
12.15 Download/stream music	1	2	3	4
12.16 Download or watch videos online	1	2	3	4
12.17 Download or play games online.	1	2	3	4

13. If you choose option 12.6 (Access to efundi) above, do you take part in the following eFundi activities on your mobile device?

	Almost always	Often	Seldom	Almost never
13.1 Check grades	1	2	3	4
13.2 Upload assignments	1	2	3	4
13.3 Download resources	1	2	3	4
13.4 Take part in the forum	1	2	3	4
13.5 Check announcements	1	2	3	4

14. If you choose option 12.8 (use social networking websites) above, do you take part in the following social networking activities on your mobile device?

	Almost always	Often	Seldom	Almost never
14.1 Stay in touch with friends	1	2	3	4
14.2 Make new friends I have never met in person	1	2	3	4
14.3 Find out more about people (I may or may not have met)	1	2	3	4
14.4 As a forum to express my opinions and views	1	2	3	4
14.5 Share photos, music, videos, or other work	1	2	3	4
14.6 For professional activities (job networking, etc.)	1	2	3	4
14.7 Participate in special-interest groups	1	2	3	4
14.8 Plan or invite people to events	1	2	3	4
14.9 Play games	1	2	3	4
14.10 Follow with my university's social activities (clubs, arts, etc.)	1	2	3	4
14.11 Use my university's administrative services, or communicate with administration (registration, advising, financial aid, billing, etc.)	1	2	3	4
14.12 Communicate with classmates about module-related topics	1	2	3	4
14.13 Communicate with instructors about module-related topics	1	2	3	4

Some of the applications you use on your desktop, laptop, netbook, or tablet computer are computer-based; that is, they run on your computer whether it is connected to the network or not. Other applications are network-based; they run only when your computer is connected to the Internet.

15. In modules this semester, are you using <u>computer based</u> applications for…?

	Almost always	Often	Seldom	Almost never
15.1 Word processors (Word, Pages, etc.)	1	2	3	4
15.2 Spreadsheets (Excel, Numbers, etc.)	1	2	3	4
15.3 Presentation software (PowerPoint, etc.)	1	2	3	4

16. In modules this semester, are you using network based applications for…?

	Almost always	Often	Seldom	Almost never
16.1 Word processors (Google Documents, etc.)	1	2	3	4
16.2 Spreadsheets (Google Spreadsheets, etc.)	1	2	3	4
16.3 Presentation software (Google Presentations, etc.)	1	2	3	4

17. Are you collaborating or working with other students using any off the following web-based tools for any of your modules this quarter/semester?

	Almost always	Often	Seldom	Almost never
17.1 Web-based word processor, spreadsheets, presentation, and form applications (Google Docs, iWork, Microsoft Office Live, etc.)	1	2	3	4
17.2 Video-sharing websites (YouTube, etc.)	1	2	3	4
17.3 Photo-sharing websites (Flikr, Snapfish, Picasa, etc.)	1	2	3	4
17.4 Web-based citation tools (CiteULike, OttoBib, etc.)	1	2	3	4
17.5 Textbook publisher resource websites (McGraw-Hill, etc.)	1	2	3	4
17.6 Micro-blogs (Twitter, etc.)	1	2	3	4
17.7 Social bookmarking/tagging (Delicious, Newsvine, etc.)	1	2	3	4
17.8 Social networking websites (Facebook, LinkedIn, etc.)	1	2	3	4
17.9 Wikis (Wikipedia, module wiki, etc.)	1	2	3	4
17.10 Blogs	1	2	3	4
17.11 Online virtual worlds (Second Life, etc.)	1	2	3	4

18. What is your opinion about the following statements?

	Strongly Agree	Agree	Disagree	Strongly Disagree
18.1 While I'm in class, I regularly use my netbook, tablet, or handheld device for module activities (notes, Internet access, etc.).	1	2	3	4
18.2 While I'm in class, I regularly use my netbook, tablet, or handheld device for non-module activities (texting, games, etc.).	1	2	3	4
18.3 Instructors should have the authority to forbid the use of netbooks, tablets, or handheld devices during class time.	1	2	3	4
18.4 I prefer taking modules that use information technology.	1	2	3	4

19. Which of the following best describes you? (Choose only one)

19.1 I am skeptical of new technologies and use them only when I have to.	1
19.2 I am usually one of the last people I know to use new technologies.	2
19.3 I usually use new technologies when most people I know do.	3
19.4 I like new technologies and use them before most people I know do.	4
19.5 I love new technologies and am among the first to experiment with and use them	5

Section D: What is your perceived skill level in the use of mobile technologies?

