MOBILE LEARNING SERVICES ACCEPTANCE MODEL AMONG MALAYSIAN HIGHER EDUCATION STUDENTS

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MOBILE LEARNING SERVICES ACCEPTANCE MODEL AMONG MALAYSIAN HIGHER EDUCATION STUDENTS

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by
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ABSTRAK

Pembelajaran mudah alih (m-pembelajaran) adalah dianggap sebagai bentuk e-pembelajaran yang menggunakan teknologi mudah alih untuk memudahkan pendidikan guru dan pelajar bagi sebarang tempat dan masa**.**. Penggunaan perkhidmatan m-pembelajaran dalam pendidikan tinggi di Malaysia dapat meningkatkan peluang dalam bidang pendidikan. Kesedaran pelajar terhadap penggunaan teknologi merupakan kunci kejayaan bagi sesuatu penerimaan. Penyelidikan ini bertujuan untuk mengkaji penerimaan dan penggunaan perkhidmatan m-pembelajaran di kalangan pelajar pendidikan tinggi Malaysia. Objektif utama adalah untuk mencadangkan model penerimaan pelajar bagi m-pembelajaran dalam persekitaran pendidikan tinggi. Bagi mencapai objektif tersebut, kajian ini menyelidik tahap penerimaan pelajar terhadap keinginan tingkah laku untuk menggunakan m-pembelajaran dan kesannya kepada tingkah laku penggunaan di peringkat pendidikan tinggi. Selain itu, kajian ini menyelidik tahap keperluan untuk menggunakan perkhidmatan m-pembelajaran di peringkat pendidikan tinggi. Ia menyediakan asas pengetahuan mengenai keadaan semasa kesedaran pelajar tentang perkhidmatan m-pembelajaran. Kajian ini mendapati bahawa persekitaran dan infrastruktur yang bersesuaian adalah faktor bagi menyebar dan menggunakan m-pembelajaran dalam persekitaran pendidikan tinggi. Tambahan pula, hasil kajian menunjukkan bahawa pelajar mempunyai pengetahuan yang mencukupi dan kesedaran untuk menggunakan teknologi tersebut dalam persekitaran pendidikan mereka. Walau bagaimanapun, halangan dan kekangan yang mungkin dihadapi semasa penggunaan sebenar pembelajaran mudah alih perlu dipertimbangkan. Keterbatasan m-pembelajaran bagi pendidikan juga mendapat perhatian dikalangan pelajar. Perspektif pelajar adalah sangat penting untuk tingkah laku penggunaan m-pembelajaran dalam persekitaran pendidikan tinggi. Dapatan kajian menunjukkan bahawa keinginan tingkah laku untuk menggunakan m-pembelajaran oleh para pelajar dalam persekitaran pendidikan tinggi mempunyai pengaruh positif ke atas tingkah laku pelajar. Oleh yang demikian, dengan adanya syarat tersebut akan lebih memudahkan pengaruh ke atas tingkah laku pelajar. Kajian ini mencadangkan beberapa faktor penentu yang penting terhadap keinginan tingkah laku untuk menggunakan m-pembelajaran dalam persekitaran pendidikan tinggi.

Kata Kunci: Perkhidmatan Pembelajaran Mudah alih, Model Penerimaan Pembelajaran Mudah alih dan Prototaip Pembelajaran Mudah alih.

ABSTRACT

Mobile learning (m-learning) is considered as the next form of e-learning using mobile technologies to facilitate education for teachers and learners anywhere and anytime. Engaging the m-learning services in the Malaysian higher education could improve the availability of education. Students’ awareness of such technology is a key for success acceptance. This research aims to study the acceptance and use of m-learning services among Malaysian higher education students. The main objective is to propose a students' acceptance model of m-learning in the higher education environment. The study investigates the students’ acceptance of behavior intention to use m-learning and its effect on usage behavior in the higher education environment. It provides the knowledge base about the current state of students’ awareness about m-learning services. The study found that both of the environment and the infrastructure are appropriate to diffuse and utilize m-learning in the higher education environment. Furthermore, the results showed that the students have adequate knowledge and awareness to use such technology in their education environment. The limitations of m-learning for education were well concerned by students. The students’ perspective is very important to investigate the use behavior of m-learning in the higher education environment. Findings of the study suggest that the behavior intention to use the m-learning by students in the higher education environment have positive influence on the use behavior. Consequently, the availability of facilitating conditions is an important to influence students’ use behavior. The study suggests several factors as important determinants of the behavior intention to use the m-learning in the higher education environment. Specifically, behavior intension to use appears to be adopted and facilitated by the usefulness of m-learning services, so more usefulness of m-learning leads to more acceptances among students in the higher education

Keywords: Mobile Learning Services, Mobile Learning Acceptance Model, Mobile Learning Prototype

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Last but not least, I wish to thank all my dearest family members, especially Mum, my Wife and My sons; Aseel, Omer, Majd, Belal, and Ahmed for being by my side since I left home for long time. To my friends who have given me moral support during my study.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

LIST OF ABBREVIATIONS

CMS	Course Management Systems
CSFs	Critical Success Factors
DSRM	Design Science Research Methodology
GPRS	General Packet Radio Service
ICT	Information and Communications Technologies
IDT	Innovation Diffusion Theory
LMS	Learning Management Systems
PDA	Personal Digital Assistant
PLE	Personal Learning Environment
PSSUQ	Post Study Satisfaction User Questionnaire
IS	Information Systems
TAM	Technology Acceptance Model
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
URL	Uniform Resource Locator
VIF	Variance Inflation Factor
W3C	World Wide Web Consortium
WAP	Wireless Application Protocol
Wi-Fi	Wireless Fidelity
WML	Wireless Mobile Markup Language
XML	Extensible Markup Language
SMIP	Student’s Mobile Information Prototype

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter provides an overview of the study background, problem statement, research questions, and objectives of the research. These are followed with discussion on the significance and contribution of the study. Scope of the study is identified and conceptual research framework is illustrated. Finally, this chapter ends with a discussion on the organization of remaining chapters.

1.2 Background of the study

In the recent years, mobile learning (m-learning) has moved from being a theory, academic exploration and technology idea, into a real and valuable contribution to learning environment (Stead, 2005) and during the past decade every area of education has been affected by the introduction and use of technology. Moreover, m-learning has coincided with the evolution of the era of online world (Downes, 2005). The rapid evolution of mobile technology leads to development of m-learning using wireless on mobile devices (Yordanova, 2007). Furthermore, the learning process evolves in parallel with the communication means development; it has developed from conventional face-to-face to become distance learning as well as e-learning (Keegan, 2002).

M-learning is an emerging form of e-learning that offers the opportunity for both teachers and learners to interact with educational material and services using mobile devices, independent of time and space (Peter J. Mirski & Dagmar Abfalter, 2004). However, the value of mobile services can be built on one of three services: utility, communication, or fun (Kaasinen, 2005). Availability and innovations of mobile technology such as wireless infrastructure, high bandwidth, and mobile devices moved e-learning to m-learning era (Triantafillou, Georgiadou, & Economides, 2006).

However, use of m-learning is growing rapidly and many universities and colleges are going to support m-learning solutions. M-learning provides two types of information services that are learning materials and administrative information (Georgieva, Smrikarov, & Georgiev, 2005).

Regardless of the fact that e-learning has not reached the explosive growth figures which were commonly predicted in the mid-1990s, scholars and industry representatives are now turning their attention towards the m-learning (Feng, Hoegler, & Stucky, 2006) which could overcome the limitations of e-learning (Williams, 2009).

1.3 Motivation for the Research

Mobile services, and their internet based, have been widely emerged to daily life since 1999. Mobile technology has been widely used in many areas such as education, health, entertainment, marketing, and banking. The occasional and sustained usage of such services in the higher education environment could encourage students to keep in touch with their education environment. Although the benefit of mobile technology is enormous and it enables learning services to be used anywhere and anytime, the application and adoption of the m-learning services is still need to tackle the obstacles that are preventing students' motivation to use such technology and the university to utilize such technology widely. Furthermore, insufficient research on m-learning adoption results in a lack of a complete view of m-learning adoption (Liu & Han, 2010).

Engaging the m-learning services in the Malaysian higher education environment will improve the availability of education. This meets the priority of Malaysian higher education strategy to brand the education (Robertson, 2008). Moreover, Robertson (2008) highlighted that the number of international students in Malaysia had increased between 2006 and 2008 by 30 percent. Hence, these motivate researcher to study the students' acceptance of m-learning services in the higher education environment.

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1.4 Problem Statement

Nowadays, many campuses of universities and colleges, as well, have wireless networks coverage. Some campuses feature Wireless Fidelity (Wi-Fi) environments where students and lecturers use mobile devices; anytime and anywhere to connect with each other as well as accessing Internet. Mobile technology has been grown. In 2005 one and half (1.5) billion people over the world had a mobile phones (Prensky, 2005) and the number of mobile phones throughout the world exceeded one and eight (1.8) billion in 2006 and it is estimated that within few years, about 70% of mobile phones will have internet access (Turban, Leidner, McLean, & Wetherbe, 2007). By the end of the year 2010, mobile phone subscribers will reach three billion over the world, which is nearly 43 percent (Lavoie, 2007).

Furthermore, the mobile phone owners will reach 75 percent in 2011(Liu & Han, 2010).

This technology presents an opportunity to affect more people in many aspects of their lives to be more mobile and accessible. However, Kalkbrenner and Nebojsa (2001) indicated that organizational infrastructure for campus and student needs to be improved more. They highlighted that there are still many weaknesses in the current version of Wireless Application Protocol (WAP) that require in-depth investigation, since every new technology arriving on the market has to be investigated of its benefit for daily use. At present, mobile phones have been popular worldwide. Mainly it is ubiquitous for students to use it anywhere and anytime for their transactions as well as their education purpose.

Consequently, the mobile penetrations have been growing. Mobile technologies potentially create a wide variety of uses and limitations that differ significantly from desktop and laptop technologies. It is the time to think of mobile phone devices as a new form of the handheld computer that has capabilities to be used in the learning environment (Prensky, 2005). According to a survey conducted by the Malaysian Communications and Multimedia Commission (MCMC) in 2007, adults (users aged between 20 and 49 years as at last birthday) continue to be the highest group of mobile phone users (66.8%) followed by pre-teens and teens (users aged up to 19 years old) (20.9%) and Senior citizens (aged 50 years and above) account for only 12.3% (Malaysian Communications and Multimedia Commission [MCMC], 2008a).

Studying the alternatives of face-to-face education has been conducted over the past eight decades (Williams, 2009). In a survey conducted in 2003 of young adults (16 – 24 years) usage of mobile phones in the United Kingdom (UK), almost half expressed an interest in using their mobile phone to improve their reading, spelling, and math or language skills. Although only 50% currently use mobile phones, 55% stated that they might use one under other conditions, especially lower prices. The survey was found more than half of participants indicated that the mobile phone had transformed the way in which they communicate with others (Learning and Skills Development Agency, 2003).

Several studies reveal the strengths and weaknesses of e-learning (Barker, Krull, & Mallinson, 2005; McLean, 2003; Quinn, 2004; Rekkedal & Dye, 2007). They state that there are great similarities between e-learning and m-learning and somehow, one of them can represent the other with new platform and more sophisticated technologies.

Nevertheless, students who are off-campus or do not have internet access through the conventional wire or wireless connection for some reasons such as traveling need to conduct their learning. Moreover, students need to access or conduct their learning services when they are somewhere away from the campus (Kadirire, 2007); the provided conventional e-learning services require internet access through computers. Fortunately, Mobile technologies are considered a viable wireless alternative and could be an ideal solution (Kadirire, 2007), and it is creating an additional channel of education (Triantafillou, et al., 2006). Consequently, such form of technology (m-learning) has to be introduced to extend and enhance the services of e-learning as well as it has been considered as a viable alternative for online learning to be anywhere and anytime through utilizing the mobile phones services in the higher education environment.

Although rapid growth has been witnessed in mobile technology, m-learning implementation (using of m-learning) still remains relatively less compared to alternative forms of learning (Anderson, 2005; Feng *et al.*, 2006; Karim, Darus, & Hussin, 2006; Rekkedal & Dye, 2007; Seppala, Sariola, & Kynaslahti, 2002; Wang, Wu, & Wang, 2009; Yordanova, 2007) Moreover, M-learning needs to tackle the obstacles that are preventing students' motivation to use such technology. Therefore a need for study and examines the factors that lead to success adoption and diffusion such technology and platform in the higher education environment.

Barker *et al.* (2005) indicated that m-learning is emerging as a portable solution that enables learners to engage in collaborative and interactive learning activities. The scholars argue that using m-learning is appropriate to support group work on projects, engage learners in learning-related activities in diverse physical locations, and enhancing communication and collaborative learning in the classroom. Furthermore, unlike most mobile services, m-learning does not always bring an immediate sense of satisfaction, but probably rewards a learner in the long term, hence the use of m-learning will depend on how learners value their education tasks (Liu & Han, 2010). Nevertheless, most often m-learning is understood as mobile e-learning, namely the use of wireless technology, particularly mobile devices and mobile internet, to facilitate learning materials and administrative services of education.

Both learner and faculty have realized the benefits of m-learning, which include mobility, availability, and flexibility (Rekkedal & Dye, 2007; Seppala, Sariola, & Kynaslahti, 2002; Sharples, Corlett, & Westmancott, 2002; Triantafillou, et al., 2006; Yordanova, 2007), but at the same time, their involvement in m-learning is also impeded by factors such as security and privacy concerns, navigation cost and unfamiliarity with medium, technical challenges (Wang, Wu, & Wang, 2009), and the capabilities of mobile devices. For life-long learning, Yordanova (2007) noted that the most three problems related to use mobile technology in education are the student acceptance; characteristics of mobile technologies and limited mobile devices display; the third problem is the privacy and confidential of user data. However, Students' satisfaction could affect highly the rate of m-learning utilization. Kaasinen (2005) state that more attention to user acceptance and user perspective should be paid for studying m-learning. The study findings indicate that adoption of m-learning services still need to be made much easier than it is today. Furthermore, users should have access to information and services wherever they are (Kaasinen, 2005; Yaseen & Zayed, 2010).

Patten, Sa´nchez, and Tangney (2006) classified m-learning services into seven distinct categories, namely administrative, referential, interactive, micro-world, data collection, location aware, and collaborative. The scholars concluded that much of the work presented across the categories of m-learning services has limited success.

Studying the factors that influence adoption and use of m-learning could provide an efficient, successful, and successive utilization in the higher education environment. User acceptance has been viewed as the pivotal factor in determining the success or failure of any information system implementation or utilization (Fred D. Davis, Bagozzi, & Warshaw, 1989; Dillon & Morris, 1996). Furthermore, identifying such factors could avoid the failure of actual usage of a new technology in such area.

Despite the diffuse and widespread use of m-learning, it still in its infancy stage and its theoretical investigation need more focusing, in particular, on how to promote learners' acceptance of m-learning are largely unsolved (Liu & Han, 2010; Muyinda, 2007). Moreover, recent reports show that whilst advanced mobile technology are increasingly diffused, advanced mobile services have not yet diffused among consumers' everyday lives and they still hesitant to use these services (Carlsson, Hyvönen, Repo, & Walden, 2005; Liu & Han, 2010).

Despite m-learning has a success stories in the western countries utilization, it needs more investigation in Malaysia and Middle East. The adoption among students in the higher institutions has been considered by researchers (Chaput & Kassas, 2009; Ismail, Idrus, Ziden, & Rosli, 2010; Liu & Han, 2010). Moreover, Liu and Han (2010) state that m-learning has not reached its maximum potential and the gap between what is offered and what is used is apparent.

One of m-learning success keys is the individual's subjective willingness and cognitive engagement in m-learning activities (Liu & Han, 2010). Moreover, universities need to understand factors that are influencing the acceptance of m-learning among higher education students as a vital alternative platform of learning services (Williams, 2009).

Understanding the determinants of student acceptance of m-learning will provide important theoretical contributions to the area of m-learning and lead to the development of more effective and meaningful m-learning services for the higher education environment. By expanding the Technology Acceptance Model (TAM) and the Innovation Diffusion Theory (IDT), this study aims to provide an integral theoretical paradigm that can successfully support a wide array of technical, administrative, and student issues involved in m-learning in the higher education environment.

1.5 Research Questions

In relation to the problem statement, this research aims to investigate the following:

i. What are the technology capabilities and limitations of m-learning services in the higher education environment?

ii. What are the user requirements towards the use of m-learning in the higher education environment?

iii. What are the factors that influence the acceptance and use of m-learning in the higher education environment?

iv. How can the identified m-learning acceptance factors be considered into the development of m-learning system in higher education environment?

1.6 Research Objectives

Related to the research questions, the main objective of this research is to propose students' acceptance model of m-learning in the higher education environment. In order to achieve this objective, the sub-objectives that guide this research are as follows:

i. To review the technology capabilities and limitations of current mobile learning services in the higher education environment.

ii. To investigate students' awareness and requirements regarding mobile learning services in the higher education environment.

iii. To identify the factors that determine students' acceptance and use of m-learning in the higher education environment.

iv. To develop and implement an m-learning prototype system for the higher education environment reflecting factors identified in the objective (iii).

1.7 Significance of the Research

Nowadays the mobile technology is one of our life components. Peoples from several backgrounds use their mobile phone, somehow and somewhat, to communicate each others. The smooth moving of such technology still entices the universities to provide their learning services over this channel as a vital alternative. This research aims to contribute to theoretical, methodological, and practical the use of mobile technology in higher education environment. Furthermore, by expanding the extended Technology Acceptance Model (TAM) and the Innovation Diffusion Theory (IDT), this study aims to provide an integral theoretical paradigm that can successfully support a wide array of technical, administrative, and student issues involved in m-learning. However, the empirical evidence supplied by this research will shed new lights on how student can be enticed by m-learning.

This research contributes to address link between students' acceptance and effects of m-learning usage in the higher education environment. Such relationship could focus on the student as an independent producer of learning rather than a passive customer of teaching in the way to change the nature of the student; learning will be at anytime regardless the location. Moreover, understanding the factors that influence the students' acceptance of m-learning provides valuable guidance to the universities to focus on the most factors that could encourage students to use their m-learning services. The prototype system could provide a sample of m-learning that concern the suggested factors to improve communication between students and their university administration.

1.8 Scope of the Research

The research in m-learning environment can be divided into two main categories; infrastructure of technology and services. This research investigates the relationship between adoption and actual use of informative m-learning services in the higher education environment. However, the research addresses the effects of m-learning usage in the higher education environment. It focuses only on students of public higher universities learning in Malaysia.

Nevertheless, this research concerned with utilizing m-learning services in the higher education environment. Learning process or educational aspects are not in the research scope. Mobile devices that are concerned by this research comprise handheld mobile phones, smart phones, and PDAs.

1.9 Conceptual Research Framework

This research is divided into three phases (see Figure 1.1). The first phase discusses the investigating of students' awareness and requirements regarding m-learning. Tackling the development of the theoretical model for students' acceptance of m-learning services is set in phase two, while phase three focuses on developing m-learning prototype system and its evaluation.

In phase one, current mobile learning technology and its capabilities are reviewed throughout the literature. A questionnaire is also formed in this phase to identify the awareness of students in terms of mobile learning aspects and its limitations.

In phase two, the theoretical model of students' acceptance of m-learning services is constructed and developed. Before the final revised instrument obtained, pilot test for the instrument of model measurement had been conducted. Then, data analysis was proceeded to test the model.

In phase three, the mobile learning services are specified based on the students' survey. These services guided to design and develop the prototype of m-learning services. The usability evaluation is conducted, which includes heuristic evaluation to determine the prototype robustness and its functionality. The instrument of user evaluation is also prepared by using the previously formed questionnaire. The questionnaire is used to measure the success implementation among students of higher education institutions as well. Lastly, the findings of this research are obtained and discussed.

1.10 Outline of the Thesis

This thesis comprises of seven chapters. The first chapter presents an overview of the study background, problem statement, research questions, and objectives of the research. These are followed by a discussion on the significance and contribution of the study. Scope of the study and the conceptual research framework are also illustrated in this chapter.