20. Do you perceive yourself as being skilled at using the following?

	Strongly Agree	Agree	Disagree	Strongly Disagree
20.1 Using the NWU library website from mobile device?	1	2	3	4
20.2 Accessing eFundi from a mobile device?	1	2	3	4
20.3 Mobile device maintenance (updates, security, etc.)?	1	2	3	4
20.4 Using the Internet to effectively search for information	1	2	3	4
20.5 Evaluating the credibility of online sources of information	1	2	3	4
20.6 Understanding the ethical/legal issues surrounding the access to and use of digital information	1	2	3	4

21. Do your lecturers…?

	Strongly Agree	Agree	Disagree	Strongly Disagree
21.1 Use information and communication technology effectively in their modules.	1	2	3	4
21.2 Provide students with training for the information and communication technology the instructor uses in his or her module.	1	2	3	4
21.3 Have adequate information and communication technology skills for carrying out module instruction	1	2	3	4
21.4 Create an environment where you can use your mobile device for learning purposes.	1	2	3	4

Section E: What do you believe to be advantages and challenges of the use of mobile technologies?

In the following questions, the term "information and communication technology (ICT)" refer to computers, networks, software, classroom display systems, learning management systems, and the like.

22. What is your opinion about the following statements?

	Strongly Agree	Agree	Disagree	Strongly Disagree
22.1 By the time I graduate, the ICT I have used in my modules will have adequately prepared me for the workplace.	1	2	3	4
22.2 When I entered University, I was adequately prepared to use ICT as needed in my modules.	1	2	3	4
22.3 It is good to take a break from going online and just NOT use the Internet from time to time.	1	2	3	4
22.4 When I don't have access to the Internet, it is really hard to get the information I need.	1	2	3	4
22.5 I get more actively involved in modules where I can use my mobile device for learning purposes.	1	2	3	4
22.6 The use of mobile devices in my modules improves my learning.	1	2	3	4
22.7 Mobile devices make doing my module activities more convenient.	1	2	3	4
22.8 I am concerned about security problems on my mobile device (exposure to files with viruses, etc.)	1	2	3	4
22.9 I am concerned about the misuse of my personal information if another person gains access to my device.	1	2	3	4
22.10 The university's network services are available when I need them for my studies.	1	2	3	4
22.11 The university's Wi-Fi services are available when I need them for my studies.	1	2	3	4
22.12 The university's IT support services are available when I need them for my studies.	1	2	3	4
22.13 I like that mobile devices allow me to be more available to others	1	2	3	4
22.14 When I get a new electronic device, I usually need someone else to set it up or show me how to use it.	1	2	3	4
22.15 I believe I am more productive because of the use of my mobile devices	1	2	3	4
22.16 When I don't have my mobile device, it is really hard to get the information I need.	1	2	3	4
22.17 In designing mobile devices, companies do not pay enough attention to the needs of average people	1	2	3	4

Thank you! You have reached the end of the survey. If you have any questions or concerns, please e-mail me at Vanessa.Olivier@nwu.ac.za

ANNEXURE B

	LECTURERS				STUDENTS			
	Freq	%	Mean	Std. Dev.	Freq	%	Mean	Std. Dev.
Section A: Biographical details.								
What is your gender?								
Male	118	46.6	1.53	0.5	183	52.4	2.14	1.11
Female	134	53.4			166	47.6		
Total	252	100.0			349	100		
How old are you?								
17-19			41.2	11	51	14.6	1.76	0.82
20-24					203	58		
29 <	35	14.2			27	7.7		
30-39	90	36.4			44	12.6		
40-49	62	25.1			21	6		
50 >	60	24.3			4	1.1		
Total	247	100			350	100		
How many years have you been at the university?								
First year.	32	12.9	3.27	1.3	54	15.5	3.28	1.64
Second year.	30	12			66	18.9		
Five yrs >/3rd or 4th year	89	35.7			99	28.4		
Ten yrs >/Post grad.	39	15.7			55	15.8		
Fifteen years >/MBA	59	23.7			65	18.6		
Other					10	2.9		
Total	249	100.0			349	100.0		
Section B: What kind of mobile devices do you own?								
How long have you been using your personal.....:								
Desktop computer								
Do not own one	37	19.1	5.63	2.4	135	45.0	3.76	2.75
Less than 1 year	1	.5			12	4.0		
1 year	4	2.1			14	4.7		
2 years	3	1.5			24	8.0		
3 years	2	1.0			18	6.0		
4 years	10	5.2			18	6.0		
More than 4 years	137	70.6			79	26.3		
Total	194	100.0			300	100		
Laptop computer								
Do not own one	13	6.6	5.84	1.9	61	19.6	3.85	2.11
Less than 1 year	9	4.6			53	17.0		
1 year	10	5.1			44	14.1		
2 years	8	4.1			58	18.6		
3 years	14	7.1			33	10.6		
4 years	12	6.1			25	8.0		
More than 4 years	130	66.3			38	12.2		
Total	196	100.0			312	100		
Lightweight netbook								
Do not own one	126	72.0	2.05	2	262	90.3	1.27	1.03
Less than 1 year	8	4.6			12	4.1		
1 year	10	5.7			6	2.1		
2 years	4	2.3			4	1.4		
3 years	9	5.1			1	0.3		
4 years	1	.6			1	0.3		
More than 4 years	17	9.7			4	1.4		
Total	175	100.0			290	100		
Tablet computer								
Do not own one	139	80.8	1.38	1.1	267	92.4	1.05	0.25
Less than 1 year	25	14.5			17	5.9		
1 year					4	1.4		
2 years	2	1.2			0	0.0		
3 years	1	.6				0.0		
4 years						0.0		
More than 4 years	5	2.9			1	0.3		
Total	172	100.0			289	100		
Dedicated e-book reader								
Do not own one	151	87.8	1.24	0.7	274	94.5	1.06	0.32
Less than 1 year	8	4.7			12	4.1		
1 year	7	4.1			3	1.0		
2 years	5	2.9			1	0.3		
3 years	1	.6			0	0.0		
Total	172	100			290	100		