The second chapter focuses on a review of the existing literature of e-learning in higher education generally and in Malaysian higher education particularly. Throughout this chapter, the discussion sheds the light on wireless technology, mobile technology, mobile learning services, and usability evaluation. Adoption and diffusion theories are reviewed as well as the theoretical framework including its hypotheses are then proposed.

The third chapter discusses the methodology of this research. It elaborates on the study's research design, the population and sample of the research, as well as data collection procedure. This chapter also reports on the pilot test done for the measurement of the students' acceptance model. It ends with a discussion on the use of statistical techniques.

The fourth chapter is devoted to the results of the initial study of this research. It describes the profile of the respondents. Then, in detail, the results of the students' awareness and requirements of m-learning services are presented.

The fifth chapter reveals the findings of data analysis for the main objective of this research which is "to identify the factors that determine students' acceptance and use of m-learning in the higher education environment". The chapter also provides an overview of data collection. The profile of the respondents, the goodness of measures to test the validity and reliability of the variables are presented. Finally, the chapter provides the results of hypotheses testing.

The sixth chapter describes the research methodology used for developing the m-learning prototype system as well as the user evaluation of the m-learning prototype. Finally, the seventh chapter recapitulates the study findings, followed by their discussion. Then it goes on to discuss the limitations and future research directions of the study. Lastly, it ends with study contributions and conclusion.

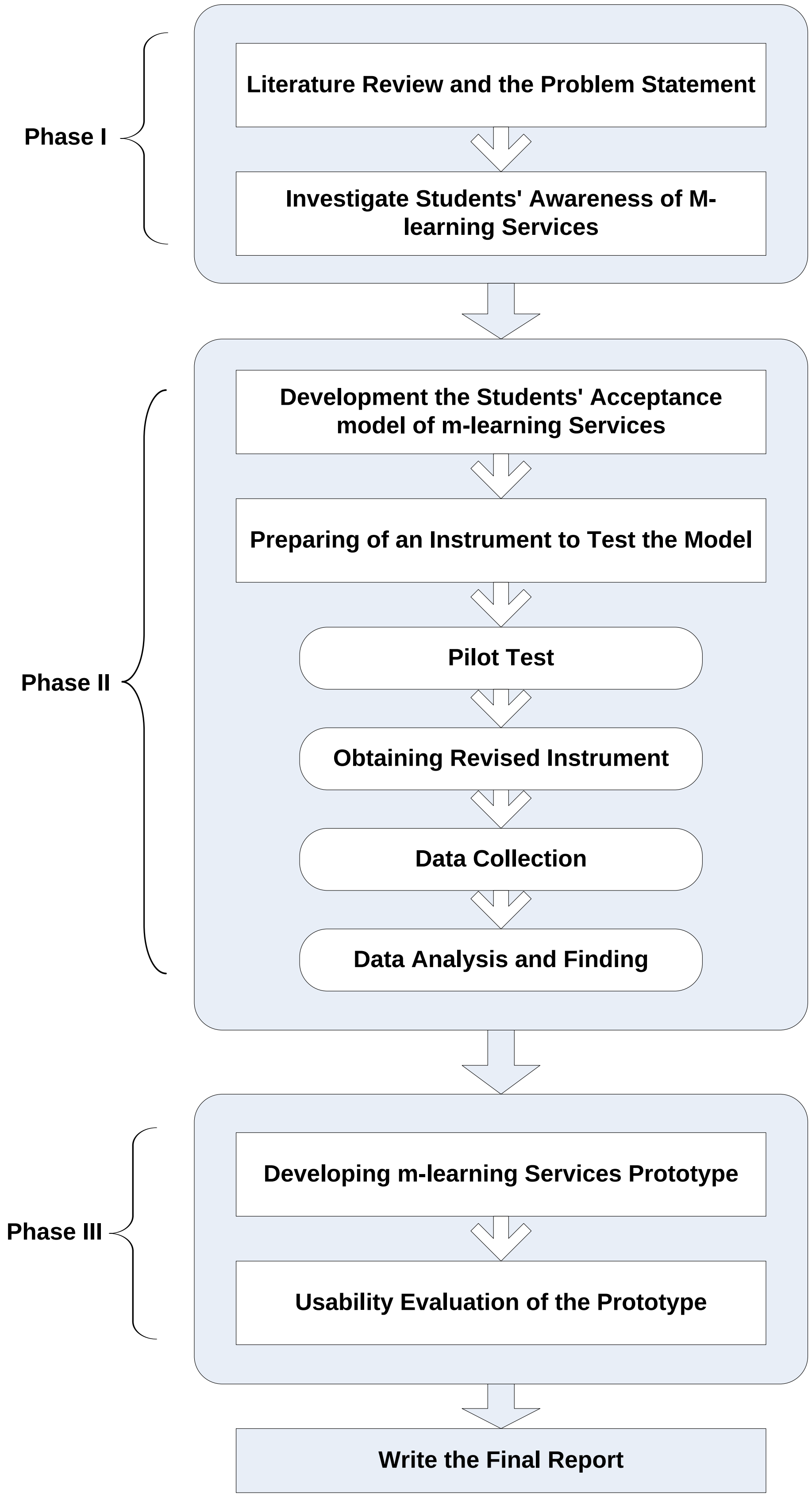

Figure 1.1: Conceptual Research Framework

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter will provide a detailed discussion on e-learning, wireless technology, mobile technology, mobile learning services, and usability evaluation. This chapter will also discuss the theoretical framework along with the proposition of mobile learning acceptance model in the higher education environment.

2.2 E-learning in Higher Education

E-learning has been increased rapidly over the last three decades. Many institutions and universities have supported e-learning in different fields of study. Such alternative learning facility has been widely used by educators, administrators, students and others especially in higher education to facilitate teaching and learning (Kim, Mims, & Holmes, 2006).

Conventionally, formal education is offered in a classroom setting where the teacher and students interact face-to-face. Currently, the main media in making, using, and manipulating information is information technology while distribution and diffusion are the main means in communication technology (Caladine, 2008). In the past twenty years, the impact of Information and Communications Technologies (ICT) has been felt in almost all aspects of life in developed countries as they have become information societies. It has had an effect on all sectors of education from kindergarten to further, technical and higher education.

Indeed, education is the cornerstone of economic development in any nation. Therefore, writing about technology issues presents the modernization and the change for having better life. Consequently, it is now the right time for e-learning to be changed to meet the requirements of the mobile era (Caladine, 2008).

2.2.1 Definitions and Concepts

E-learning could be named online learning, flexible learning, open learning, or blended learning. E-learning delivers education to students in distant locations or to people face difficulty in attending classes through limitations of time or mobility (Caladine, 2008). Scholars provided several definitions of e-learning. For instance Trifonova and Ronchetti (2003) defined e-learning as “technology delivered or technology enhanced learning”. While Rosenberg (2001) defined it as “The use of internet technologies to deliver a board array of solutions that enhance knowledge and performance”.

In more extensiveness, Downes (2005) states that e-learning is more than electronic tool, it is a learning management system that takes learning content and organizes it electronically, as a course divided into modules and lessons, supported with quizzes, tests and discussions, and it can be integrated into the college or university's student information system and services. Despite the fact that e-learning is highly crucial as it is the electronic learning format using Information Communication Technology (ICT), it is unlikely to replace the conventional learning but merely functions it as an alternative facility.

2.2.2 E-learning Capabilities

Originally e-learning consisted of a limited number of technologies, all of which were text-based. These were generally communications technologies such as e-mail, list servers, bulletin boards, and other computer mediated communications. The first appearance of the World Wide Web (WWW) in the early 1990s added an easy way to display text and graphical content. Today online learning refers to a mixture of technologies that are often encapsulated within an environment or management system. Early online or virtual learning environments allowed students to interact with content, fellow students, and faculty within the one Web site. Today these environments have grown to include other functions such as student tracking, grade management, student feedback (Caladine, 2008), and interoperation with databases of resources and records. Moreover, students can register, drop, update his/here subjects and profile as well. These are now referred to as learning management systems (LMS), virtual learning environments, or course management systems (CMS) (Caladine, 2008).

Wilson *et al.* (2006) corroborate this notion and suggest that Personal Learning Environments (PLEs), see Figure 2.1, will link elements from the educational institution, with elements from students. The student elements could contain: photos, bookmarks, personal hosting, blogs, wikis, forums, and other applications. However, Anderson and Whitelock (2004) suggested that e-learning enhanced education as it is based on three fundamental PLEs. These are:

i. Better ways of storing and retrieving information.
ii. Nonhuman agents that will enhance learning through taking on some of the information processing in learning.

iii. Increase the capabilities of the Internet to support communications between humans in many formats across time and location constraints.

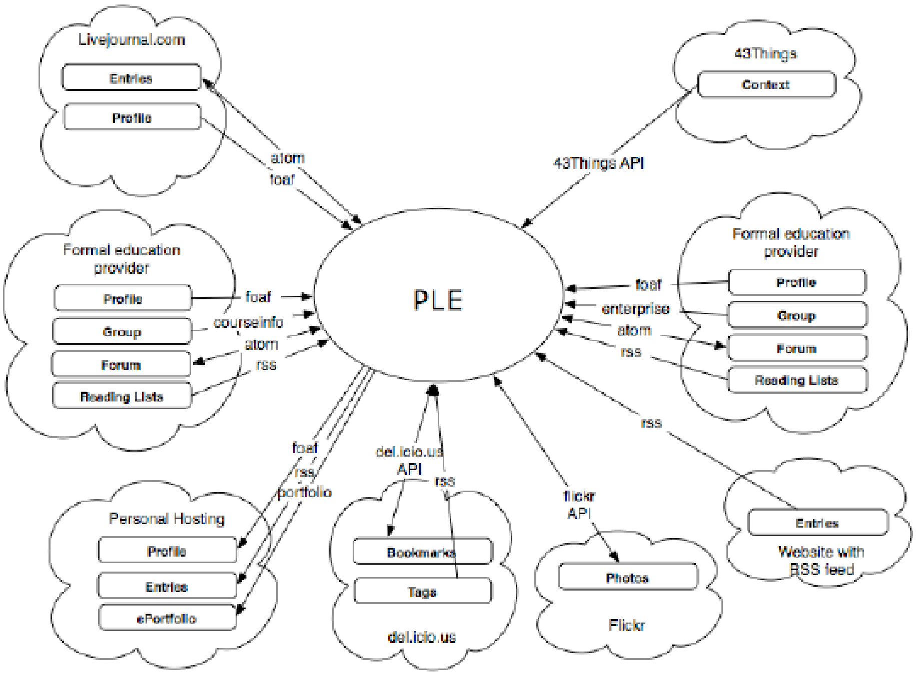

Figure 2.1: Conceptual Model of a Personal Learning Environment (PLE)
Source: Anderson and Whitelock (2004)

Moreover, in recent years, lecturers and students continue to access Internet using their desktop or laptop to conduct education. This access way was known e-learning since it utilizes the electronic media in the education. In last decade, wireless technology has grown up and engaged in many environments and activities such as economic, industrial, and marketing as well as education environment.

Table 2.1 shows the main features of e-learning, w-learning, and m-learning. It shows that m-learning services are more portable than the previous kind of services. The differentiation is based on the capability of the service which comprises the connection protocol using to access the service; the accessibility of the service regarding the place; the connectivity of the service based on the ability to connect via various networks; and the size of the device and its screen which used in such service (Attewell, 2005; Wentzel, Lammeren, Molendijk, Bruin, & Wagtendonk, 2005).

Table 2.1
Comparison Features of E-Learning, W-Learning and M-Learning

Feature	E-Learning	W-Learning	M-Learning
Protocol	Web-Based	Web-Based	WAP-Based
Accessibility	Anywhere	Campus	Anywhere and Anytime
Network	Wired	Wireless	Wireless
Connectivity	Intranet or Intranet Networks	Local Campus Networks such as Wi-Fi	Mobile Networks: GSM, GPRS, UMTS or CDMA
Device Size	PC or Laptop	Laptop or Tablet PC	Mobile Phone, Smart Phone or PDA Phone
Screen Size	"Normal" screen size, 14 to 17 inches	"Medium" screen size, 10 to 15 inches	Very Small (mobile phone) to a maximum of 480 x 640 pixels. More common for PDA is 240 x 320 pixels

However, Mulliah (2006) summarized the previous e-learning researches questions investigated which were:

i. How can Information Communication Technology (ICT) support traditional, classroom-based education?

ii. How can ICT help instructors and students to be in interaction either synchronous or asynchronous mode?

iii. How can mobile devices be used to enhance regular activities with potential for learning?

Rosenberg (2001) outlined three fundamental criteria for e-learning which are:

i. E-Learning is networked, which makes it capable of instant updating, storage, retrieval, distribution and sharing of instruction or information.
ii. It is delivered to the end-user via a computer using standard internet technology.
iii. It focuses on the broadest view of learning – learning solutions that go beyond the traditional paradigms of training.

According to Allen (2007), the approaches of instructional design can be classified as intuitive, research-based, theory-based, and success-based. The author believes that the principles of different design approaches and theories overlap and generally support each other. Moreover, the author argues that the successful e-learning designs should be meaningful, memorable, motivational learning experiences, and measurable results.

However, Rekkedal and Dye (2007) in their study, from e-learning to m-learning, aimed to design mobile learning solutions to support and maximize learner's freedom to study with increased flexibility. They found that both e-learning and m-learning functions should be available adequately.

2.2.3 The Implication of E-learning in Higher Education on the Research

From the literature, there is evidence that e-learning services have been utilized in the higher education as an alternative form of conventional learning media. E-learning still has some kind of the limitation in terms of connectivity and mobility. Wireless technology has been supported and maximized the accessibility of e-learning but such platform of learning still depends on the pc or laptop connected to the internet which limited by the place and the equipment itself. The current limitation of mobility encouraged the researcher to study this issue and try to find out a viable to maximize the accessibility to be anywhere and anytime.

2.3 Wireless Technology

The concept of wireless is to access the information using wireless connection. wireless technologies that used in m-learning area is any wireless technology that uses radio frequency spectrum in any band to facilitate transmission of text data, voice, video, or multimedia services to mobile devices with freedom of time and location limitation (Kim, et al., 2006). Wireless network is one of the major issue affecting the spread of m-learning (McLean, 2003). The popular wireless networks comprise Wi-Fi (Wireless Fidelity), GPRS (General Packet Radio Service), Bluetooth as well as IrDA (Infrared Data Association).

This section will describe briefly WAP (Wireless Application Protocol), WAP architecture, WAP session and WML (Wireless Mobile Markup Language) concern in such technology.

2.3.1 WAP Protocol

Wireless Application Protocol (WAP) is a collection of wireless application protocol and specification standard that allows mobile devices to communicate with the web server using the WAP browser and display the contents back on the mobile devices screen, basically, it is the protocol that allow mobile devices to access the internet (WapForum, 2002a).

In the early day of wireless web, several companies produced their own proprietary application protocol, this made the wireless web developed that followed one company communication protocol standard can only be view by mobile phone that use that standard (Nylander, 2004). Lacks of standardization hinder the growth of wireless web, users were confused, and developers were screaming for standardization.

One of the most important aspects of wireless communications is standardization. WAP is intended primarily for Internet enabled mobile phones. It is designed to standardize development across different wireless technologies worldwide. In 1997, the Wireless Application Protocol (WAP) was developed by Nokia, Ericsson, Motorola and others to foster the emergence of the wireless Internet. It is designed to standardize development across different wireless technologies worldwide (Holzberg, 2000). Moreover, in June 2002, 350 member companies –involved WAP forum companies- joined together and formed the Open Mobile Alliance (OMA). They represent the world's leading mobile operators, device and network suppliers, information technology companies, application developers and content providers (Open Mobile Alliance, 2004).

According to analysts at Lehman Brothers Inc. (Kustin, 2002), the number of wireless Internet access devices being utilized worldwide is expected to double annually from approximately 50 million units in the year 2000 to approximately 600 million units in the year 2004. Based on this data, recognizing the upcoming need to have pricing information and purchasing opportunities available for users of mobile

Internet access devices is essential for companies looking to become the most preferred suppliers of consumer goods on the Web. Moreover, International Engineering Consortium (IEC) has believed that the future for WAP will be bright; based on (75%) of the world company's stand behind the mobile telephone market and the huge development potential of WAP (International Engineering Consortium, 2007).

2.3.2 WAP Architecture

WAP has a client and server approach that compounds wireless network and internet technology. In fact, the motivation for developing WAP was to extend Internet technologies to wireless networks, bearers and devices (Wapforum, 2002c).

The First specification of WAP (WAP 1.0) released in 1998 by WAP Forum. Followed by WAP 2.0 which is a next-generation set of specifications that utilized and supported enhancements in the capabilities of the latest wireless devices and Internet content technologies, also WAP 2.0 provides managed backwards compatibility to existing WAP content, applications and services that comply with previous WAP versions.

It was designed to work on any mobile network standard whether Wireless LAN (IEEE 802.11 protocol), Bluetooth, Infrared (IR) or cellular networks such as Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS) (Antovski, 2003; Cervera, 2002; Kalliola, 2005). WAP has a layering concept like the internet; each of the layers of the architecture is accessible by the layers above, as well as by other services and applications. Figure 2.2 shows the

WAP layers stack (centre) and internet OSI (International Standard Organization) layer stack (left). WAP stack consist of Wireless Application Environment (WAE), Wireless Session Protocol (WSP), Wireless Transaction Protocol (WTP), Wireless Transport Layer Security (WTLS) and Wireless Datagram Protocol (WDP).

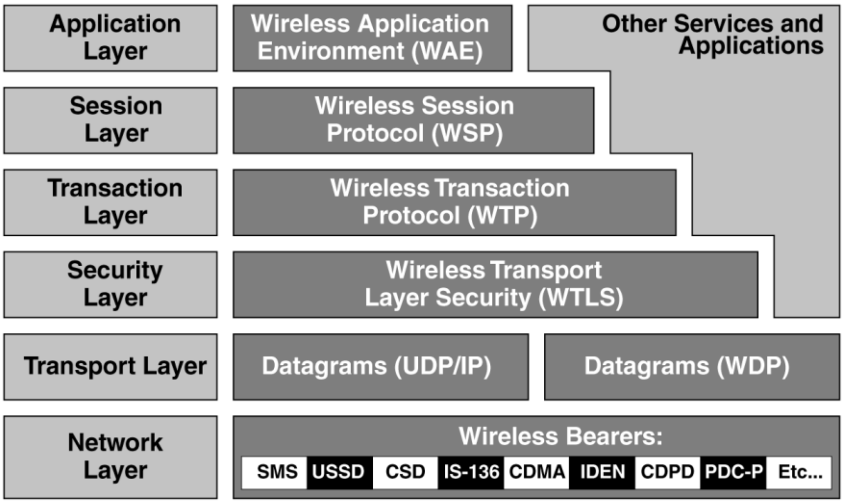

Figure 2.2: WAP Protocol Stack
Source: WapForum (2002b)

i. Wireless Application Environment (WAE)

The WAE layer is where the protocol for the user interface resides, WAE interact with Wireless Markup Language (WML), and WML is equivalent to the HTTP in the internet, WML Script and Wireless Telephony Application (WTA) to display content on the screen.

ii. Wireless Session Protocol (WSP): Compose of two protocols:

1. Work with WTP to make connection oriented session.
2. Allow server to make connectionless oriented session (PUSH technology).

iii. Wireless Transaction Protocol (WTP)

WTP layer responsible to manage a transaction, WTP employed the User Datagram Protocol (UDP) on the internet OSI (International Standard Organization) model; WTP offers three classes of transaction service: unreliable one way request, reliable one way request and reliable two way request respond.

iv. Wireless Transport Layer Security (WTLS)

WTLS layer deal with security, data integrity and authentication protocol.

v. Wireless Datagram Protocol (WDP)

WDP is data transport protocol that manages the transmission; WDP allows WAP protocol to adapt any data communication protocol from network standard, thus allowing WAP to communicate with any network standards.