	LECTURERS				STUDENTS			
	Freq	%	Mean	Std. Dev.	Freq	%	Mean	Std. Dev.
More than 4 years						0.0		
Total	172	100.0			290	100		
Internet capable handheld device								
Do not own one	65	34.9	3.78	2.6	102	33.8	4.07	2.47
Less than 1 year	16	8.6			52	17.2		
1 year	13	7.0			33	10.9		
2 years	17	9.1			30	9.9		
3 years	9	4.8			10	3.3		
4 years	7	3.8			9	3.0		
More than 4 years	59	31.7			66	21.9		
Total	172	100.0			302	100		
Section C: Which mobile technologies are you using?								
***Wireless mediums* to gain access to the Internet on campus?**								
Cellular network - voice/cell phone (Cell C, Vodacom, MTN)								
Almost always	33	16.5	3.03	1.1	126	45.7	2.1	1.21
Often	29	14.5			59	21.4		
Seldom	38	19.0			29	10.5		
Almost never	100	50.0			62	22.5		
Total	200	100.0			276	100.0		
Edge, GPRS, 3G								
Almost always	24	12.5	3.2	1.1	127	46.2	2.13	1.25
Often	27	14.1			55	20.0		
Seldom	28	14.6			22	8.0		
Almost never	113	58.9			71	25.8		
Total	192	100.0			275	100.0		
Bluetooth or Infra Red on your laptop or cell phone								
Almost always	7	3.7	3.63	0.7	29	10.8	3.24	1.03
Often	8	4.2			31	11.5		
Seldom	33	17.3			56	20.8		
Almost never	143	74.9			153	56.9		
Total	191	100.0			269	100.0		
Wi-Fi (e.g. Hotspots, Wireless LAN)								
Almost always	10	5.2	3.35	0.9	42	15.6	2.97	1.13
Often	31	16.1			48	17.8		
Seldom	32	16.7			55	20.4		
Almost never	119	62.0			125	46.3		
Total	192	100.0			270	100.0		
WiMAX (Wireless broadband network spanning up to 50km)								
Almost always	4	2.1	3.78	0.6	7	2.6	3.69	0.69
Often	9	4.7			13	4.9		
Seldom	12	6.3			35	13.1		
Almost never	167	87.0			212	79.4		
Total	192	100.0			267	100.0		
***Wireless mediums* to gain access to the Internet off campus?**								
Cellular network - voice/cell phone (Cell C, Vodacom, MTN)								
Almost always	63	32.0	2.39	1.2	149	53.8	1.9	1.16
Often	44	22.3			57	20.6		
Seldom	40	20.3			20	7.2		
Almost never	50	25.4			51	18.4		
Total	197	100.0			277	100.0		
Edge, GPRS, 3G								
Almost always	68	36.2	2.39	1.3	157	57.3	1.88	1.19
Often	37	19.7			50	18.2		
Seldom	24	12.8			11	4.0		
Almost never	59	31.4			56	20.4		
Total	188	100.0			274	100.0		
Bluetooth or Infra Red on your laptop or cell phone								
Almost always	14	7.6	3.42	0.9	32	11.9	3.24	1.07
Often	15	8.1			31	11.6		
Seldom	36	19.5			45	16.8		
Almost never	120	64.9			160	59.7		
Total	185	100.0			268	100.0		
Wi-Fi (e.g. Hotspots, Wireless LAN)								
Almost always	43	22.5	2.85	1.2	45	16.6	3.05	4.05
Often	29	15.2			36	13.3		
Seldom	32	16.8			53	19.6		
Almost never	87	45.5			137	50.6		
Total	191	100.0			271	100.0		

	LECTURERS				STUDENTS			
	Freq	%	Mean	Std. Dev.	Freq	%	Mean	Std. Dev.
WiMAX (Wireless broadband network spanning up to 50km)								
Almost always	14	7.6	3.57	0.9	10	3.8	3.59	4.59
Often	12	6.5			25	9.4		
Seldom	13	7.1			29	10.9		
Almost never	145	78.8			201	75.8		
Total	184	100.0			265	100.0		
Approximately how many hours each week do you actively spend on Internet activities on your mobile device for work/study purposes?								
	232		7.9	12	276		5.6	7.2
Approximately how many hours each week do you actively spend on Internet activities on your mobile device for recreation?								
	230		3.6	5.2	274		6.5	8.9
How often do you use any of these internet/mobile activities?								
Place and receive telephone calls.								
Almost always	22	11.0	2.62	0.9	185	65.8	1.48	0.78
Often	69	34.5			68	24.2		
Seldom	72	36.0			17	6.0		
Almost never	37	18.5			11	3.9		
Total	200	100.0			281	100.0		
Text messaging.								
Almost always	18	9.0	2.69	0.9	201	71.5	1.34	0.61
Often	66	33.2			68	24.2		
Seldom	75	37.7			8	2.8		
Almost never	40	20.1			4	1.4		
Total	199	100.0			281	100.0		
Instant messaging.								
Almost always	7	3.8	3.38	0.8	171	60.9	1.75	1.08
Often	21	11.3			47	16.7		
Seldom	53	28.5			26	9.3		
Almost never	105	56.5			37	13.2		
Total	186	100.0			281	100.0		
E-mail.								
Almost always	114	57.0	1.58	0.8	119	42.3	2.07	1.11
Often	63	31.5			69	24.6		
Seldom	17	8.5			48	17.1		
Almost never	6	3.0			45	16.0		
Total	200	100.0			281	100.0		
The university library website.								
Almost always	13	6.7	3.22	1	38	13.6	2.93	1.08
Often	35	18.1			57	20.4		
Seldom	42	21.8			70	25.1		
Almost never	103	53.4			114	40.9		
Total	193	100.0			279	100.0		
eFundi.								
Almost always	94	48.2	2.01	1.2	67	23.8	2.68	1.21
Often	47	24.1			64	22.8		
Seldom	12	6.2			42	14.9		
Almost never	42	21.5			108	38.4		
Total	195	100.0			281	100.0		
Twitter or a similar application								
Almost always	2	1.0	3.88	0.5	44	15.9	3.14	1.15
Often	5	2.6			34	12.3		
Seldom	7	3.6			38	13.7		
Almost never	179	92.7			161	58.1		
Total	193	100.0			277	100.0		
Social networking websites (Facebook, LinkedIn, etc.).								
Almost always	8	4.1	3.58	0.8	131	46.5	1.96	1.09
Often	18	9.1			71	25.2		
Seldom	23	11.7			39	13.8		
Almost never	148	75.1			41	14.5		
Total	197	100.0			282	100.0		
Check information (news, weather, sports, specific facts, etc.) online using a mobile device.								
Almost always	7	3.5	3.51	0.8	97	34.5	2.18	1.11
Often	15	7.6			91	32.4		
Seldom	46	23.2			39	13.9		
Almost never	130	65.7			54	19.2		
Total	198	100.0			281	100.0		

	LECTURERS				STUDENTS			
	Freq	%	Mean	Std. Dev.	Freq	%	Mean	Std. Dev.
Post or contribute to blogs.								
Almost always	2	1.0	3.77	0.5	23	8.3	3.38	0.94
Often	5	2.5			21	7.6		
Seldom	29	14.6			60	21.6		
Almost never	162	81.8			174	62.6		
Total	198	100.0			278	100.0		
Photo-sharing websites (Flickr, Snapfish, Picasa, etc.)								
Almost always	1	.5	3.84	0.5	15	5.4	3.51	0.84
Often	5	2.5			18	6.5		
Seldom	18	9.1			57	20.4		
Almost never	173	87.8			189	67.7		
Total	197	100.0			279	100.0		
Watch mobile TV in class								
Almost always			3.9	0.4	10	3.6	3.76	0.67
Often	4	2.0			6	2.2		
Seldom	11	5.6			23	8.3		
Almost never	183	92.4			237	85.9		
Total	198	100.0			276	100.0		
Download or watch videos online.								
Almost always	1	.5	3.45	0.8	22	7.9	3.28	1
Often	29	14.9			44	15.8		
Seldom	47	24.1			48	17.2		
Almost never	118	60.5			165	59.1		
Total	195	100.0			279	100.0		
Play educational games online.								
Almost always			3.88	0.4	8	2.9	3.64	0.74
Often	3	1.5			19	6.8		
Seldom	17	8.6			38	13.7		
Almost never	177	89.8			213	76.6		
Total	197	100.0			278	100.0		
Social bookmarking/tagging (Delicious, Newsvine , etc.)								
Almost always			3.86	0.4	8	3.0	3.64	0.71
Often	7	3.7			11	4.2		
Seldom	12	6.4			48	18.3		
Almost never	169	89.9			196	74.5		
Total	188	100.0			263	100.0		
Social networking websites (Facebook, LinkedIn, etc.)								
Almost always	11	5.8	3.55	0.9	50	18.8	2.71	1.14
Often	14	7.3			72	27.1		
Seldom	24	12.6			50	18.8		
Almost never	142	74.3			94	35.3		
Wikis (Wikipedia, module wiki, etc.)								
Almost always	12	6.3	3.32	1	30	11.5	2.97	1.07
Often	30	15.8			63	24.0		
Seldom	33	17.4			55	21.0		
Almost never	115	60.5			114	43.5		
Total	190	100.0			262	100.0		
Blogs								
Almost always	1	.5	3.74	0.6	8	3.0	3.6	0.74
Often	12	6.5			17	6.4		
Seldom	21	11.4			48	18.2		
Almost never	150	81.5			191	72.3		
Total	184	100.0			264	100.0		
Online virtual worlds (Second Life, etc.)								
Almost always			3.91	0.3	7	2.7	3.74	0.64
Often	3	1.6			8	3.1		
Seldom	10	5.4			30	11.5		
Almost never	173	93.0			217	82.8		
Total	186	100.0			262	100.0		
To what extent do you agree with the following statements?								
While in class students use their mobile devices for module activities								
Strongly agree	5	2.5	3.06	0.8	34	12.5	2.92	1.07
Agree	49	24.5			64	23.4		
Disagree	75	37.5			64	23.4		
Strongly disagree	71	35.5			111	40.7		
Total	200	100.0			273	100.0		
Students use mobile devices for non-module activities								
Strongly agree	33	16.4	2.28	0.9	22	8.1	3	0.99
Agree	104	51.7			66	24.3		