2.3.3 WAP Session

WAP session consists of interaction between mobile phone, Telco, WAP gateway and web server. WAP gateway is a software that acts as an intermediary between mobile phone and internet, it process request from micro browser, forward the request to the corresponding web server, encode the content in WML if the content not in WML format and divided the content into smaller chunk to be transmitted back to the micro browser.

The WAP gateway performs two main functions (WapForum, 2002a):

i. Protocol Gateway: Translates WAP protocol request to the WWW protocol request (HTTP and TCP/IP) and vice versa.

ii. Content Encoders and Decoders: Translate Web content into compact encoded formats to reduce the size and number of packets traveling over the wireless data network.

WAP phone cannot communicate directly with the web server due to the different markup language and protocol used; web server normally uses Hypertext Markup Language (HTML) while WAP phone uses WML. One of the reasons why WAP phone cannot use the available internet protocol such as TCP/IP and HTML was the limited amount of information that can be transfer by the wireless network, WAP was primarily design to minimize bandwidth use (Foo, Hoover, & Lee, 2001), therefore WAP phone require WAP gateway to perform all the conversion and synchronization. Figure 2.3 shown process flow, it assumed that the user is already connected to the internet (Andersson, Greenspun, & Grumet, 2005).

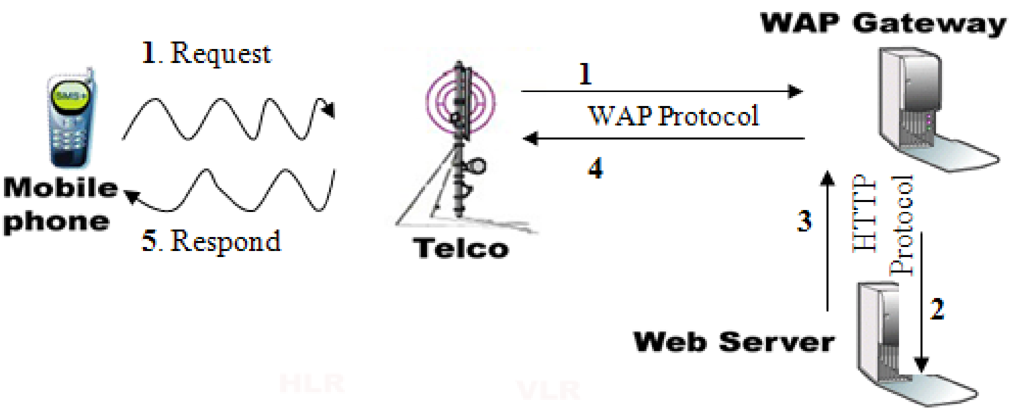

Figure 2.3: The WAP Process Flow
Source: Ghani (2005)

WAP process flow described briefly in the following points:

1. A Uniform Resource Locator (URL) request for a WAP site is send out by micro browser reside in user’s mobile phone to a WAP gateway.

2. The request will be processed by the WAP gateway, WAP gateway will query the requested URL for the content, the requested URL (web server) will reply back by sending the content to the WAP gateway.
3. If the requested content is WML format, the requested content is directly send back to the micro browser, but if the requested content is written in HTML language, WAP gateway will translate the content to WML format before transmitting it to the micro browser.
4. The requested content is send back to the micro browser.
5. Micro browser will display the content on the mobile phone screen.

Despite TCP/IP might be the efficient method to transfer data between internet and computer, large amount of data can be transmit by the network and displayed back on the computer monitor screen. However unlike the computer, mobile phone has many limitation such as small display, low storage capacity and processing power and limited input capabilities, furthermore the amount of data that can be transmit by wireless network is limited, due to the limited bandwidth. The WAP protocols were specifically design to address all of these limitations (Andersson, et al., 2005).

2.3.4 Wireless Mobile Markup Language

WML is an official markup language endorsed by the WAP forum (WapForum, 2002a). It is An XML based scripting language for creating content for wireless system (Turban, et al., 2007). As mentioned in WAP session section the relation between WAP and WML is: The Wireless Application Protocol (WAP) enables different kinds of wireless devices to communicate and access the Internet using the Wireless Markup Language (WML) (Deitel, Deitel, Nieto, & Steinbuhler, 2001).

The page written in the WML language can be displayed back on any WAP phone using a micro browser, WML language is based on Extensible Markup Language (XML), a markup language that conform to the stricter standard, can be shared across different systems, and also the language that recommended by the World Wide Web Consortium(W3C).

A WML document is called a deck and it contains one or more sections called cards. Each card consists of text content and/or navigational controls for user interaction. Only one card can be viewed at a time, but navigation between cards is rapid because the entire deck is stored by the micro browser (Deitel, et al., 2001).

A Deck is the smallest unit of WML that can be transmitted by a WAP gateway, when user request for URL, WAP gateway will send deck to the mobile phone; micro browser will display the first card as defined by the deck. However due to limitation of mobile phone, WAP gateway will not send compiled WML deck larger than 1,429 bytes to the mobile phone to avoid data crashing (Foo, et al., 2001). Nevertheless, WML supports most features of Hypertext Markup Language (HTML) (Deitel, et al., 2001):

2.3.5 The Implication of Wireless Technology on the Research

From the literature, there is evidence that the wireless technology could increase the accessibility of e-learning. Such technology and its elements are suitable to be utilized in the education on-campus and off-campus as well. The WAP protocol is the synonym of WEB concept that is used in e-learning. These benefits of wireless technology encouraged the researcher to engage it in education and to concern its elements and capabilities.

2.4 Mobile Technology

Mobile technologies have a wide variety of uses and limitations that differ significantly from the conversional personal computers (PCs), and it is the time to think of handset as a new form of the computer and it has a capabilities to use in education environment (Prensky, 2005).

Malaysia today stand in the front of the ASEAN countries (Malaysian Communications and Multimedia Commission [MCMC], 2008a), Figure 2.4 shows the Internet users per 100 inhabitants in ASEAN countries, Malaysia (51.98%) has the highest Internet users in 2007, while Singapore (43.62%) and Brunei (43.35%). Vietnam, Thailand, Indonesia and Filipina were (17.21%), (13.07%), (7.18%), and (5.48%) respectively and Laos, Cambodia, Myanmar were less than (1.0%). Figure 2.5 shows Malaysia compared with some of economies countries. While United Kingdome (UK) was (56.03%) and Malaysia was (51.98%), China was (10.35%).

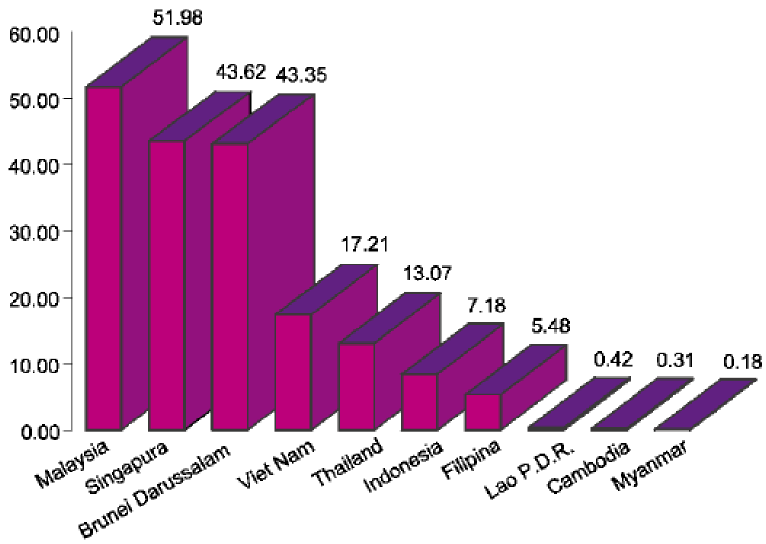

Figure 2.4: Internet Users per 100 Inhabitants in ASEAN Countries

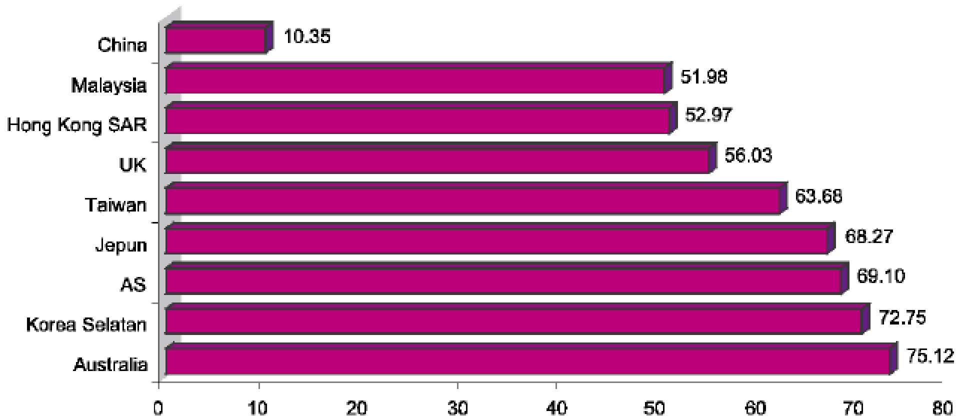

Figure 2.5: Internet Users per 100 Inhabitants in Economies Countries

Figure 2.6 shows the infrastructure for mobile computing based on Internet technology. It depends on the wireless technology such as radio waves and wireless access points.

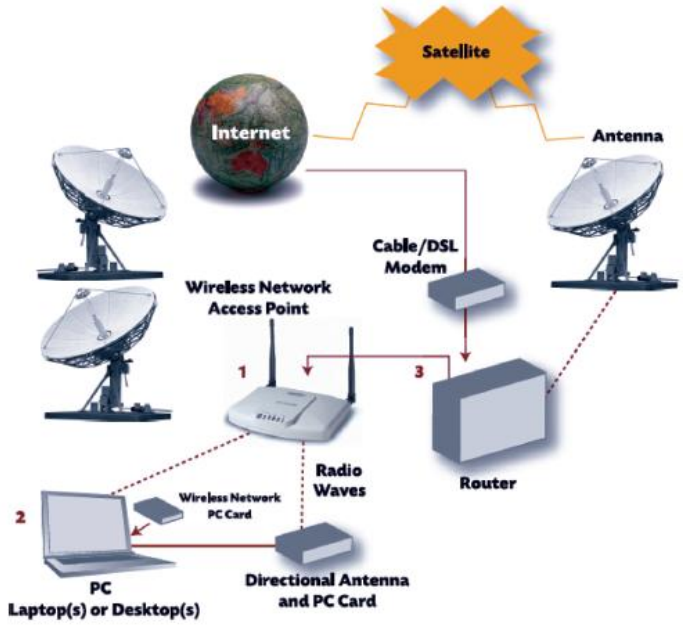

Figure 2.6: Mobile Computing Infrastructure
Source: Turban et al. (2007)

2.4.1 Mobile Devices

The mobile phone is seen as personal, rather than household equipment. This is because mobile phone is normally carried by its owner anywhere and anytime. Moreover, nowadays, mobile phone is the first and foremost a personal communication device (Kaasinen, 2005). Nevertheless, When the mobile phone rings at home, often the caller expects main user who will answer him rather than the person closer to it (Malaysian Communications and Multimedia Commission [MCMC], 2008b).

A Personal Digital Assistant (PDA) is a handheld computer with mobile phone capabilities (J. Chen & Kinshuk, 2005; Nilas, Sueset, & Muguruma, 2004; Schei & Fritzner, 2002). It is a mobile phone device that contains applications like word processor, calculation program, calendar and perhaps some communication possibilities (What-Is.Net, 2006). Prensky (2005) summarized the major features of the mobile devices which being voice, Short Messaging Service (SMS), graphics, user-controlled operating systems, downloadable, browsers, camera functions, and supporting the Global Positioning System (GPS).

Constantly, the number of mobile phones has increased rabidly. In Norway, 78,000 PDAs were sold in 2000, and 60,000 in 2001. In 2002, the sales were much lower (Schei & Fritzner, 2002). Worldwide in 2001, 13.1 million units were sold (McDonough, 2002), and according to Intel Developer Update Magazine in 2002, there were approximately 1 billion cellular phones used, with 1.8 billion in 2006. Moreover, according to Cellular Statistics (2006) in the first quarter of 2006, the worldwide users of mobile are more than two billion, sending 235 billion SMS, and 130 million using 3G technology.

Market penetration is approaching (50%) in the U.S., and has reached (70%) in Western Europe, Japan, and Korea (Deshpande & Keskar, 2002). However, over the world there are fewer than 50 million PDAs but there are more than 1.5 billion cell phones (Prensky, 2005).

However, today most people are equipped with mobile devices and most of them already have good knowledge and experiences in using mobile devices to access internet applications (Dankers, Garefalakis, Schaffelhofer, & Wright, 2002). For instance, in 2005, (28%) of mobile phone owners worldwide browsed the

Internet on a wireless handset, up from (25%) in 2004 (eMarketer, 2006; Lombardi, 2006; Rossi, Pastor, Schwabe, & Olsina, 2007). More significantly, the increase is driven by adults aged 35 (Lombardi, 2006). The total number of remote workers in European Union (EU) has grown from six (6%) to thirteen percent (13%) in the period from 1999 to 2002 (Schei & Fritzner, 2002).

Moreover, China has 206 million subscribers in 2002, which is (16.19%) of China's population (J. Chen & Kinshuk, 2005). One reason for this growth can be the expansion of mobile devices like smart phones, PDAs and mobile phones in the market. However, most of countries their mobile reigns often having 5 to 10 times more mobile phones than personal computers (PCs) (Prensky, 2005). In 2005, the penetration of student mobile phones in United States (US) was (40%) in many junior high schools and (75%) in many high schools; penetration was (90%) in US colleges (Prensky, 2005). Furthermore, the mobile subscribers in Malaysia have increased by around (20%) to reach 11 million subscribers by the end of December, 2004 which is (45%) (TeleGeography, 2005).

McLean (2003) mentioned some of different factors that user concern when select the right mobile device. These factors comprise cost, battery life, display size, data input, processing power; storage capacity, communications options, security, application development tools, IT support, and supporting m-learning.

2.4.2 Mobile Penetration

Mobile penetrations increasingly affect the diffusion of information as well as business and learning activities. They gain broad acceptance due to the increased need in supporting the mobile workforce and the rapid improvement in the devices and wireless technologies for communication. However, many mobile applications provide rich personal services such as sending and viewing email, browsing the world wide web, viewing traffic and weather reports , watching movies and chatting with others (El-Alfy, 2005).

According to survey conducted by IPSOS company (eMarketer, 2006), almost all wireless device activities experienced growth in 2005 were m-commerce, financial transactions, sending or receiving digital pictures, and downloading entertainment. The IPSOS found that the leader of the world in browsing the Internet via mobile phone was Japan followed by the UK, US and South Korea; and the browsing focused on news and information. Figure 2.7 shows the percentage of adult mobile users in some countries who had searched for news and information (eMarketer, 2006). Moreover, Figure 2.8 shows the mobile phones penetration in Association of Southeast Asian Nations (ASEAN) countries; it shows that Malaysia (72.3%) stand in the front of the ASEAN after Singapore (109.3%) followed by Brunei (66.5%), Thailand (63.0%) and Filipina (50.8%). While Indonesia, Vietnam, Laos and Cambodia were (28.3%), (18.2%), (10.8%), and (7.9%) respectively, Myanmar was only (0.4%) (MCMC, 2008a).

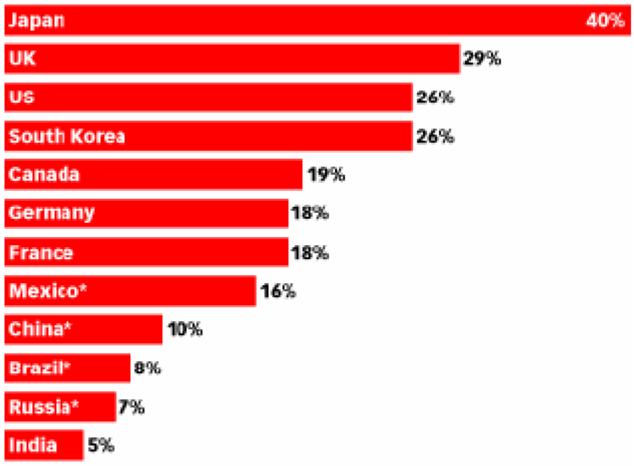

Figure 2.7: Adult Mobile Users Who Had Searched For News and Information

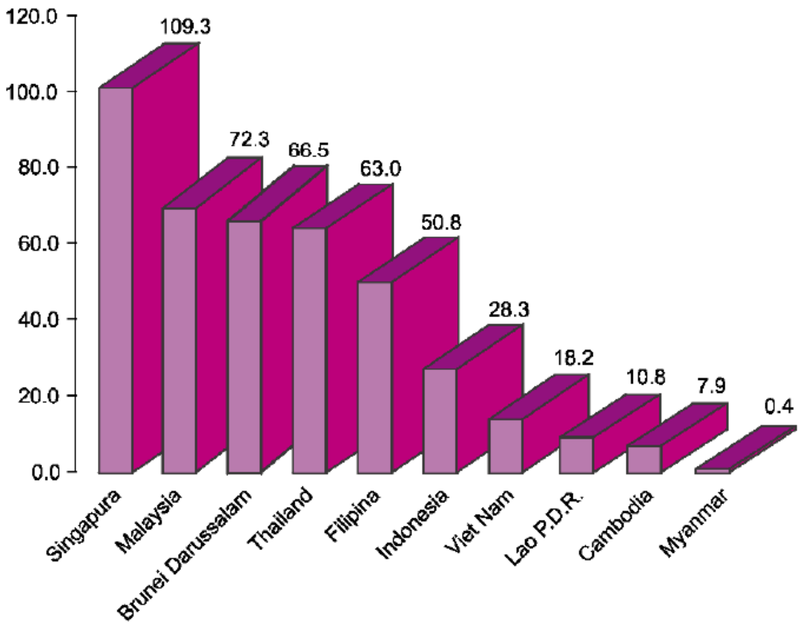

Figure 2.8: Mobile Phones Penetration per 100 Inhabitants in ASEAN Countries

Figure 2.9 shows the mobile phones penetration per 100 inhabitants in some selected countries. It shows Malaysia (72.3) comes before China (34.8); while the highest penetration for Hong Kong which was 131.5.

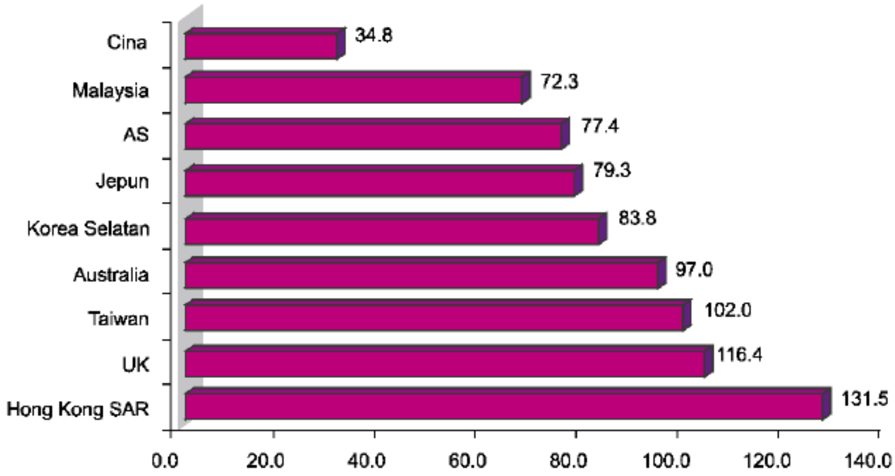

Figure 2.9: Mobile Phones Penetration per 100 Inhabitants in Selected Economies

The Malaysia's mobile subscriber growth has increased by years. Figure 2.10 below shows the penetration of mobile phones in Malaysia in last decade (MCMC, 2008a, 2009). The rate keeps increasing from 9.7 subscribers per 100 inhabitants in 1998 to reach 106.3 subscribers in 2009.