	LECTURERS				STUDENTS			
	Freq	%	Mean	Std. Dev.	Freq	%	Mean	Std. Dev.
Disagree	39	19.4			74	27.2		
Strongly disagree	25	12.4			110	40.4		
Instructors should have the authority to forbid the use of mobile devices during class time.								
Strongly agree	51	25.4	2.45	1	36	13.3	2.97	1.07
Agree	38	18.9			49	18.1		
Disagree	83	41.3			71	26.3		
Strongly disagree	29	14.4			114	42.2		
Total	201	100.0			270	100.0		
I prefer using information technology in modules.								
Strongly agree	54	26.9	1.95	0.7	76	28.0	2.17	0.99
Agree	110	54.7			110	40.6		
Disagree	31	15.4			48	17.7		
Strongly disagree	6	3.0			37	13.7		
Total	201	100.0			271	100.0		
Which of the following best describes you? (Choose only one)								
Laggard	12	6.0	3.16	1	30	10.9	3.18	4.18
Late adopter	33	16.5			46	16.8		
Mainstream	91	45.5			96	35.0		
Early adopter	40	20.0			52	19.0		
Innovator	24	12.0			50	18.2		
Total	200	100.0			274	100.0		
Students <u>collaborating</u> using web-based tools in modules this semester?								
Web-based word processor, spreadsheets, presentation applications								
Almost always	15	7.8	3.36	1	49	18.4	2.85	1.15
Often	21	10.9			52	19.5		
Seldom	36	18.8			54	20.3		
Almost never	120	62.5			111	41.7		
Total	192	100.0			266	100.0		
Video-sharing websites (YouTube, etc.)								
Almost always	6	3.2	3.51	0.8	23	8.6	3.21	1
Often	23	12.1			41	15.4		
Seldom	30	15.8			58	21.8		
Almost never	131	68.9			144	54.1		
Total	190	100.0			266	100.0		
Photo-sharing websites (Flikr, Snapfish, Picasa, etc.)								
Almost always	4	2.1	3.84	0.4	12	4.5	3.54	0.81
Often	5	2.6			18	6.8		
Seldom	21	11.1			49	18.6		
Almost never	163	86.2			185	70.1		
Total	189	100.0			264	100.0		
Web-based citation/bibliography tools (CiteULike, etc.)								
Almost always	4	2.1	3.54	0.8	9	3.4	3.57	0.78
Often	22	11.6			21	8.0		
Seldom	31	16.4			45	17.1		
Almost never	132	69.8			188	71.5		
Total	189	100.0			263	100.0		
Textbook publisher resource websites (McGraw-Hill, etc.)								
Almost always	6	3.1	3.4	0.8	16	6.1	3.38	0.91
Often	26	13.6			30	11.4		
Seldom	44	23.0			54	20.5		
Almost never	115	60.2			163	62.0		
Total	191	100.0			263	100.0		
Micro-blogs (Twitter, etc.)								
Almost always	5	2.6	3.76	0.7	10	3.8	3.58	0.77
Often	9	4.8			15	5.7		
Seldom	12	6.3			51	19.4		
Almost never	163	86.2			187	71.1		
Total	189	100.0			263	100.0		
Section D: What is students skill level in the use of mobile technologies?								
Using the NWU library website on a mobile device?								
Strongly agree	32	16.8	2.19	0.8	70	27.0	2.22	0.99
Agree	98	51.6			97	37.5		
Disagree	52	27.4			58	22.4		
Strongly disagree	8	4.2			34	13.1		
Total	190	100.0			259	100.0		

	LECTURERS				STUDENTS			
	Freq	%	Mean	Std. Dev.	Freq	%	Mean	Std. Dev.
Accessing eFundi on a mobile device?								
Strongly agree	51	26.8	1.99	0.8	73	28.4	2.24	1.04
Agree	95	50.0			91	35.4		
Disagree	38	20.0			52	20.2		
Strongly disagree	6	3.2			41	16.0		
Total	190	100.0			257	100.0		
Mobile device maintenance (software updates, security, etc.)?								
Strongly agree	38	20.4	2.11	0.8	66	25.8	2.25	0.98
Agree	96	51.6			92	35.9		
Disagree	46	24.7			65	25.4		
Strongly disagree	6	3.2			33	12.9		
Total	186	100.0			256	100.0		
Using the Internet to effectively and efficiently search for information								
Strongly agree	62	32.5	1.94	0.8	135	52.5	1.63	0.79
Agree	85	44.5			94	36.6		
Disagree	37	19.4			17	6.6		
Strongly disagree	7	3.7			11	4.3		
Total	191	100.0			257	100.0		
Evaluating the reliability and credibility of online sources of information								
Strongly agree	17	9.0	2.74	0.8	78	30.6	2.06	0.94
Agree	43	22.8			109	42.7		
Disagree	102	54.0			42	16.5		
Strongly disagree	27	14.3			26	10.2		
Total	189	100.0			255	100.0		
Understanding the legal issues surrounding the access to and use of digital info.								
Strongly agree	15	8.0	2.82	0.8	95	37.3	1.93	0.92
Agree	36	19.1			106	41.6		
Disagree	104	55.3			31	12.2		
Strongly disagree	33	17.6			23	9.0		
Total	188	100.0			255	100.0		
Do lecturers perceive themselve to be skilled at the following?								
Using information and communication technology effectively in your modules								
Strongly agree	33	17.1	2.08	0.7	58	22.6	2.02	0.74
Agree	115	59.6			146	56.8		
Disagree	41	21.2			43	16.7		
Strongly disagree	4	2.1			10	3.9		
Total	193	100.0			257	100.0		
Providing students with adequate training for the ICT in modules								
Strongly agree	21	10.9	2.34	0.8	38	14.8	2.32	0.81
Agree	98	51.0			118	46.1		
Disagree	60	31.3			81	31.6		
Strongly disagree	13	6.8			19	7.4		
Total	192	100.0			256	100.0		
Having adequate ICT skills for carrying out module instruction								
Strongly agree	35	18.1	2.08	0.7	43	16.8	2.16	0.77
Agree	111	57.5			145	56.6		
Disagree	43	22.3			53	20.7		
Strongly disagree	4	2.1			15	5.9		
Total	193	100.0			256	100.0		
Can students use their mobile devices for learning purposes.								
Strongly agree	18	9.3	2.52	0.8	34	13.3	2.6	0.96
Agree	78	40.2			87	34.0		
Disagree	77	39.7			82	32.0		
Strongly disagree	21	10.8			53	20.7		
Total	194	100.0			256	100.0		
Section E: What is your opinion towards mobile technologies?								
To what extent do you agree/disagree to the following statements?								
I was adequately prepared to use ICT as needed in my modules.								
Strongly agree	30	16.0	2.42	0.9	58	24.9	2.09	0.82
Agree	76	40.6			107	45.9		
Disagree	54	28.9			58	24.9		
Strongly disagree	27	14.4			10	4.3		
Total	187	100.0			233	100.0		
It is good to take a break from going online.								
Strongly agree	25	13.4	2.35	0.8	48	20.5	2.27	0.91
Agree	88	47.1			100	42.7		
Disagree	58	31.0			60	25.6		