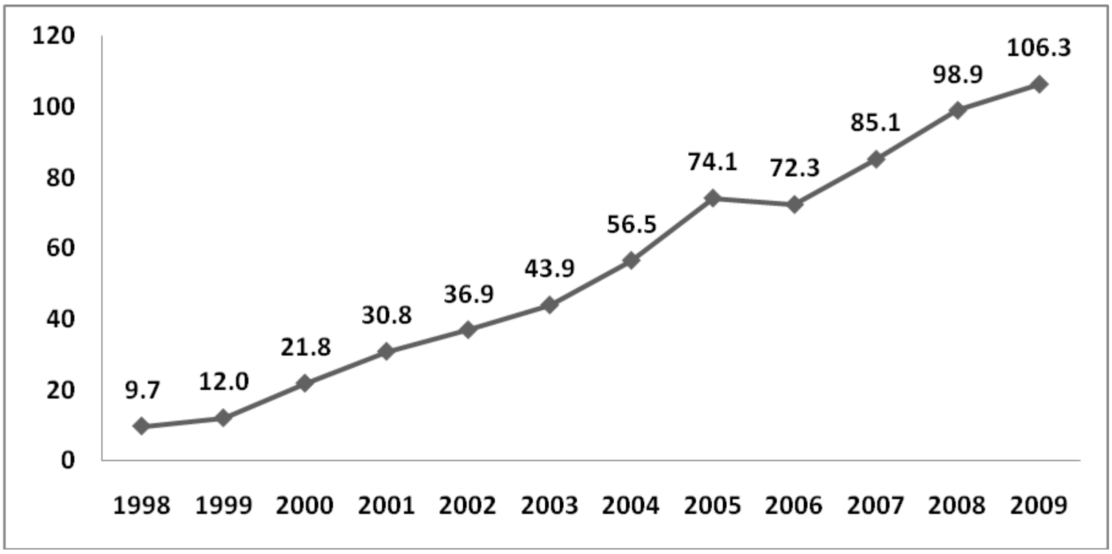

Figure 2.10: Mobile Phone Penetration Rate in Malaysia by Years

Table 2.2 below shows penetration of mobile phones in Malaysia in last four years by state. The survey indicates that the mobile penetration in the last four years kept growing in most states of Malaysia..

Table 2.2
Mobile Phone Penetration in Malaysia in Last Decade by State

State	Per 100 Inhabitants			
	2004	2005	2006	2007
Johor	48.8	63.8	70.0	71.4
Kedah	39.6	45.7	60.2	58.8
Kelantan	27.3	35.2	51.5	46.1
Melaka	56.1	60.3	87.6	85.5
Negeri Sembilan	48.3	59.9	75.6	73.0
Pahang	32.1	45.2	56.6	59.0
Pulau Pinange	53.6	72.2	72.6	73.1
Perak	40.9	46.3	57.1	57.5
Perlis	35.5	51.0	70.6	58.2
Selangor	60.7	74.8	76.3	78.1
Terengganu	28.3	39.5	62.4	59.2
Sabah	23.6	31.4	36.9	39.6
Sarawak	31.7	36.6	51.5	43.3
W. P. Kuala Lumpur	69.7	89.3	93.1	91.4

According to survey conducted by Malaysian Communications and Multimedia Commission (MCMC) in 2007 shown in Table 2.3, Adults (users aged between 20 and 49 years) represented the highest group of users (66.8%) followed by 20.9% pre-teens and teens (users aged up to 19 years old). Seniors (aged 50 years and above) represented only (12.3%) (Malaysian Communications and Multimedia Commission [MCMC], 2008b).

Table 2.3
Percentage Distribution of Mobile Phone Users by Broad Age Categories

Age Category	Percentage (%)		
	2005	2006	2007
Pre-teens and teens (up to 19)	13.1	20.5	20.9
Adults (20-49)	78.2	66.8	66.8
Seniors (50+)	8.7	12.6	12.3

The MCMC (2008b) survey showed that Selangor state continues as the highest number of mobile phone users at (22.1%) followed by Johor (13.5%), Federal Territory of Kuala Lumpur (8.6%) and Perak (7.8%). Among other states, Sabah (including Federal Territory of Labuan), Penang, Kedah, and Sarawak have between (6%) and (7%) of mobile phone users, while Pahang, Kelantan, Negeri Sembilan, Terengganu and Melaka have between (4%) and (5%) users. Perlis has the smallest number of users with only (0.8%), see Table 2.4.

Seppala, Sariola, and Kynaslahti (2002) claimed that ninety eight percent (98%) of Finnish University students have mobile phone and they are highly experienced of mobile technology. Moreover, a study conducted at University Utara Malaysia (UUM) in February 2007 investigated student’s perception of m-learning services at their university (Al-Mushasha & Hasan, 2007). The study found that 93% of the respondents have mobile phones.

Table 2.4
Percentage Distribution of Mobile Phone Users by State

State	Percentage (%)		
	2005	2006	2007
Johor	13.7	13.0	13.5
Kedah	5.9	6.6	6.6
Kelantan	3.7	4.6	4.2
Melaka	3.0	3.7	3.7
Negeri Sembilan	3.9	4.3	4.2
Pahang	4.5	4.8	5.1
Pulau Pinange	7.4	6.4	6.5
Perak	7.3	7.7	7.8
Perlis	0.8	0.9	0.8
Selangor	24.7	21.7	22.1
Terengganu	2.9	3.8	3.7
Sabah	6.4	6.4	7.1
Sarawak	5.9	7.1	6.1
W. P. Kuala Lumpur	9.7	8.6	8.6

Moreover, Figure 2.11 shows the increase up of number of mobile broadband subscriptions among Malaysian. While in 2006 were only 4.5 subscribers, in 2008 reached to 386.3 subscribers. The growth keeps increasing to reach 747.7 in the third quarter of 2009. This made up 31.7% of the percentage of the broadband subscriptions by technology. While the other wireless subscriptions made up only 5.4%, the majority (62.1%) were for Asymmetric Digital Subscriber Line (ADSL) subscriptions MCMC (2009).

The survey of MCMC (2008b) also investigated the use of internet through mobile phones in Malaysia. The results found that only 13.7% of users accessed the

Internet through their mobile phones. This is a drop of 4.7% points from year 2006 which was 18.4% (see Table 2.5)

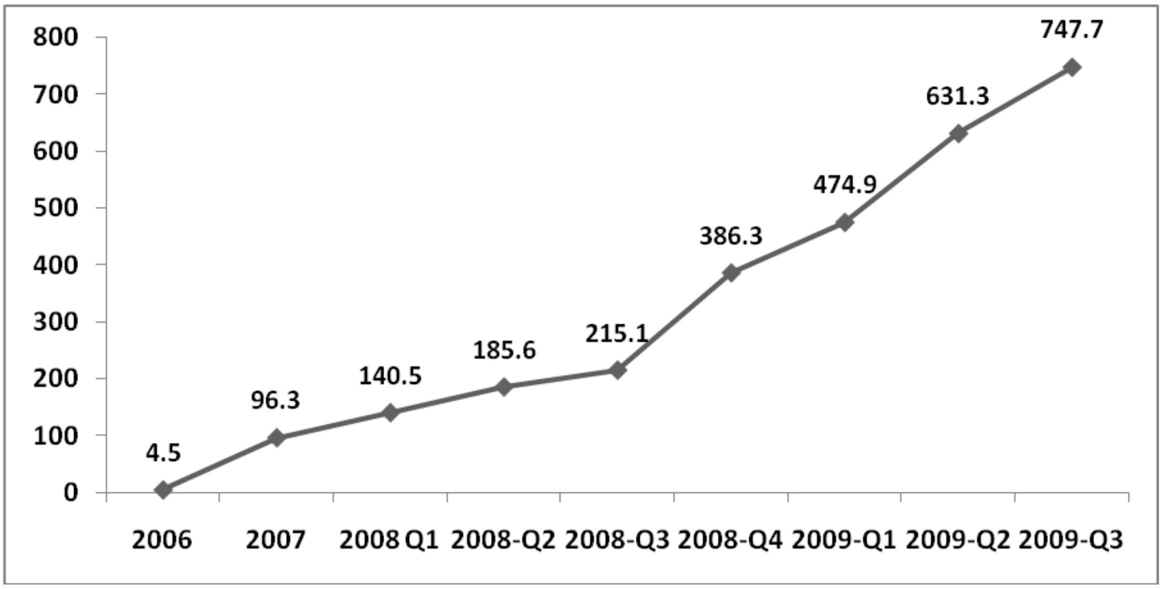

Figure 2.11: Number of Mobile Broadband Subscriptions in Malaysia by Years

Table 2.5
Percentage Users Access Internet Using Mobile Phones in Malaysia

Use of Hand phone to access Internet	Percentage (%)	
	2006	2007
Yes	18.4	13.7
No	81.6	86.3

Among those who accessed the Internet on their mobiles through wireless services, 84.4% used General Packet Radio Service (GPRS) while 16.5% used 3G, 12.1% used WAP, and 1.5% used Enhanced Data Rates for Global Evolution (EDGE). 0.6% declared that they do have no knowledge about.

Furthermore, Figure 2.12 and Figure 2.13 below show that the hotspot number grows constantly in most of Malaysian states, for instance, in Perlis State, it increased from 43 hotspots in 2006 to reach 111 in 2007, in the same duration, Kedah State increased from 31 hotspots to 56, and Perlis State from no hotspot in the first quarter of 2007 to 2 hotspots in the fourth quarter of the same year (MCMC, 2008a).

State	2005	2006	2007 1	2	3	4
Johor	79	94	104	102	100	81
Kedah	36	31	38	54	56	56
Kelantan	30	30	34	33	33	37
Melaka	20	34	37	40	43	41
Negeri Sembilan	24	31	37	37	36	36
Pahang	58	80	82	80	89	88
Perak	44	43	92	93	92	111
Pulau Pinang	88	94	105	107	105	120
Perlis				1	2	2
Selangor	319	352	355	350	360	356
Terengganu	43	35	39	39	38	39
Sabah	37	44	38	38	42	42
Sarawak	75	75	75	75	78	79
W. P. Kuala Lumpur	352	395	399	394	373	376
W.P. Labuan	9	9	9	9	10	10
W.P. Putrajaya	13	11	12	11	11	11
Jumlah *(Total)*	1,227	1,358	1,456	1,463	1,468	1,485

Figure 2.12: Number of Hotspot Locations by Malaysian State in Last Three Years
Source: MCMC (MCMC, 2008a)

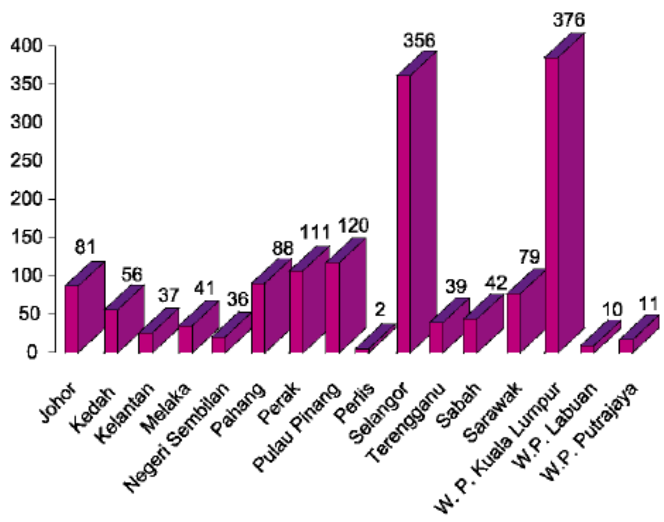

Figure 2.13: Number of Hotspot Locations by Malaysian State in 2007

2.4.3 Wireless Communication Standard and Generations

The first-generation (1G) of wireless technology is analog cell phone that were introduced in the 1980s and continued until being replaced by digital mobile phones (2G). The second-generation technologies (2G) which is fully digital technology transmissions such as Personal Communication System (PCS), Global System for Mobile Communication (GSM) (Deitel, et al., 2001). It was launched commercially in 1991, on the Global System for Mobile Communications (GSM) standard in Finland by Radiolinja (later on it is part of Elisa). At the first of 2008, CELCOM had 5801 GSM stations covers whole of Malaysia (Telekom Malaysia Berhad [TM], 2008).

The 2.5G generation technologies represent an intermediate step between second generation (2G) technologies and third-generation technologies (3G). In this stage, networks begin using packet-switching technologies. 2.5G networks enable subscribers to access a wide selection of new non-voice services. Meanwhile, the performance of 2.5G networks has been improved by the new EDGE (Enhanced Data Rates for GSM Evolution) technology. EDGE is a technology that increases capacity, improves quality, and allows use of advanced services over the existing GSM network. EDGE is an upgrade of the GPRS system for data transfer in GSM networks (Attewell, 2005).

3G considers the great influence on the wireless communication; it allows increasing data speed and networking capacity. Nevertheless, 3G can support the transmission of multiple data types such as video streaming, video call, video downloads, full track downloads, mobile TV, and interactive game (Deitel, et al., 2001; TM, 2008). First pre-commercial of 3G network was launched by NTT

(Nippon Telegraph and Telephone) DoCoMo in Japan branded FOMA, in May of 2001 on a pre-release of W-CDMA (Wireless-Code Division Multiple Access) technology. The first commercial launch of 3G was also by NTT DoCoMo in Japan on October 1, 200. In 2005, CELCOM launched the first 3G services in Malaysia and at first of 2008, it has 2280 3G station covers (98.5%) of Malaysia, while in 2005 and 2006 it had 806 station covers (97%) and 1499 station covers (98%), respectively (TM, 2008).

The last Generation so far, is fourth-generation (4G) (also known as Beyond 3G). 4G is a term used to describe the next complete evolution in wireless communications. A 4G system will be able to provide a comprehensive IP (Internet Protocol) solution where voice, data, and streamed multimedia can be given to users at anytime regardless the place, and with higher data rates than previous generations.

2.4.4 The Implication of Mobile Technology on the Research

After reviewing the mobile technology and its elements, it becomes much clearer to the researcher that such technology can be utilized in the higher education environment to provide service of learning for students anywhere regardless the time. Moreover, both of the environment and the infrastructure are appropriate to diffuse m-learning in the higher education environment.

2.5 Mobile Learning Services in the Higher Education

M-learning is considered as the next form of e-learning using mobile technologies to facilitate education for teachers and learners anywhere and anytime.

However, The main difference between e-learning and m-learning is in the addition of capabilities and limitations in the evolution aspects (Lavoie, 2007).

M-learning definition has been on the focus of scholars attention in relationship with to e-learning; Moura and Carvalho (2008) defined m-learning as an extension of distance learning supported by wireless mobile technologies, Trifonova and Ronchetti (2003) defined it as e-learning through mobile computational devices. Quinn (2004) defined m-learning as the intersection of mobile computing and e-learning in terms of accessible resources wherever you are; strong search capabilities; rich interaction; powerful support for effective learning; and performance-based assessment. Moreover, the scholar believes that m-learning is an e-learning regardless location and time.

Mirski and Abfalter (2004) defined m-learning as an emerging form of e-learning that offers both teachers and learners the opportunity to interact and gain access to educational material using a mobile devices independent of time and space. Despite Georgieva, Smrikarov, and Georgiev (2005) state that m-learning is based on the use of mobile devices supported with wireless technology to facilitate education anywhere and anytime, Liu and Han (2010) state that "*m-learning presents to be a new education conduit helping people to acquire knowledge and skill in a ubiquitous manner with the support of mobile technologies*".

Nevertheless, several scholars went on to discuss the vision rather than definition. According to Mobilearn Consortium (2006) and McLean (2003); The future of m-learning is to support creation, brokerage, delivery and tracking of learning and information contents; location-dependence, personalization, multimedia, instant messaging and distributed databases.

Several studies reveal the capabilities and limitations of e-learning (Barker, et al., 2005; McLean, 2003; Quinn, 2004; Rekkedal & Dye, 2007). They state that there are great similarities between e-learning and m-learning, one may represent the other with new platform and more sophisticated technologies.

Barker *et al.* (2005) indicated that m-learning is emerging as a portable solution that enables learners to engage in collaborative and interactive learning activities. They argued that using m-learning is appropriate to support group work on projects, engage learners in learning-related activities in diverse physical locations; and to enhance communication and collaborative learning in the classroom.

However, most often m-learning is understood as mobile e-learning, namely the use of wireless technology, particularly mobile devices and mobile internet, to facilitate learning materials and services of education. Therefore, the m-learning services can be classified into two main categories based on the information provided: 1) learning material services and 2) learning administrative services.

2.5.1 Services of m-learning

Mobile learning services have been increased through the capability of the mobile technology itself. However, Georgieva *et al.* (2005) investigated the m-learning systems and classified them into seven divisions based on mobile devices and their capabilities; communication technology used; communication between students and lecturers; access of services whether online or offline (Rekkedal & Dye, 2007); the location of learners; information which comprise learning materials and administrative information; and e-learning standards whether supported or not.

Figure 2.14 shows the Georgieva *et al.* (2005) classifications based on criteria. Furthermore, in more focusing, Patten *et al.* (2006) classified m-learning services into seven distinct categories, namely administrative, referential, interactive, micro-world, data collection, location aware, and collaborative.

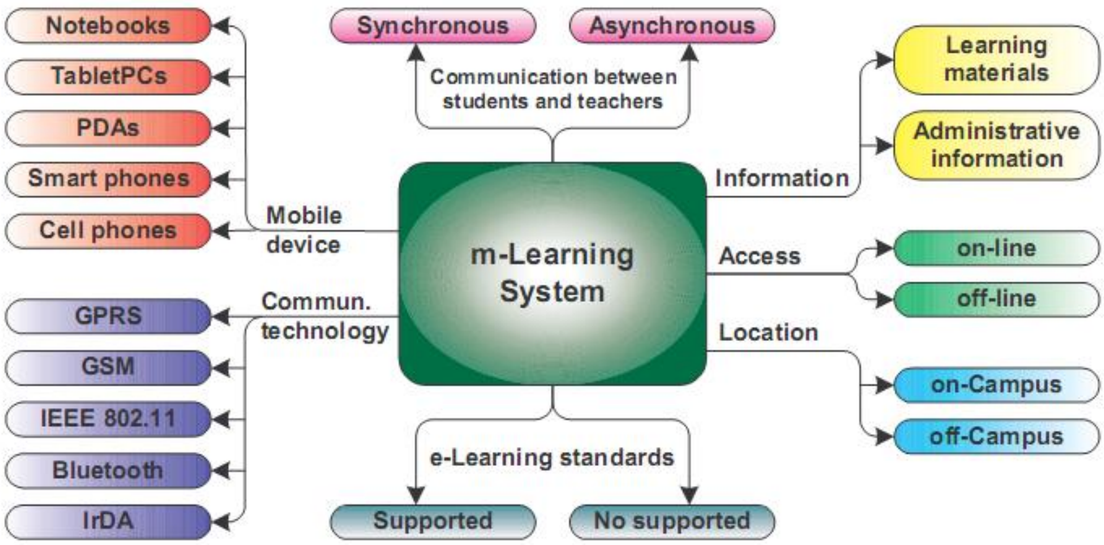

Figure 2.14: A General Classification of M-Learning System
Source: Georgieva et al. (2005)

M-learning provides many advantages including: freedom to study with flexibility (Rekkedal & Dye, 2007), low cost, timely application (Triantafillou, et al., 2006), improvement experiential, authentic and reliable learning situations, enhanced availability of guidance, ease of use, support in learning situations (Alzaza, 2007), fast production of digital learning materials and copyright issues, and flexibility of learning (Seppala, et al., 2002). Moreover, mobile technology offer a new generation of learning for people of all ages anywhere and anytime (Sharples, et al., 2002).

Anderson (2005) presented the distance learning engaged in cooperative learning activities. The study concluded that social software needs to increase the effort to find out new effective tools to develop and enhance the creation and maintenance of social presence in education. Indeed, learning type's evolution developed from traditional face to face learning to be m-learning through Computer Supported Collaborative Learning (CSCL) (Yordanova, 2007), this evolution series is shown in Figure 2.15.

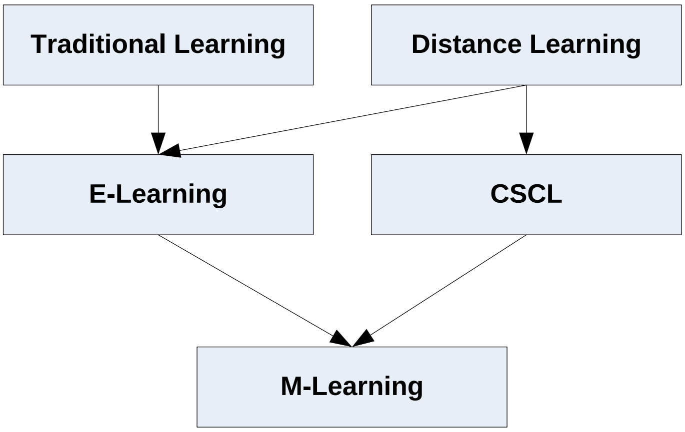

Figure 2.15: Learning Evolution Series

Rekkedal and Dye (2007) determined acceptable m-learning solutions that access and interact with university learning materials and for lecture-student, student-lecture, and student-student communication. They depended on the view states that *"learning is an individual process that can be supported by adequate interaction and/or collaboration in groups".* However, Mulliah (2006) titled the most three advantages of m-learning over conventional form and e-learning that are:

i. Convenience: Students can access and study their learning materials anytime and anywhere.

ii. Fun: Many m-learning applications adopt the guise of console games (edu-games) to engage the learners.

iii. Collaboration: Lightweight communication protocols, like SMS and chat, make collaboration and peer learning a very natural activity in the m-learning context.

A survey conducted at Sofia University about the student's attitude towards the m-learning and its integration in education environment among students. Bachelor of Science (B.Sc.) and Master of Science (M.Sc.) programs were involved at age 19 to 26 years old. The study found that 62% appreciate the concept of mobile learning very highly, 10% high, 15% middle, and 3% low. While only 10% of the respondents do not have the idea at all (Yordanova, 2007).

Despite the revolution of communication and computing technology, Seppala *et al.* (2002) found that no detailed discussion of the design of the m-learning. However, they designed and implemented a prototype enables children to capture learning events in the field, to annotate, share and organize them into resources for learning, and to communicate directly with other learners or teachers; using mobile technology (Sharples, et al., 2002).

According to Karim, Darus, and Hussin (2006) mobile services in Malaysian educational environment concern on information delivery via SMS. The information consists of admission status, course registrations, and examination results. Furthermore, Ismail *et al.* (2010) investigated the adoption of m-learning in one of the Malaysian higher institution. Study found that m-learning services such as SMS were very helpful for the students.

Al-Mushasha and Hasan (2007) investigated the student's perception toward the m-learning services. The scholars found that m-learning should provide support information platform and e-learning. They summed up such supporting services as follow:

i. Timetables, abstracts of lectures, messages and notes, carry out tests, questionnaires and results, Present briefly and clearly the information about subjects;
ii. Ensure fast and convenient access to learning materials suitable for the resources of the mobile device;
iii. Regularly to send information via SMS/MMS about news or announcements;
iv. Ensure closer and faster connection between students and teachers; and with other e-learning systems.

Yordanova (2007) discussed the integration of advanced technology and mobile technology in education in order to provide effective learning services as well as high quality. The study investigated the main elements of m-learning which are mobile technology, mobile devices, wireless application protocol (WAP), wireless language (WML), wireless applications, and wearable computing.

Corlett *et al.* (2005) investigated the student side of m-learning while Seppala *et al.* (2002) investigated teacher side. However, both studies argue that mobile technology offers an opportunity to improve the students learning experience and to provide a new dimension to acquire more knowledge during studying period. In addition, they indicated that teachers and students need to more training on the use of mobile technology in order to achieve the maximum benefit introduced for education. Corlett *et al.* (2005) provide a prototype application that enables students to access course material, view their timetables, communicate via email and instance messaging and organize their ideas and notes. They found course work tool has the most impact on the learning despite it has the lower perceived of usefulness.

Although Corlett *et al.* (2005) found that only a few students used the PDAs for their own personal activities, students had adapted them with mobile technology capabilities through the time usage. Meng, Chu, and Zhang (2004) provide a prototype that enables teachers and students to discuss with each other through PDAs or Personal Computers (PCs). Their prototype provides some beneficial services including shared whiteboard, online presentation and user management permissions.

Furthermore, Meng *et al.* (2004) provided a vital idea that enables mobile developers to transform conventional web pages into mobile web pages. However, their study needs more enhancements since they used an old technology that depends on Java Applet, which is not widely used in mobile devices like smart phones and PDAs.

Alzaza and Zulkifli (2007) provided a prototype that helps students to access library loan services through mobile devices. They found that there is a significant difference between novice and expert users for Usefulness and Ease of Use, while no significant difference for Outcome/Future Use of their prototype. Kadirire (2007) provided an Instant Message (IM) prototype that enables students to communicate with each others. The prototype detects various types of mobile devices then adapts the content to fit the particular devices capability. Kadirire (2007) argued that IM is becoming widespread in universities and is encouraging learners to become more engaged. However, IM is now being used for online discussions, chatting, file transfer, library access, and usage. Some of the IM applications widely used such as AOL Instant Messenger, MSN Messenger, Yahoo Messenger, Google Talk, and Skype.

Rekkedal and Dye (2007) investigated in comprehensive a project for Norwegian Knowledge Institute (NKI) that includes three intervals, which are from e-learning to m-learning (2000-2003), mobile learning (2003-2005), and the ongoing project, incorporating m-learning into mainstream education (2005-2007). The authors determined the specifications and characteristic of m-learning services that can provide via m-learning (see Table 2.6). The services based on the content of student course; ability to access the coursework functions; communication between learners and tutor using synchronous or asynchronous means; academic issues and rules; and the navigation issues and capabilities.

Sharples *et al.* (2002) aimed to design human-centered systems that are based on sound understanding of how people think, learn, perceive, work, communicate, and interact. The participants of evaluation suggested improving the interface of prototype and stated some hardware problems that include device weight and short battery life. Nevertheless, Barker *et al.* (2005) highlighted some considerations that need to be taken into account when exploring the adoption of m-learning range from limitations of the wireless technologies themselves, to broader issues such as safety, security, and training.

Table 2.6

Specifications and Characteristic of M-learning Services

Service	Services provided
Course content	• archive course content • provide easy navigation • provide a zoom function
Access to courseware	• provide access to online resources such as libraries, references, glossaries, exams, databases, and to course planning tools and calendars • submit assignments • allowed to comment on lecturer • Access class set (students) information • questions using multiple choices • drag-and-drop test/ exercises • support multimedia such as graphics, audio and video, moving, and images • access to library and search engines
Communication	• access to online synchronous communication tools such as chat • access to asynchronous communication tools such as email, SMS, and MMS • Access course forums
Academic issues	• enroll in a course online • changing passwords or email addresses • access to technical support services, frequently asked questions, and contact information • Access to general study information such as exam dates, course syllabus, and regulations
Navigation issues	• site map should also be provided for easy navigation • users should be able to print from their mobile devices • Storage space to upload and store personal files • Text-to-speech options

2.5.2 Limitations of m-learning

Limitations of m-learning services is considered as one of the issues that should be taken of care and be aware when discussing m-learning implementation. Nevertheless, many of these limitation issues also exist in the e-learning industry but they are more crucial in the m-learning space because of the current limited technological capacity.

Moreover, Triantafillou *et al.* (2006) and Barker *et al.* (2005) maintained that using mobile technology in education is generally cheaper than conventional technology. Hence, mobile technology may concern the current choice as well as the future choice, to enhance education services.

Several studies (Corlett, et al., 2005; Rekkedal & Dye, 2007; Seppala, et al., 2002) noted that mobile devices have some limitations including: memory size, battery life, high line cost, small screen, small and limited keyboard. These limitations can hinder using mobile technology widely in learning. Nevertheless, Corlett *et al.* (2005) gave directions to extend the wireless network across the campus and to redesign software and hardware for m-learning purpose. Hence, university environment will be adequate to utilize the latest technology innovation without delay (Seppala, et al., 2002).

For life-long learning, Yordanova (2007) noted that the most three problems related to use mobile technology in education are the student acceptance; characteristics of mobile technologies and limited mobile devices display; the third problem is the privacy and confidential of user data.

McLean (2003) titled some of obstacles that face community to implement significant m-learning application, based on the present limitation of mobile technology that comprise:

- Limited memory and storage are major inhibitors.
- Screens are generally too small for using sophisticated applications.
- Intermittent connectivity is a major barrier.
- Cross-platform solutions are not yet possible.
- The industry is plagued by proprietary solutions.
- Existing applications are not easily integrated to the mobile technology environment.
- Start-up costs are invariably high.
- Security is a major issue.
- Cost of accessing major third-party networks is punitive.
- Multiple permissions are necessary in terms of negotiated access.
- Continuous technology development militates against stability and sustainability in terms of mounting viable m-learning applications.

However, m-learning can be considered a life-long activity that can take place in changing communities and mixed with everyday life situations where people repeatedly enhance their knowledge and skills (Sharples, 2000). In a survey of young adults (16–24 years) use of mobile phones in the UK, almost half expressed an interest in using mobile phone to improve their reading, spelling, and math's or language skills. Although only (50%) currently use palmtops, (55%) stated that they might use it under lower prices conditions (Learning and Skills Development Agency, 2003).

Developments in telecommunication technology provide new facilities and interfaces for students and staff of universities. In order to improve the organizational infrastructure for students and staff, every new technology arriving to the market has to be investigated for its benefit for daily use. In the case of the WAP, the consortium of Mobile Services for Campus and Student needs "Campus Mobile" was founded in order to investigate innovative services (Kalkbrenner & Nebojsa, 2001).

Broadly, using m-learning at educational institutions can be beneficial to all involved, provided the necessary guidelines and policies (Barker, et al., 2005).

2.5.3 The Implication of Mobile Learning Services in the Higher Education on the Research

After reviewing the m-learning services in the higher education environment, the researcher found that the informative m-learning services are the most successive and interest for students. However, this classification of services meets the limitations and capabilities of the mobile devices such as mobile phones, smart phones, and PDAs.

Moreover, m-learning needs to tackle the obstacles that are preventing students' motivation to use such technology and it becomes much clearer to the researcher that there is indeed a need to identify the factors that should be considered when utilizing such technology in the higher education environment.

2.6 Adoption and Diffusion Theories

Technology diffusion is an important area of academic research and it has been a valuable to understand the factor succeed implementation (Grantham & Tsekouras, 2005; Williams, 2009). The starting point of the Critical Success Factors (CSFs) research was a paper of Daniel (1961) who analyzed some critical factors in context of management information systems. The concept itself can be defined as follows: A success factor is a factor which has a sustainable and positive effect on the success of a company or organization. By using these factors a competitive advantage could be realized (Feng, et al., 2006). Because, however, there are many different potential success factors, the academic research in this field is only interested in the most critical ones.

Understanding the determinants of student acceptance of m-learning will provide important theoretical contributions to the area of online learning and lead to the development of more effective and meaningful m-learning services for higher education environment.

Nevertheless, over the past on two decades, several theories were developed to study and explain the user intention or acceptance to use new technology that has been recognized since the mid-1980s. The theories that most popular and influential such as Theory of Reasoned Action (TRA) that proposed by Ajzen and Fishbein (1980), Technology Acceptance Model (TAM) proposed by Davis (1989), Theory of Planned Behavior (TPB) proposed by Ajzen (1985, 1991), Innovation Diffusion

Theory (IDT) propose by Rogers (1995), extended TAM or TAM2 proposed by Venkatesh and Davis (2000) and most recently, the Unified Theory of Acceptance and Use of Technology model (UTAUT) proposed by Venkatesh, Morris, Davis, and Davis (2003).

The above theories have some common factors and similarities. Furthermore, Social factors are similar to subjective norms in TRA and TPB (Jairak, Praneetpolgrang, & Mekhabunchakij, 2009). TPB posits that individual behavior is driven by behavioral intentions where behavioral intentions are a function of an individual's attitude toward the behavior, the subjective norms surrounding the performance of the behavior, and the individual's perception of the ease with which the behavior can be performed (behavioral control). Furthermore, TPB is based on cognitive processing and level of behavior change. Compared to affective processing models, TPB overlooks emotional variables such as risk, fear, mood and negative or positive feeling and assessed them in a limited fashion (Sniehotta, 2009). In particular, in the students' behavior situation, given that most individuals' acceptance behaviors are influenced by their personal emotion and affect-laden nature, this is an influential drawback for predicting students' behaviors.

Venkatesh *et al.* (2003) summarized and reviewed the most eight models that have been used to examine the factors of user acceptance of the new technology. They found that the basic conceptual framework underlying the class of models explaining individual acceptance of information technology comprises individual reactions to using information technology, intentions to use Information technology, and actual use of information technology with some kind of relation presented in Figure 2.16.

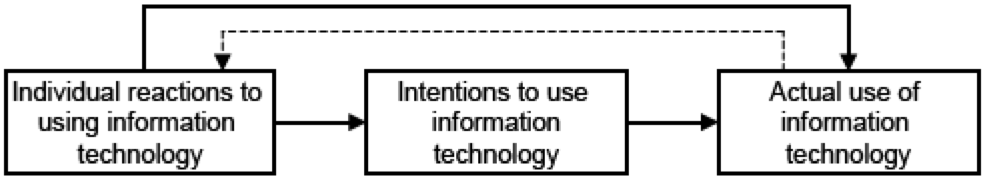

Figure 2.16: Based Concept Underlying User Acceptance Models
Source: Venkatesh et al. (2003)

In Table 2.7 Liu and Han (2010) summarized the adoption research on m-learning service and technology-mediated learning.

Table 2.7
Summary of the Adoption Research on M-learning Services

Author	IS applications	Samples	Results
Ju *et al.* (2007)	M-learning	245 university students	Perceived self efficacy significantly influences perceived ease of use, which positively impacts perceived usefulness. Perceived usefulness significantly affects users' attitude which further impacts the intention to use m-learning
Huang *et al.* (2007)	M-learning	313 university students	Individual differences have a great impact on user acceptance in which the perceived enjoyment and PMV can predict users' intention of using m-learning
Wang *et al.* (2009)	M-learning	330 useful responses from five organizations	Performance expectancy, effort expectancy, social influence, perceived playfulness, and self-management significantly impact behavioral intention

Author	IS applications	Samples	Results
Liu (2008)	M-learning	A conceptual model	Based on the basic structures of UTAUT, a model is proposed with an integration of self-efficacy, mobility, attainment value, perceived enjoyment, and self-management of learning, to explain learners' behavior intention
Phuangthong and Malisawan (2005)	M-learning	Preliminary research with 385 responses	In addition to basic constructs of TAM, perceived enjoyment was included to explain users' behavior
Liao and Lu (2008)	E-learning websites	137 university students	Perceptions of relative advantage and compatibility are significantly related to users' intention to the use of e-learning; prior experience affects learners' adoption of technology
Liaw (2008)	Blackboard e-learning system	424 university students	Perceived self-efficacy is a critical factor affecting learners' satisfaction while perceived usefulness and perceived satisfaction impact learners' behavioral intention to use the e-learning system
Saade *et al.* (2007)	Multimedia learning	362 students	TAM is found to be a solid theoretical model where its validity can be extended to multimedia and e-learning contexts
Shih (2008)	Web-based learning	350 part-time students	This study concludes that learners' efficacy control and efficacy expectations can be used

Author	IS applications	Samples	Results
			to guide their adaptation learning behaviors on the web
Chiu and Wang (2008)	Web-based learning	286 part-time students	Performance expectancy, effort expectancy, computer self-efficacy, attainment value, utility value, and intrinsic value were significant predictors of individuals' intentions to continue the use of web-based learning while anxiety had a negative effect
Chiu *et al.* (2007)	Web-based learning	221 students of a web-based learning program	Attainment value, utility value, intrinsic value, distributive fairness, and interactional fairness are predictors for learners' satisfaction, while utility value and satisfaction exhibited significant positive effects in shaping learners' intention to continue using web-based learning
Chiu *et al.* (2005)	E-learning	189 students using e-learning services	The result suggest that perceived usability, perceived quality, perceived value, and usability disconfirmation impact perceived satisfaction while perceived satisfaction determine users' continuance intention to use e-learning
Eom and Wen (2006)	Online education	397 students enrolled in web-based courses	The research found that course structure, self-motivation, learning styles, instructor knowledge and facilitation, interaction, and instructor

Author	IS applications	Samples	Results
			feedback significantly influenced students' satisfaction
Lopez-Nicolas *et al.* (2008)	Advanced mobile services	542 valid questionnaires by households	Social factor is found to have an important impact on people's decision to adopt advanced mobile services. The results also suggest that both ease of use and perceived usefulness can be linked to diffusion-related variables, such as social influence and perceived benefits
Koivumaki *et al.* (2008)	Mobile services	243 service users	Whilst duration of the use does not effect consumers' perceptions of mobile services, the familiarity of the device and user skills have an impact on the perceptions of the services
Kargin and Basoglu (2007)	Mobile services	A qualitative research with 12 interviewees	Ease of use and usefulness are the most significant factors in mobile service adoption. Content and mobility are dominant factors from a service perspective while social influence is also important
Carlsson *et al.* (2006b)	Mobile services	300 Finnish consumers	Performance and effort expectancies are found as predictors for behavioral intention, but the social influence cannot be used as predictor
Shin (2007)	Mobile internet	986 adult Koreans	Perceived quality and perceived availability are found to have significant influence on users' extrinsic and intrinsic motivation to use mobile internet in Korea

Author	IS applications	Samples	Results
Cheong and Park (2005)	Mobile internet	1,279 replies from an online survey	The research identified the positive impact of perceived playfulness and the negative impact of perceived price level in forming the attitude and adoption intention. Perceived content and system quality are positively affecting the perceived usefulness. In addition, there is a causal relationship between internet experience and perceived ease of use
Lu *et al.* (2005)	Wireless internet services	357 MBA students	The research revealed strong relationships between personal innovativeness and social influences and the perceptual beliefs – usefulness and ease of use, which further affect intentions to adopt innovation
Lu *et al.* (2008)	Wireless mobile data services	1,432 individuals living in five cities in China	The research revealed the importance of perceived usefulness, ease of use, personal innovativeness in IT and mobile trust belief in affecting individuals' intention to use wireless mobile data service

By expanding the Technology Acceptance Model (TAM) and the Innovation Diffusion Theory (IDT), this study aims to provide an integral theoretical paradigm that can successfully support a wide array of technical, administrative, and student issues involved in m-learning.

To achieve this objective, this study chooses to revisit some of the most influential adoption theories. A theoretical model for student acceptance of m-learning will be developed by adapting and expanding the existing adoption theories. These theories and the form of the base model for this study are discussed in the forthcoming section.

2.7 Theoretical Framework and Hypotheses

The theoretical constructs pertinent to this study are consumer (student) acceptance, adoption, and behavior prediction. Two of the well-established adoption and intention models, Technology Acceptance Model (TAM) and Innovation Diffusion Theory (IDT), can help develop a solid theoretical foundation for this study. Both theories are revised in the forthcoming subsections. Williams (2009) concluded that Unified Theory of Acceptance and Use of Technology (UTAUT) model did not provide as much insight into m-learning environment as it had when applied to other technology contexts.

2.7.1 Technology Acceptance Model (TAM)

Theory of Reasoned Action (TRA), proposed by Ajzen and Fishbein (1980), is well-established model that has been used broadly to predict and explain human behavior in various domains (Wu & Wang, 2005). Based on TRA (Wu & Wang, 2005), TAM was designed to explain the determinants of user acceptance of a wide range of end-user computing technologies (F. D. Davis, 1986).