	LECTURERS				STUDENTS			
	Freq	%	Mean	Std. Dev.	Freq	%	Mean	Std. Dev.
Strongly disagree	16	8.6			26	11.1		
Total	187	100.0			234	100.0		
When I don't have access to the Internet, it is hard to get info.								
Strongly agree	62	33.2	1.99	0.9	80	34.3	1.96	0.88
Agree	72	38.5			98	42.1		
Disagree	46	24.6			40	17.2		
Strongly disagree	7	3.7			15	6.4		
Total	187	100.0			233	100.0		
Mobile devices used for teaching and learning improves involvement								
Strongly agree	12	6.5	2.59	0.7	39	16.7	2.35	0.85
Agree	69	37.5			93	39.9		
Disagree	86	46.7			82	35.2		
Strongly disagree	17	9.2			19	8.2		
Total	184	100.0			233	100.0		
ICT that students can use on mobile devices improves my teaching/learning.								
Strongly agree	20	10.9	2.45	0.8	36	15.5	2.41	0.88
Agree	77	42.1			91	39.1		
Disagree	69	37.7			81	34.8		
Strongly disagree	17	9.3			25	10.7		
Total	183	100.0			233	100.0		
Missing	69				117			
The university's Wi-Fi services are available when I need them for work/study								
Strongly agree	12	6.7	2.75	0.9	31	13.5	2.5	0.95
Agree	62	34.6			98	42.6		
Disagree	63	35.2			57	24.8		
Strongly disagree	42	23.5			44	19.1		
Total	179	100.0			230	100.0		
The university's IT support services are available when I need them.								
Strongly agree	34	18.3	2.1	0.8	25	10.9	2.43	0.87
Agree	115	61.8			115	50.0		
Disagree	22	11.8			57	24.8		
Strongly disagree	15	8.1			33	14.3		
Total	186	100.0			230	100.0		
I like that mobile devices allow me to be more available to my students.								
Strongly agree	30	16.7	2.26	0.8	75	32.3	1.89	0.78
Agree	86	47.8			117	50.4		
Disagree	52	28.9			31	13.4		
Strongly disagree	12	6.7			9	3.9		
Total	180	100.0			232	100.0		
When I get a new electronic device, I usually need someone else to set it up.								
Strongly agree	27	14.4	2.58	0.9	18	7.8	3	0.97
Agree	58	31.0			54	23.4		
Disagree	69	36.9			68	29.4		
Strongly disagree	33	17.6			91	39.4		
Total	187	100.0			231	100.0		
Missing	65				119			
I am more productive in work/study as a result of the use of my mobile devices.								
Strongly agree	34	18.4	2.39	0.9	56	24.1	2.05	0.79
Agree	69	37.3			119	51.3		
Disagree	58	31.4			47	20.3		
Strongly disagree	24	13.0			10	4.3		
Total	185	100.0			232	100.0		
Missing	67				118			
When I don't have my mobile device, it is hard to get the info I need.								
Strongly agree	27	14.5	2.43	0.9	54	23.2	2.26	0.93
Agree	71	38.2			88	37.8		
Disagree	69	37.1			67	28.8		
Strongly disagree	19	10.2			24	10.3		
Total	186	100.0			233	100.0		
Mobile devices, companies do not pay attention to the academic environment.								
Strongly agree	20	11.0	2.32	0.7	38	16.3	2.41	0.87
Agree	91	50.0			83	35.6		
Disagree	63	34.6			90	38.6		
Strongly disagree	8	4.4			22	9.4		

	LECTURERS				STUDENTS			
	Freq	%	Mean	Std. Dev.	Freq	%	Mean	Std. Dev.
The university's network services are available when I need it.								
Strongly agree	41	21.9	1.99	0.7	56	24.0	2.1	0.85
Agree	112	59.9			115	49.4		
Disagree	29	15.5			44	18.9		
Strongly disagree	5	2.7			18	7.7		
Total	187	100.0			233	100.0		
I am concerned about possible security risks when I use my mobile device (exposure to files with viruses, etc.)								
Strongly agree	27	14.4	2.28	0.8	51	21.9	2.25	0.89
Agree	90	47.9			93	39.9		
Disagree	62	33.0			69	29.6		
Strongly disagree	9	4.8			20	8.6		
Total	188	100.0			233	100.0		
I am concerned about the misuse of my personal information.								
Strongly agree	29	15.5	2.29	0.8	65	27.9	2.05	0.84
Agree	87	46.5			102	43.8		
Disagree	58	31.0			55	23.6		
Strongly disagree	13	7.0			11	4.7		
Total	187	100.0			233	100.0		