The original TAM consisted of perceived ease of use (PEOU), perceived usefulness (PU), attitude toward using (ATU), behavioral intention to use (BI), and actual system use (AU). PU and PEOU are the two most important determinants for system use. The ATU directly predicts users' BI which determines AU. PEOU refers to the degree to which a user believes that using a particular service would be free of effort while PU is defined as the degree to which an individual perceives that using a particular system would enhance his or her job performance (Fred D. Davis, 1989). However, PEOU and PU are the key beliefs leading to user acceptance of information technology (Liu & Han, 2010).

Venkatesh and Davis (2000) proposed an extension, TAM2, which included social influence processes (subjective norm, voluntarism, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and PEOU), but it omitted ATU due to weak predictors of either BI or AU. This is consistent with the prior research findings by Taylor and Todd (1995a; 1995b). Their research indicated that both social influence processes and cognitive instrumental processes significantly influenced user acceptance and that PU and PEOU indirectly influenced AU through BI.

2.7.2 Innovation Diffusion Theory (IDT)

IDT is another well established theory for user adoption; it is proposed by Rogers (1962, 1983, 1995, 2003). Innovation diffusion is achieved through users' acceptance and use of new ideas or things (Zaltman & Stiff, 1973). The theory explains, among many things, the process of the innovation decision process, the determinants of rate of adoption, and various categories of adopters, and it helps predict the likelihood and the rate of an innovation being adopted. Rogers (1995) stated that an innovation's relative advantage, compatibility, complexity, triability and observability were found to explain 49 to 87 percent of the variance in the rate of its adoption.

i. *Relative advantage* is the degree to which an innovation is perceived as being better than the idea it replace.
ii. *Compatibility* is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters.
iii. *Complexity* is the degree to which an innovation is perceived as relatively difficult to understand and use. In general, more complex, or less well understood innovations are more difficult to adopt.
iv. *Triability* is the degree to which an innovation may be experimented with on a limited basis. Adoption becomes much easier if adopter can try an innovation on a small scale.
v. *Observability* is the degree to which the results of an innovation are visible to others. The rate of adoption increases with visibility.

These characteristics are used to explain the user adoption and decision making process (Wu & Wang, 2005). They are also used to predict the implementation of new technological innovations and clarify how these variables interact with one another. The central concept of innovation diffusion is "the process in which an innovation is communicated through certain channels, over time, among the members of a social system" (Rogers, 1995, 2003). However, several researches

(Agarwal & Prasa, 1998; Tornatzky & Klein, 1982) have suggested that only relative advantage, compatibility and complexity are consistently related to the rate of innovation adoption.

2.7.3 Combination of Tam2 and IDT Models

TAM and IDT are among the most influential theories in explaining and predicting system use and innovation adoption. They are chosen as the base theories for this study because both theories have been proven highly successful in empirical studies (e.g. (Igbaria, Guimaraes, & Gordon, 1995; Igbaria, Zinatelli, Cragg, & Cavaye, 1997; Karahanna, Straub, & Chervany, 1999; G.C. Moore & Benbasat, 1996; S. Taylor & P. Todd, 1995)). TAM, especially, has been often used to study the acceptance of Internet applications (e.g. (D. Gefen & Straub, 2000; David Gefen & Straub, 1997)). Therefore, these theories are well versed to study the Electronic Commerce (EC) and Internet application adoption, and they provide this study with a strong theoretical foundation. Originating from different disciplines, TAM and IDT have some obvious resemblances. The relative advantage construct in IDT is often viewed as the equivalent of PU construct in TAM, and the complexity construct in IDT is very similar to PEOU concept in TAM (Moore & Benbasat, 1991; Wu & Wang, 2005). However, some scholars combined both, TAM and IDT, in their studies. while Chen, Gillenson, and Sherrell (2004) combined the original TAM with the compatibility construct of IDT to evaluate and explain consumer behavior in the virtual store context, Wu and Wang (2005) combined TAM2 with IDT. The compatibility construct of IDT and two more Factors that are Cost and Perceived

Risk to investigate what determined user Mobile Commerce (MC) perception and acceptance.

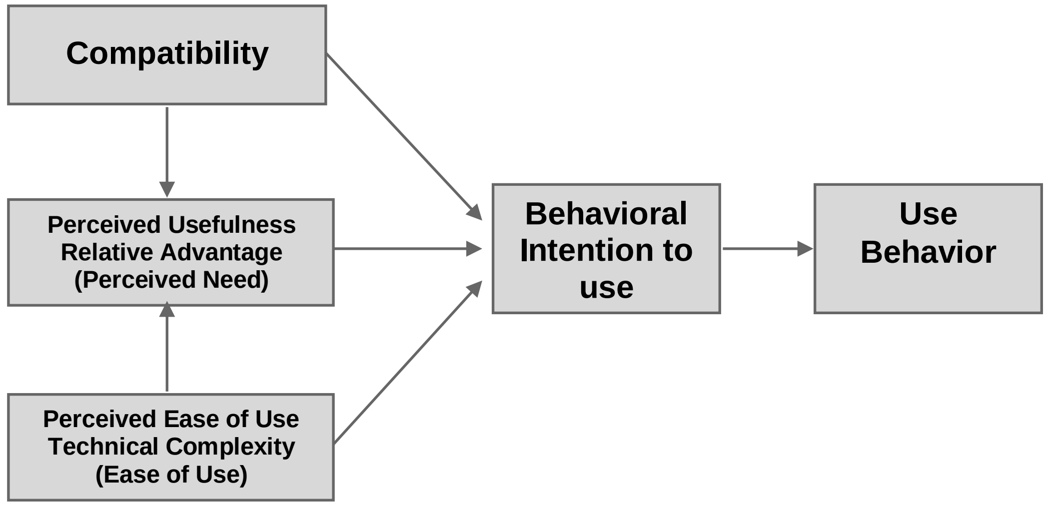

Figure 2.17: Based Model for Student Acceptance of m-learning

Based on TAM and IDT models, the base model for studying student acceptance of m-learning services is displayed in Figure 2.17. Empirical studies have suggested that TAM be integrated with other acceptance and diffusion theories to improve its predictive and explanatory power (e.g. (Hu, Chau, Sheng, & Tam, 1999; Wu & Wang, 2005)). By including the compatibility (C) construct of IDT, the model is able to address the social context in which m-learning takes place. C is evaluated by assessing the innovation's compatibility with existing values and beliefs, previously introduced ideas, and potential adopters' needs (Rogers, 2003). Like PEOU, C is suspected to have a significant impact on PU. The rationale behind this assumption is that if a student finds using an m-learning service compatible with his or her needs and lifestyle, the student will consider the m-learning services useful.

It also needs to be noted that although initial acceptance of an m-learning service is important, the student's continuance in using the m-learning service is equally, if not more, important. As an extension to the TAM research, the number of studies has addressed the important issue of Information System (IS) continuance in the recent few years. Parthasarathy and Bhattacherjee's (1998) work profiled potential discontinuity of a technology. They suggested that the potential factors of discontinuity could be identified based on the sources of the influence for users initial adoption (interpersonal), perceived usefulness, perceived compatibility, service utilization, and the usage of complementary product.

Adopting the Expectation-Confirmation theory, Bhattacherjee (2001) empirically proved that the decision of IS continuance was influenced by the user's satisfaction with the IS, which was a direct result of the confirmation or disconfirmation of the user's expectation. By the same token, students who will potentially discontinue using an m-learning service can be identified based on their confirmation / satisfaction and usage level of the m-learning service during the initial adoption.

The strong theoretical and empirical support for TAM and IDT ensures the validity of the base model in electronic commerce domain; however, the base model possesses a weakness inherited from TAM. While TAM has been very successful in predicting the potential user acceptance, it provides little assistance in the design and development of systems with a high level of acceptance. One remedy for this weakness is to identify the determinants of PU, PEOU, and BI to supply system designers with meaningful solutions (V. Venkatesh & Davis, 1996). These determinants can also be used to help identify the student's confirmation and satisfaction level of an m-learning service, which has significant implications on predicting the student's continuance of usage. Hence, the next step in this study is to identify a list of students' acceptance factors that m-learning services need to focus on. The factors outlined in the next section will be incorporated in the final research model and will be tested for validity.

2.7.4 Research Model Factors

M-learning needs to tackle the obstacles that are preventing students' motivation to use such technology. This study takes the CSF approach to identify the key areas where things must go right for the m-learning to flourish. Identifying CSFs is a well-accepted practice that allows businesses to focus on a limited number of areas in which satisfactory results ensure successful competitive performance (Digman, 1990).

Leidecker and Bruno (1984) proposed several techniques for identifying CSFs. They include environment scanning, industry structure analysis, opinions of experts in the industry, analysis of competitors, analysis of the industry's dominant firm, a specific assessment of the company, intuitive judgment or "feel" of insiders, and profit impact of market strategy (PIMS) data. When analyzing the CSFs for m-learning, the opinions of experts in the industry and education environment will be employed by reviewing a large quantity of electronic commerce literature and cases. The analysis rendered five CSFs for m-learning: perceived service quality, perceived trust, facilitating condition, cost of service, and experience. The potential CSFs are incorporated as the antecedents of student acceptance of m-learning in the final research model, and their validity will be empirically tested later in the study.

Although most of the CSFs proposed here have appeared in prior research, no single study has integrated these factors in one comprehensive model to examine the complex relationships between these CSFs and student acceptance of m-learning. Furthermore, the empirical evidence supplied by this research will shed new lights on how student can be enticed by m-learning. The five proposed CSFs are defined in the forthcoming section.

2.7.4.1 Perceived Service Quality

Perceived service quality is a recurring research issue for IS discipline. Service quality is crucial to its success. Perceived service quality is defined as the discrepancy between what customers (students) expect and what customers (students) get. It is also acknowledged as one of the measures of IS success (Pitt, Watson, & Kavan, 1995). Currently, m-learning courses and products are mostly sold as a kind of education products, such as in USA and China. M-learning users therefore gain a role as consumers as well. For customers perceived quality of products or services impacts customer’s intentions to use them. Perceived quality is defined by Zeithaml (1988) as “the consumer’s judgment about a product’s overall excellence or superiority”. Quality research tends to be most important stream of services research.

Parasuraman *et al.*, (1988) identified five dimensions which consumers use to evaluate service quality. They are tangibles, reliability, responsiveness, assurance, and empathy. These five dimensions are translated into the m-learning services context as follows.

i. Tangibles: The conventional facilities provided by an m-learning service (the appearance of the m-learning, the existence of online and offline service facilities).
ii. Reliability: An m-learning's ability to perform the promised action dependably and accurately (i.e. on time and updated information).
iii. Responsiveness: An m-learning's willingness to offer help to its user on a timely fashion (e.g. quick responses to students' inquiries).
iv. Assurance: An m-learning's ability to inspire trust and confidence.
v. Empathy: The caring and individualized attention given to its user by m-learning (e.g. personalized messages and announcements).

Service quality has an affects users' acceptance intention. Furthermore, it has a positive causal relationship between the perceived overall service quality and a user's satisfaction towards a web portable (Liu & Han, 2010). Chiu, Hsu, Sun, Lin, and Sun (2005) and Liaw (2008) found that perceived quality is a significant predictor of perceived satisfaction with e-learning.

Gefen and Devine (2001) found that service quality effectively reduces the effects of perceived risk, cost to switch and relative price, thus creates more attention for m-learning usage. However, the quality of m-learning delivered would affect the perceived quality of services as a whole (Liu & Han, 2010).

Therefore, the perceived service quality is an important determinant of students' attitude towards using m-learning.

2.7.4.2 Perceived Trust

A number of studies suggest that the reason why many people have not yet used online services is due to the lack of trust in online businesses (L. Chen, et al., 2004; D. Gefen, 2000; Hoffman, Novak, & Peralta, 1999). However, user trust can be defined as feeling secure and confidence about relying on service. In the mobile services environment trust get an important factor for user to accept it (Kaasinen, 2007). Moreover, it has a positive influence on the development of positive user intention to use (L. Chen, et al., 2004). Gefen (2000) found that familiarity, which was defined as an understanding of what, why, where, and when other parties do what they do, also contributes to trust in e-commerce situations.

Moreover, Prior research suggested that trust can be built up through interactions. In the context of m-learning, the influencing factors for students' lack of trust in wireless technology are found to be personal information privacy and data security concerns. According to a survey conducted in 1999, privacy is the number-one consumer issue facing the Internet (Benassi, 1999).

Hoffman *et al.* (1999) suggested that personal information privacy concerns are represented in two dimensions: environment control and secondary use of information control. Environment control refers to consumers' ability to control the action of m-learning services, and secondary use of information control refers to consumers' ability to apply control over m-learning service's use of the information for other purposes. When these two controls are perceived to be low, consumers are leery about giving personal information over the Web. Students' lack of trust is also partly due to their data security concerns. Information sent over the Internet travels through many unsecured computer systems, and it is at risk of interception and misuse. Many consumers are still hesitant about transmitting private information, especially financial information, over this open electronic network. Nevertheless, generally, m-commerce customers require more assurance of privacy protection and more control over the personal information that can be released (Khalifa & Shen, 2006).

However, if m-learning is not able to effectively demonstrate its commitment to superior data security technologies, few students will feel comfortable entrusting the m-learning services with their sensitive information. Information exchange in a trustful environment is an essential part of electronic commerce (L. Chen, et al., 2004). Student trust can only be inspired if the risks associated with wireless connection are reduced to a level that is tolerable to students.

The theory of perceived risk has been applied to explain consumer’s behavior in decision making since the 1960s (Taylor, 1974). The definition of perceived risk has changed since online transactions became popular. In the past, perceived risks were primarily regarded as fraud and product quality. Today, perceived risk refers to certain types of financial, product performance, social, psychological, physical, or time risks when consumers make transactions online (Forsythe & Shi, 2003).

Credit ratings, bank balances and financial data could be changed without the owner knowing during online transactions. Some users perceive potential risks from immature technology. Others hesitate before trusting online transactions and other activities. The reliability of online transactions is still far from perfect.

Cognitive and affective factors are important variables that prevent people from trusting online services. Other research also indicated that perceived risk is an important determinant of consumers' attitude toward online transactions (Cho, 2004). Since intention to use the m-learning services involves a certain degree of uncertainty, perceived risk is incorporated as a direct antecedent of behavioral intention to use. However, Kaasinen (2007) emphasized that the trust factor is an important factor for measuring the user acceptance of mobile services. Users should be made aware of the possible risks of utilizing such services to identify their reliability of services provided. Moreover, Kaasinen (2005) studied the user acceptance based on the human-centered design approach. The author proposed a technology acceptance model for mobile services. The model comprises four factors that are perceived value (usefulness), perceived ease of use, trust, and perceived ease of adoption.

2.7.4.3 Facilitating Condition

Facilitating conditions are defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system. This definition captures concepts embodied by three different constructs: perceived behavioral control, facilitating conditions, and compatibility (Viswanath Venkatesh, et al., 2003). Each of these constructs is operationalized to include aspects of the technological and/or organizational environment that are designed to remove barriers to use. Taylor and Todd (1995) acknowledged the theoretical overlap by modeling facilitating conditions as a core component of perceived behavioral control in Theory of Planned Behavior (TPB)/DTPB. The compatibility construct from IDT incorporates items that tap the fit between the individual's work style and the use of the system in the organization.

The empirical results of Venkatesh *et al.* (2003) study indicated that facilitating conditions do have a direct influence on usage beyond that explained by behavioral intentions alone. Moreover, their study found that there is no significant influence on behavioral intention to use. Consistent with TPB/DTPB, facilitating conditions are also modeled as a direct antecedent of usage.

2.7.4.4 Cost of Service

According to behavioral decision theory, the cost-benefit pattern is significant to both perceived usefulness and ease of use. Chen and Hitt (2002) pointed out that consumers must deal with non-negligible costs in switching between different brands of products or relative services in various markets. Transitioning from wired Electronic Commerce (EC) to MC implies some additional expenses. Equipment costs, access cost, and transaction fees are three important components (Constantinides, 2002) that make MC use more expensive than wired EC. Furthermore, frustrating experiences, such as slow connections, poor quality, out-of-date content, missing links, and errors have infuriated online users. Unfortunately, consumers must pay for all these frustrations.

Undoubtedly, the anticipation is that these early investments will lead to a long-term stream of profits from loyal customers, and that this will make up for the expense. Otherwise, MC will not thrive because users can obtain the same information or results through alternative solutions (Wu & Wang, 2005).

Khalifa and Shen (2006) investigated the influence of services' price on potential adopters of m-commerce, they noted that m-commerce providers need to pay particular attention to their pricing strategy. Furthermore, Chiu and Wang (2008) found that cost of service has a major influence on students' learning behaviors adoption. Indeed, "adopters of m-commerce are highly sensitive to the issues of cost and privacy" (Khalifa & Shen, 2006). However, Wu and Wang (2005) concluded that although cost is one of major concerns in the initial stage, it has the less influence on users' behavioral intent than perceived risk, compatibility, and perceived usefulness. Furthermore, they provided some explanations for this based on the interviewed users as follow: (1) when there is an emergency or sudden need; the MC utility benefits will definitely outweigh the factor of cost. (2) Although the expenses for using MC are higher than Internet EC, users are still able to afford it.

2.7.5 Research Hypotheses

The five potential CSFs are incorporated with the base model to form the final research model for this study (see Figure 2.18). This study intends to develop a theoretical model for explaining and predicting student acceptance and use of m-learning services in the higher education environment. The model adopts TAM's and IDT's belief - intention - behavior relationship. It hypothesizes that the use behavior of an m-learning (USE) is immediately determined by a student's behavioral intention to use (BI) (Viswanath Venkatesh, et al., 2003). Based on this, the following hypothesis is proposed:

H1: A student's behavioral intention to use an m-learning service has effect on use behavior of the m-learning services (BI → USE).

This study chose to examine student acceptance of m-learning services by the student's intention to use and use behavior of the m-learning services. This choice was based on the following reasons. First, this study is not only interested in looking at acceptance but the level of acceptance as well, and this is better assessed by the data of use behavior rather than the intention to use alone. Second, the data of use behavior is a good indicator of continued use in the future, which is of great importance to m-learning. As Parthasarathy and Bhattacherjee (1998) found in their research, online service utilization ensured continuance in service adoption. Therefore, both intention to use and actual usage were employed to measure student acceptance of m-learning in this study for these reasons.

The model expands the belief concept in TAM and IDT by including five more constructs: perceived service quality (SQ), perceived Trust (T), facilitating condition (FC), and cost of service (CS). The inclusion of perceived service quality represents the service-oriented aspect of m-learning, and the inclusion of perceived Trust addresses a common concern of students about mobile technology and the Internet in general. The model proposes that PU, PEOU, C, SQ, T, FC, and CS form a student's attitude about an m-learning. Based on this, the following hypotheses are proposed:

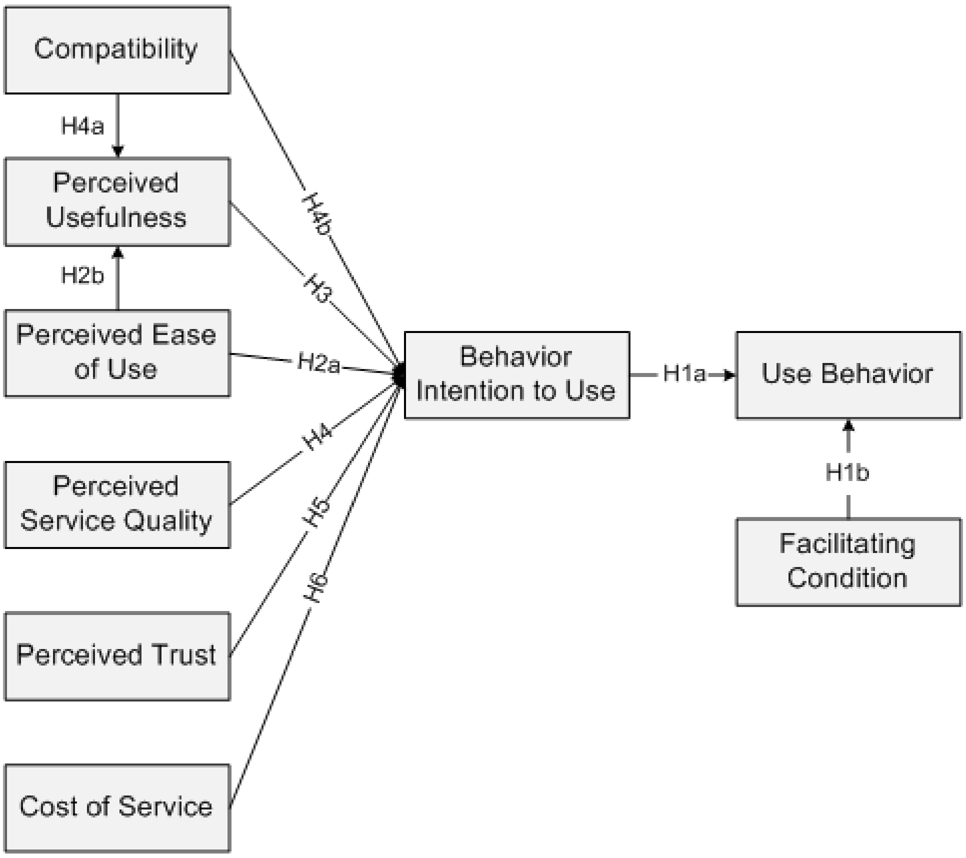

Figure 2.18: Proposed Research Model for Students' Acceptance of m-learning Services

H2a: A student's perceived ease of use of an m-learning service has a direct effect on behavioral intention to use the m-learning service (PEOU → BI).

H2b: A student's perceived ease of use of an m-learning service has a direct effect on perceived usefulness of the m-learning service (PEOU → PU).

H3: A student's perceived usefulness of an m-learning service has a direct effect on behavioral intention to use the m-learning service (PU → BI).

H4a: The compatibility has a direct effect on perceived usefulness of the m-learning service (C → PU).

H4b: The compatibility has a direct effect on behavioral intention to use the m-learning service (C → BI).

H6: A student's perceived service quality of m-learning service has a direct effect on behavioral intention to use the m-learning service (SQ → BI).

H7: A student's perceived Trust has a direct effect on behavioral intention to use the m-learning service (T → BI).

H8: the facilitating condition of m-learning service has a direct effect on actual use of the m-learning services (FC → USE).

H9: The cost of m-learning service has a direct effect on behavioral intention to use the m-learning service (CS → BI).

2.8 Summary

This chapter discussed the background of this research, which was about e-learning in the higher education. From the discussion, there is an evidence that e-learning services have been utilized in the higher education as an alternative form of conventional learning media. E-learning still has some limitations in terms of connectivity and mobility. Wireless technology has been supported and maximized the accessibility of e-learning but such platform of learning still depends on the pc or laptop connected to the internet which limited by the place and the equipment itself. The current limitation of mobility encouraged the researcher to study this issue and to try to find out a viable solution to maximize the mentioned accessibility to be anywhere and anytime. Furthermore, wireless technology was reviewed throughout this chapter whereby the outcome showed that the wireless technology could increase the accessibility of e-learning. Such technology and its elements are suitable to be utilized in education on-campus and off-campus. These benefits of wireless technology advocated and urged the researcher to scrutinize it by which it was engaged into education with its elements and capabilities.

Consequently, after reviewing the mobile technology and its elements, it has become much clearer to the researcher that such technology can be used in the higher education environment in order to provide service of learning for students anywhere regardless the time. Moreover, both of the environment and the infrastructure are appropriate to diffuse and utilize m-learning in the higher education environment. Indeed, the informative m-learning services are the most successive and preferable for students in the higher education environment. On the other hand, this classification of services sets the limitations and capabilities of the mobile devices such as mobile phones, smart phones, and PDAs. Nevertheless, m-learning needs to tackle the obstacles that are preventing students' motivation to use such technology. Therefore, the researcher fully realized that there is indeed a need to identify the factors that should be considered when utilizing such technology in the higher education environment.

The factors of the proposed research model and the theory base are also discussed. Based Model for Student Acceptance of m-learning was constructed based on two theories (TAM and IDT). Finally, the research model was formulated and the hypotheses were proposed.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the methodology of this research. Amongst others, this chapter will elaborate on the study's research design, the population and sample of the research, as well as data collection procedure. This chapter also reports on the pilot test done for the measurement of the students' acceptance model. This chapter ends with a discussion of the statistical techniques that were used to analyze the data.

3.2 Research Design

This research has three different surveys for different research objectives. Therefore, for each questionnaire, there is a specific data collection procedure which is presented in detail. While data collection procedure for students' awareness and requirements of m-learning services is presented in section 3.4.1; data collection procedure for the model of the adoption and use of m-Learning services is presented in section 3.4.2. Furthermore, the data collection procedure for mobile prototype evaluation is presented in chapter six.

However, The Design Science Research Methodology (DSRM) is chosen to precede the prototype development and evaluation as it emphasizes the knowledge generation inherent in the method of development. DSRM was proposed by Vaishnavi and Kuechler (2008). It consists of five phases which are awareness of problem, suggestion, development, evaluation, and conclusion. The procedure and its details are presented in chapter six. Indeed, the main contribution of this research is about the model of adoption and use of m-Learning services.

This research is an experimental type of study and it belongs to Information System (IS) category. Methodology is the philosophy of the research (Nunamaker, Chen, & Purdin, 1991) and in IS field, scholars believe that without system development, research has no used and without research, development has no base (Nunamaker, et al., 1991). A survey method was employed, as it is the most successful adapted to obtain personal and social facts, beliefs, and attitude (Kerlinger & Lee, 2000).

3.3 Study Population and Sample

A purposive (non-probability) sampling method was used in selecting the participants (subjects). The power of purposive sampling lies in selecting information rich-cases for in-depth analysis related to the central issues being studied. Furthermore, purposive sampling is best used with small numbers of individuals / groups who may well be adequate for understanding human perceptions, problems, needs, behavior, and contexts (Commonwealth of Learning, 2000). Nevertheless, purposive sampling can be used with both quantitative and qualitative studies.

In Malaysia, within the sphere of the ministry of higher education's control, there are 20 full-fledged public universities, 21 polytechnics and 37 community colleges in Malaysia today. The public universities can be further divided into four research universities, four comprehensive, and twelve focused universities (Ministry of Higher Education [MOHE], 2011a). Subjects of the study were the students of the five public higher education of Malaysia: UUM, UM, USM, UIAM, and UPM (refer to Table 3.1). The chosen universities cover different geographic areas, for instance, UUM from the north; USM from the east and west. UM, USM, UPM, and UKM are regarded as research universities; UIAM is a comprehensive university; and UUM is a focuses university), and mobile technology coverage (Mustafa, 2009). Furthermore, three of the chosen universities were in the top 100 of the QS Asian university rankings 2010 (topuniversities.com, 2010). UM was the highest ranked at 42, followed by USM at 69. Furthermore, While UPM was at 77, IIUM was at 159.

Table 3.1
Malaysian Universities that are Involved in the Research

Name in English	Official Name in Malay	Acronym
Northern University, Malaysia	Universiti Utara Malaysia	UUM
University of Malaya	Universiti Malaya	UM
Science University, Malaysia	Universiti Sains Malaysia	USM
International Islamic University of Malaysia	Universiti Islam Antarabangsa Malaysia	UIAM
Putra University, Malaysia	Universiti Putra Malaysia	UPM

Table 3.2 shows the enrolment of local, international and disabled students of public higher education of Malaysia by the five Universities in years 2009 – 2010 (Ministry of Higher Education [MOHE], 2011b). Disabled category includes deaf and dumb, blind, hands deformity, legs deformity, paralytic, deaf with device usage and other deformities. The average of increasing percentage is 1.2.

Table 3.2
Enrolment of Local, International and Disabled Students of the Five Universities

University	Year	Local	Inter-national	Disabled	Total	Increase %
UM	2010	24,132	3,208	83	27,423	.5
	2009	24,149	2,925	95	27,169	
USM	2010	24,531	2,474	34	27,039	-.7
	2009	24,984	2,388	30	27,402	
UPM	2010	26,178	2,829	396	29,403	1.8
	2009	25,282	2,622	474	28,378	
UUM	2010	34,416	2,918	11	37,345	2.7
	2009	32,479	2,890	19	35,388	
UIAM	2010	24,537	4,940	23	29,500	1.6
	2009	24,007	4,545	16	28,568	
Total	2010				150,710	
	2009				146,905	

To determine the sample size, the study used the rule of thumb by Roscoe (1975) by multiplying the number of variables by 10. The model of the adoption and use of m-Learning services consisted of nine variables. Therefore, following the rule, the minimum sample size required is 90. However, to ensure this minimal response number, 261 questionnaires were collected for students' awareness and requirements of m-learning services (Appendix A). Consequently, 623 questionnaires were distributed for the model of the adoption and use of m-Learning services (Appendix

B). Both samples were included both undergraduate and postgraduate levels, male and female from distinctive universities and various courses.

3.4 Data Collection Procedure

This section comprises two data collection procedures that are data collection procedure for students' awareness and requirements of m-learning services; then data collection procedure for the model of the adoption and use of m-Learning services.

3.4.1 Data Collection Procedure for Students' Awareness and Requirements of M-learning Services

Both primary and secondary data were collected for this research part. The primary data was collected by distributing questionnaires (survey) to the students of five public Malaysian universities (refer to Table 3.2). Those students are different in terms of their education: Science Business and, Art Studies; and education level: bachelor, Master, PhD. Data collection for this research part (Students' Awareness of m-learning) was undertaken during the second semester of the academic year 2008/2009. The survey was conducted to answer the second research question that is "What are the user requirements towards the use of m-learning in the higher education environment". This preliminary study aims to explore the students' awareness and requirements of mobile learning services among Malaysian students in the higher education environment. The instrument was adapted from Karim *et al.* (2006), Kim *et al.* (2006) and Walton, Childs, and Blenkinsopp (2005). The cover letter accompanying the questionnaire used university stationary in order to increase the credibility of the response rate (Bruvold & Comer, 1988). The cover letter also emphasized the importance of the respondents' answers which could really make a difference between the success and failure of the study (Diamantopoulos & Schlegelmilch, 1996). The letter guaranteed complete confidentiality throughout the entire data collection and processing of the data.

The questionnaires were distributed to the students by hand in the classrooms with cooperation from the lecturers and professors during they stay in the classrooms (Karim, et al., 2006). This method provides a great opportunity to meet with a great number of students under the supervision of their lecturer/professor, which gives an opportunity to motivate and encourage them to cooperate. All the respondents were given a brief about the study and its importance.

The instrument comprises two sections: student's awareness of mobile learning services aspects; and general information (see Appendix A). The first section covers six dimensions that include the following: awareness of mobile learning service aspects; current access to learning resources; mobile technologies for learning services; applications used through mobile technologies; limitations of mobile technologies; and the university mobile services that suggested for using through mobile technologies.

Dimension A contains questions that concerning the awareness of the mobile technologies names. The respondents were given a list of six items to identify their awareness of mobile technology. A five point Likert scale type was used and students were required to state the extent to which mobile technology in their point of view was important or not important for them as students. The scale was anchored by 1= Not Aware, 2= Somewhat Aware, 3= Not Sure, 4= Aware, 5= Very Aware.

Questions in this dimension were adapted from Karim *et al.* (2006) and Walton *et al.* (2005).

Dimension B contains questions about accessing the available learning recourses such as online learning care. Six items were used to measure the respondents' perception towards accessing of online learning resources. Questions in this dimension were adapted from Walton *et al*. (2005).

Dimension C contains questions that targeted at the views on the use of mobile technologies for learning services. Six items were used to measure the respondents' view on the use of mobile technologies for learning services. Questions in this dimension were adapted from Kim *et al.* (2006) and Walton *et al.* (2005).

Dimension D contains questions to determine what applications that would like to use through mobile technologies. The respondents were given a list of six applications that may like to use through mobile technologies. Questions in this dimension were adapted from Walton *et al.* (2005).

Dimension E contains questions that targeted at the views on the limitation of mobile technologies. Thirteen items were used to measure the respondents' view on the limitations of mobile technologies. Questions in this dimension were adapted from Kim *et al.* (2006) and Walton *et al.* (2005).

Nevertheless, a five point Likert scale type was used for Dimensions B, C, D and E and students were required to state the extent to which statement in their point of view were important or not important for them as students. The scale was anchored by 1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree.

Dimension F contains questions to determine what university mobile services that would like to use through mobile technologies. The respondents were given a list of nine services that may like to use through mobile technologies. Participants were given a chance to add more mobile services that they would like to add, other than the nine listed. A five point Likert scale type was used for this dimension. The scale was started from 1= Lowly to 5= highly. Participants were required to state the extent to which services in their point of view were important or not important for them as students. Questions in this dimension were adapted from Karim *et al.* (2006).

The second section (General Information) was not containing any personal or identifiable questions. The general information functions as a mechanism to collect users' demographic data, and users' experience and knowledge with the mobile technology media. The general information used in this section is gender, age, education, education level, own mobile device, mobile devise type, mobile application experience, wireless connection, mobile service provider. This section was adapted from Khalifa and Shen (2006), Karim *et al.* (2006), and Walton *et al.* (2005).

3.4.2 Data Collection Procedure for Model of Acceptance and Use of M-learning Services

Both primary and secondary data were collected for this research part. The primary data was collected by distributing questionnaires (survey) to the students of five public Malaysian universities (refer to Table 3.2). Those students are different in terms of their education: Science Business and, Art Studies; and education level:

bachelor, Master, PhD. Data collection for this research part (i.e. Model's questionnaire) was undertaken during the first semester of the academic year 2009/2010. The survey was conducted to answer the third research question that is "What are the factors that influence the acceptance and use of m-learning in the higher education environment?"

Careful attention was paid to methods for increasing the study's response rate. The key problem with low response rate is the presence of non-response; a situation where non-respondents may differ from respondents. The cover letter accompanying the questionnaire used university stationary in order to increase the credibility of the response rate (Bruvold & Comer, 1988). The cover letter also emphasized the importance of the respondents' answers which could really make a difference between the success and failure of the study (Diamantopoulos & Schlegelmilch, 1996). The letter guaranteed complete confidentiality throughout the entire data collection and processing of the data. The questionnaires were distributed to the students by hand in the classrooms; with cooperation from the lecturers and professors during they stay in the classrooms (Karim, et al., 2006). This method provides a great opportunity to meet with a great number of students under the supervision of their lecturer/professor, which gives an opportunity to motivate and encourage them to cooperate.

Furthermore, to avoid any ambiguity or confusion in the understanding about m-learning services themselves, the m-learning definition was provided and the infrastructure diagram of m-learning were attached with the questionnaires. All the respondents were given a brief about the study and its importance.

The instrument comprises four sections that are general information; using m-learning services; m-learning services acceptance factors; m-learning services (see Appendix B). Some of the sections' items were generated from previous research and modified to fit the context of m-learning when necessary. New items were developed through a thorough literature review on the topics. Section A (General Information) was not containing any personal identifiable questions. The general information functions as a mechanism to collect users' demographic data and users' experience and knowledge with the mobile technology media. The general information used in this section is gender, age, education, current study program, own mobile device, mobile devise type, mobile applications experience, wireless connection used, mobile service provider. This section was adapted from Khalifa and Shen (2006), Karim *et al.* (2006), and Walton *et al.* (2005).

Section B contains questions to determine the m-learning services that often use in the higher education environment. The respondents were given a list of nine services that could be available at their universities. Participants were given a chance to add more mobile services that may use, other than the nine listed. A five point Likert scale type was used and students were required to state the extent to which services in their point of view were important or not important for them as students. The scale was started from 1= Lowly to 5= highly. Questions in this section were adapted from Karim *et al.* (2006).

Section C covers nine subsections that include the following: use behavior, behavior intention to use, perceived usefulness, perceived ease of use, compatibility, perceived service quality, perceived trust, cost of service, facilitating condition. All participants’ answers for subsection should be based on the m-learning services that they have chosen in section B.

Subsection 1 contains questions that targeted at use behavior of m-learning services in the higher education environment. The respondents were given two questions. The first was whether the participant uses m-learning services frequently. A five point Likert scale type was used for the first question. Second question targeted at how often use m-learning services. Respondents were given four frequent periods that are daily, weekly, monthly, and a few times a semester, then they asked to report the approximate number of times they used the m-learning services. Although both questions can be used to as alternative measures for usage; Igbaria, Zinatelli, Cragg, and Cavaye (1997) suggested that frequency provided a different perspective of usage from the actual number of times of use, hence they are both employed in this section to measure actual usage. Questions in this subsection were adapted from Chen *et al.* (2004) with modifications to make them suitable for m-learning services context.

Subsection 2 contains questions that targeted at behavioral intention to use m-learning services in the higher education environment. Four items were used to measure the behavioral intention of respondents towards using of m-learning services in their higher education environment. Questions in this subsection were adapted from Venkatesh *et al.* (2003) with modifications to make them suitable for m-learning services context.

Subsection 3 contains questions concerning the perceived usefulness to use m-learning services in the higher education environment. Six items were used to measure the respondents’ perception towards usefulness to use m-learning services in their higher education environment. Questions in this subsection were adapted from Davis *et al.* (1989) with modifications to make them suitable for m-learning services context.

Subsection 4 contains questions targeted at the perceived ease of use m-learning services in the higher education environment. Six items were used to measure the respondents' perception that used m-learning services in their higher education environment and found them easy to use. Questions in this dimension were adapted from Davis *et al.* (1989) with modifications to make them suitable for m-learning services context.

Subsection 5 contains questions concerning the facilitating conditions of m-learning services in the higher education environment. Four items were used to measure the respondents' perception towards availability of the facilities needed for actual use of m-learning services in their higher education environment. Questions in this subsection were adapted from Venkatesh *et al.* (2003) with modifications to make them suitable for m-learning services context.

Subsection 6 contains questions targeted at the compatibility of m-learning services in the higher education environment. Three items were used to measure the degree to which using m-learning services is compatible with the most aspects of their education purposes and information seeking; their lifestyles, and their engaging in the higher education environment. Questions in this subsection were adapted from Chen *et al.* (2004) and Moore and Benbasat (1991) with modifications to make them suitable for m-learning services context.

Subsection 7 contains questions targeted at the perceived service quality of m-learning services in the higher education environment. Twelve items were used to measure the performance based of using m-learning services in the higher education environment. This subsection reflects five dimensions with which respondents use to evaluate service quality: tangibles, reliability, responsiveness, assurance, and empathy. Questions in this subsection were adapted from Chen *et al.* (2004) and Cronin and Taylor (1992) with modifications to make them suitable for m-learning services context.

Subsection 8 contains questions targeted at the perceived trust of using m-learning services in the higher education environment. Eight items were used to measure the information privacy aspect of perceived trust of using m-learning services in the higher education environment. This subsection reflects four dimensions of students' information privacy concerns: collection, errors, unauthorized secondary use, and improper access. Questions regarding students' security concerns are included to reflect the data security aspect of trust. Questions in this subsection were adapted from Chen *et al.* (2004) and Smith, Milberg, and Burke (1996) with modifications to make them suitable for m-learning services context.

Subsection 9 contains questions concerning the cost of using m-learning services in the higher education environment. Three items cover the cost of mobile device, access cost, and transaction fees; were used to measure the respondents' perception towards use of m-learning services in their higher education environment. Questions in this subsection were adapted from Wu and Wang (2005) with modifications to make them suitable for m-learning services context.

Table 3.3
Summary of Model's Variables

variable	# of items	Source
Use Behavior	2	Chen *et al.* (2004)
Behavior Intention to Use	4	Venkatesh *et al.* (2003)
Perceived Usefulness	6	Davis *et al.* (1989)
Perceived Ease of Use	6	Davis *et al.* (1989)
Compatibility	3	Chen *et al.* (2004), Moore and Benbasat (1991)
Perceived Service Quality	12	Chen *et al.* (2004), Cronin and Taylor (1992)
Perceived Trust	8	Chen *et al.* (2004), Smith *et al.* (1996)
Cost of Service	3	Wu and Wang (2005)
Facilitating Condition	4	Venkatesh *et al.* (2003)

Section D contains questions to determine the m-learning services that would like to use in the higher education environment. The respondents were given a list of nine services that may available at their universities. Participants were given a chance to add more mobile services that may use, other than the nine items listed in the questionnaire. A five point Likert scale type was used and students were required to state the extent to which services in their point of view were important or not important for them as students to use. The scale was started from 1= Lowly to 5= highly. Respondents were given a space to register their comments and opinions about m-learning services from their point of view. Questions in this section were adapted from Karim *et al.* (2006).

Data collection for this research part (Model's questionnaire) was undertaken during the first semester of the academic year 2009/2010. The questionnaire was pilot tested with 33 students. Pilot study of this research part will be illustrated in the next section.

3.5 Pilot Study

Before deciding on the actual instrument to be utilized in this research, a pilot study was conducted. According to Sekaran (2000), sample size could be effective if it is greater than 30 and less than 500 for most research. Therefore, the pilot study for both research questionnaires in Appendix A and Appendix B was conducted using 30 and 33 subjects, respectively. The researcher sat with the respondents while they completed the questionnaires to identify difficulties in wording, to answer respondents' questions, and generally to check on the ease of completion. However, the reliability and validity were employed. The reliability test for each instrument was calculated using the pilot study data.

Validity is the degree of questionnaire that actually measures or collects data (Coakes, 2005). If a question can be misunderstood, the information is said to be of low validity. In order to avoid this situation, the questions for the survey were planed carefully and optimized before distributing and it were reviewed after pilot test.

Reliability is synonymous with the consistency of a test, survey, observation, or other measuring device. Because the proposed research is of quantitative trait, the reliability of the findings can be ensured by ensuring the survey time scale, stability, equalization questionnaires design and even the objectivity of the measurement instrument itself. However, one of the criteria for selection of past instruments was internal consistency of the scales using Cronbach's Alpha reliability coefficients.

The results on measures for the pilot study of students' awareness and requirements of m-learning services are shown in Table 3.4. Reliability estimates ranged from .699 to .871 are generally considered sufficient for research purposes (Hair, Black, Babin, Anderson, & Tatham, 2009; Sekaran, 2003), so the scales can be regarded as relatively reliable. The pilot test also identified several problems such as the questionnaire content, understanding of items, and time taken. Some vague sentences were noted and corrected.

Each respondent took approximately 10 minutes to complete the entire questionnaire. As expected, there were some confusion on the sentences in the questionnaire, thus some amendments were made to the final version (refer to Appendix A).

Table 3.4
Reliability Coefficient for Multiple Items in Pilot Study of Students' Awareness of M-learning (n=30)

variable	# of items	Reliability
Awareness of mobile learning service aspects	6	.747
Current access to learning resources	6	.699
Mobile technologies for learning services	6	.864
Applications used through mobile technologies	6	. 767
Limitations of mobile technologies	13	.810
Suggested university mobile services	9	.871

The results on measures for the pilot study of the model of the adoption and use of m-Learning services are shown in Table 3.5. Reliability estimates ranged from .674 to .931 are generally considered sufficient for research purposes (Hair, et al., 2009; Sekaran, 2003), so the scales can be regarded as relatively reliable. The pilot test also identified several problems such as the questionnaire content, understanding of items, and time taken. Some vague sentences were noted and corrected.

Each respondent took approximately 15 minutes to complete the entire questionnaire. As expected, there were some confusion on the sentences in the questionnaire, thus some amendments were made to the final version (refer to Appendix B).

Table 3.5
Reliability Coefficient for Multiple Items in Pilot Study of Model's Questionnaire (n=33)

variable	Number of items	Reliability
Use Behavior	2	.805
Behavior Intention to Use	4	.931
Perceived Usefulness	6	.890
Perceived Ease of Use	6	.901
Compatibility	3	.674
Perceived Service Quality	12	.876
Perceived Trust	8	.854
Cost of Service	3	.893
Facilitating Condition	4	.752

3.6 Data Analysis

For the purpose of data analysis and hypothesis testing, several statistical tools and methods were employed using Statistical Package for the Social Sciences (SPSS) software, version 17. These include factors and reliability analysis to test the goodness of measures; descriptive statistics to describe the characteristic of respondents; test of differences to test the non response bias and compare the extent of use behavior and behavioral intention to use, by the respondents between deferent demographic profiles; correlational analysis to describe the relationship between variables; and regression analysis to test the impact of students acceptance factors on the behavioral intention to use the m-learning services as well as the influence of behavioral intention to use on use behavior.

3.4.3 Factor Reliability Analysis

One of the important steps in data analysis is to understand the dimension of the variables in the proposed model or the relationships in empirical research (Hair, et al., 2009; Pallant, 2007). In other words, factor analysis is conducted to identify the structure of interrelationship (correlation) among a large number of items. This is done by defining common underlying dimension, known as factors (Hair, et al., 2009). In this study, the cut-off point chosen for significant factors loading will be .30, which is suggested by Hair *et al.* (2009) for sample of more than 350.

In assessing the appropriateness of factor analysis, Hair *et al.* (2009) suggested that as a general rule, the minimum is to have at least five times as many observations as there are variables to be analyzed. The more acceptable size would have a ten-to-one ratio. The present study has nine variables, and therefore the minimum sample size needed was 45 (5 X 9 variables) or preferably 100 observations (10X10 variables).

Another test to determine the appropriate of factor analysis is the Barlett test of sphericity which examines the presence of sufficient number of significant correlations among the variables. It provides the statistical probability those correlations among the variables. It provides the statistical probability that the correlations matrix has significant correlations among at least some of the variables (Hair, et al., 2009).

It should be noted that all the negative worded items in the questionnaire were first be reversed coded before the items were submitted for reliability test. In the case of coefficient alpha was smaller than .70, the item with the lowest corrected item-to-total correlation was removed until the .7 level was met (Pallant, 2007).

3.4.4 Descriptive Statistics

To acquire a feel for the data, descriptive statistics (mean values and standard deviations) for all the variables of interest were obtained. The purpose of descriptive analysis was to present raw data transformed into a form that will make them easy to understand and interpret.

3.4.5 Test Differences

T-test was used to see if there is a statistically significant difference in the mean scores for two groups of variables, such as gender, in terms of their level of use behavior as well as behavioral intention to use. The assumption of homogeneity of variance was first examined through Levene's test for equality of variance. In the case where the assumption of equal variances was violated, the t-value reported for equal variances not assumed, was used.

One way analysis of variance (ANOVA) was used to examine whether there exist any differences in the level of use behavior by demographic variables with more than two categories that are age, education background, and mobile experience. As ANOVA test assumed equal variances, the Levene's test for homogeneity of variance was first examined in order to ensure that the assumption of homogeneity of variance has not been violated.

3.4.6 Correlation Analysis

Pearson correlation was used to describe the strength and direction of the relationship between two variables. In this study, the relationship between acceptance factors and *behavioral intention to use (BI)* as well as between BI and *use behavior (USE)* were examined using this analysis. A positive correlation indicates that as one variable increases, so does the other. A negative correlation indicates that as one variable increases, the other decreases. A perfect correlation of (1) or (-1) indicates that the value of one variable can be determined exactly by knowing the value of the other variable. On the other hand, a correlation of 0 indicates no relationship between the two variables.

3.4.7 Multiple Regressions

Despite correlation is used to describe the strength and direction of the relationship between two variables, multiple regression is more sophisticated of correlation and is used to explore the predictive ability of a set of independent variables on one dependent variables (Pallant, 2007).

In order to test the hypotheses developed in the present study, multiple regression analyses were conducted. Besides that, the amount of variance of use behavior explained by behavioral intention to use as well as the variance of behavioral intention to use explained by the acceptance factors were also examined through this analysis.

Before proceeding with the analysis, basic assumptions of the linearity (represents the degree to which the change in the dependent variable is associated with the independent variable), normality of the error terms distribution and homoscedasticity (constant variance of the error terms) were first examined.

Since multiple regression is very sensitive to outliers, that is standardized residual values above about 3.3 (or less than -3.3) (Pallant, 2007), it was detected by case wise diagnostics in the regression analysis in SPSS package version 17. To minimize the effect of outliers, they were deleted from the data set. Before the regression results are considered valid, the degree of multicollinearity and its effect on the results are examined. Therefore, the variance inflation factor (VIF) and the condition indices for all the variables were examined. According to Hair *et al.* (2009), the VIF should be closed to 1.00 to indicate little or no multicollinearity. They further suggested the cutoff value of 10.00 as an acceptable VIF.

The development and evaluation of the prototype are discussed in separate chapter (see chapter six).

3.7 Summary

This chapter elaborates the detail aspect of the approach that was undertaken by this research. Four important aspects: the research design, data collection, data analysis, and developing of m-learning prototype have been discussed.

Consequently, study population, sampling was discussed then data collection procedure for students' awareness and requirements of m-learning services; and data collection procedure for model of acceptance and use of m-learning services was presented.

Pilot study for both research questionnaires in Appendix A and Appendix B was conducted and endorsed using 30 and 33 subjects, respectively. Finally, analysis tests and technique such as factor reliability analysis, correlation analysis, and multiple regressions have been stated and elaborated.

CHAPTER FOUR

STUDENTS' AWARENESS AND REQUIREMENTS OF M-LEARNING SERVICES

4.1 Introduction

This chapter presents the results of the initial study of this research. Firstly, it describes the profile of the respondents. Finally, the results of the survey are presented.

4.2 Findings

A sample of 261 was randomly selected from students of five public Malaysian universities (refer to Table 3.2 in chapter three). As shown in Table 4.1, 36.4% of respondents were male and 63.6% female, 85.8% were under the age of 26. Despite science and business made up the largest groups of respondents 46.4% and 44.4%, respectively, art studies were only 9.2%. In terms of education level, Bachelor made up the largest number with 86.2%, followed by master degree with 11.9%, and PhD was only 1.9%. This indicates that the findings represent opinions of different levels of students.

Table 4.1
Demographic Data of Students

Measure	Item	N	(%)	Cumulative %
Gender	Male	95	36.4	36.4
	Female	166	63.6	100.0
Age	Below 20	43	16.5	16.5
	21-25	181	69.3	85.8
	26-30	20	7.7	93.5
	31-35	9	3.4	96.9
	36-40	6	2.3	99.2
	More than 40	2	.8	100.0
Education	Science	121	46.4	46.4
	Business	116	44.4	90.8
	Art Studies	24	9.2	100.0
Education Level	Bachelor	225	86.2	86.2
	Master	31	11.9	98.1
	PhD	5	1.9	100.0
Own Mobile device	Yes	248	95.0	95.0
	No	13	5.0	100.0
Mobile Devise Type	PDA	13	5.0	5.2
	Smart Phone	26	10.0	15.7
	Hand Phone	209	80.1	100.0
Mobile Application Experience	< 5 Years	135	51.7	51.7
	5 - 9	111	42.5	94.3
	>= 10 Years	15	5.7	100.0
Wireless Connection	GPRS	115	44.1	44.1
	Wi-Fi	97	37.2	81.2
	None	49	18.8	100.0
Mobile Service Provider	CELCOM	90	34.5	34.5
	MAXIS	117	44.8	79.3
	DiGi	54	20.7	100.0

95% of the participants declared that they own a mobile device. Among those who own mobile devices, 80.1% own mobile phone and 10% own smart phone, while only 5% own a PDA. In terms of mobile application experience 51.7% have less than 5 years of using the mobile application experience; 42.5% have experience between 5 and 9 years; while only 5.7 have more than or equal 10 years. This indicates that the respondent experience, in terms of mobile application, is respectable.

This study also examined the data on how participants connect through the wireless networks, 44.1% of participants are connecting through GPRS and 37.2% connecting through Wi-Fi, while 18.8% have no knowledge or experience before about the terms of wireless network connection. Regarding the mobile service provider, MAXIS (44.8%) made up the highest rate followed by CELCOM (34.5%) and DIGI (20.7%).

For the ranges of five point Likert-scales were categorized into equal sized categories of low, moderate, and high (see Table 4.2). Therefore, scores of less than 2.33 [4/3 + lowest value (i.e.”1”)] is considered as low; scores of 3.67 [highest value (5) - 4/3] is considered high; and those in between considered moderate.

Table 4.2
Ranges and Corresponding Weights of Five Points Likart-scale

Weight Mean	Range (Level)
1.00 - 2.32	Low
2.33 - 3.66	Moderate
3.67 – 5.00	High

The study also explored the students' awareness of the various mobile technology names. The abbreviations used below are NA= Not Aware, SA= Somewhat Aware, NS= Not Sure, A= Aware, VA= Very Aware. Table 4.3 and Figure 4.1 show that the participants are highly aware in terms of *Laptop/Notebook* (34.5% A, 57.5% VA) and *Wireless connection* (36.4% A, 4.25% VA). The remained were in moderate of awareness. However, for all mobile technology names, more than 50 percent of participants were aware or very aware of such technology.

Table 4.3
Student's Awareness of Mobile Technologies Names

Item	Percent of Awareness (%)						
	NA	SA	NS	A	VA	M	StdD
Personal Digital Assistant	8.8	11.5	21.8	39.5	18.4	3.47	1.18
Tablet PC	8.8	11.9	28.7	35.6	14.9	3.36	1.14
WAP mobile phone	4.2	13.0	24.5	40.6	17.6	3.54	1.06
Laptop/Notebook	.8	1.9	5.4	34.5	57.5	4.46	.751
Smart phone	4.6	8.4	24.5	41.4	21.1	3.66	1.05
Wireless connection such as Wi-Fi and GPRS	1.5	3.1	11.5	36.4	47.5	4.25	.889

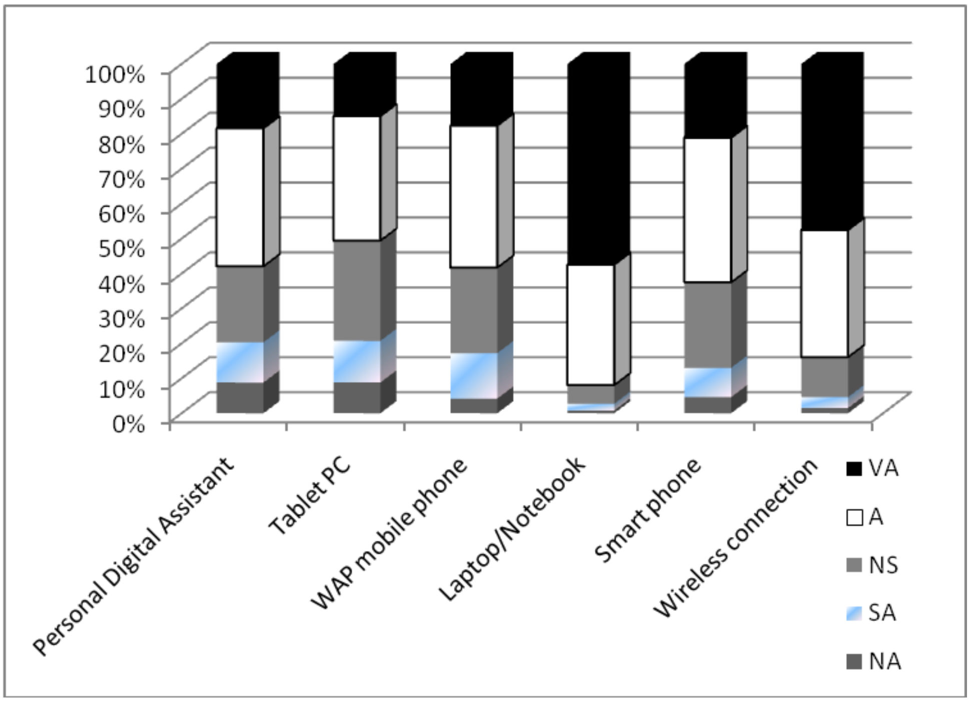

Figure 4.1: Students' Awareness of Mobile Technologies Names

The abbreviations used below are SD=Strongly Disagree, D= Disagree, N= Neutral, A= Agree, SA= Strongly Agree. Table 4.4 shows that there was a correlation with the participant and learning resources where it found that they were highly agreed that the distance access to the University learning resources (47.1% A, 24.9% SA) with 72 percent overall agree; and the access to learning resources while placement (47.1% A, 22.2% SA) are important for their learning. Furthermore, the results indicate moderately to respondents' perceptions of various barriers and obstacles that face them to access online learning resources. The mean of obstacles were 2.89, 2.76, 2.59, and 2.48 for difficulty in accessing electronically the University learning resources from workplace; difficulty in visiting the University learning resources; not aware of how to access the University learning resources by distance means; and do not have access to a University academic service by distance means, sequentially

Table 4.4
Accessing Online Learning Resources

Item	Percent (%)						
	SD	D	N	A	SA	M	StdD
Access to learning resources while placement is important to me	2.7	2.3	25.7	47.1	22.2	3.84	.888
Distance access to the University learning resources is important for my studies	1.1	6.1	20.7	47.1	24.9	3.89	.891
Difficulty in visiting the University learning resources	10.0	27.2	42.9	16.9	3.1	2.76	.952
Not aware of how to access the University learning resources by distance means	12.6	33.7	36.8	15.3	1.5	2.59	.947
Difficulty in accessing electronically the University learning resources from my workplace	8.0	29.9	32.6	24.5	5.0	2.89	1.028
Do not have access to a University academic service by distance means	18.8	34.5	28.4	16.5	1.9	2.48	1.036

The potential for mobile technologies was examined for learning services and the results are included in Table 4.5. Overall, participants were highly agreed with all potentials of mobile technologies for learning services. The most beneficial aspects of using mobile technologies for learning services were to give student current information (54.8% A, 27.6% SA) with 82.4 percent over all agree and give students an immediate access to information (51.3% A, 29.1% SA) with 80.4 percent over all agree.

Moreover, they were highly forwarded to keep in touch with their classmates and their lecturers, as well. The results also show that the increase contact with other students (M = 3.97) followed by provide increased contact with place of study (M = 3.91) were highly mean followed by improve the ability to study (M = 3.87) and Increase contact with lecturers (M = 3.84).

Table 4.5
Students' Views on the Use of Mobile Technologies for Learning Services

Item	Percent (%)						
	SD	D	N	A	SA	M	StdD
Give me current information	.4	4.2	13.0	54.8	27.6	4.05	.780
Provide me with increased contact with my place of study	.4	5.0	19.9	52.5	22.2	3.91	.806
Increase my contact with other students	.4	3.4	18.4	54.8	23.0	3.97	.766
Increase my contact with my lecturers	.4	7.7	19.9	51.3	20.7	3.84	.852
Give me immediate access to information	.8	2.7	16.1	51.3	29.1	4.05	.792
Improve my ability to study	1.5	3.1	26.8	44.4	24.1	3.87	.869

Participants were also asked about the mobile applications that they like to use through mobile technologies (see Table 4.6). Usage for normal mobile phone functions such as calling, SMS and MMS were the high rank (33.3% A, 59.4% SA), followed by internet access (35.2% A, 49.8% SA). Furthermore, the usage for Intranet access, Word processing, Calendar, and Database access were highly respected.

Table 4.6
The Important Mobile Applications

Item	Percent (%)						
	SD	D	N	A	SA	M	StdD
Word processing	1.9	5.0	23.0	40.2	29.9	3.91	.947
Calendar	1.5	6.9	23.0	41.0	27.6	3.86	.951
Internet access	1.5	4.2	9.2	35.2	49.8	4.28	.908
Mobile phone (Calling, SMS, MMS)	1.1	.8	5.4	33.3	59.4	4.49	.737
Database access	1.5	6.9	28.0	35.6	28.0	3.82	.971
Intranet access (Local network)	2.7	7.3	19.9	35.6	34.5	3.92	1.04

The students' perceived limitations of mobile technologies were investigated. Table 4.7 shows the students view on the limitations of mobile technology for learning. The cost of transaction (40.6% A, 26.1% SA) and Slow data exchange with networks were the highest ranked limitation (39.8% A, 24.9% SA), followed by concerns over confidentiality of personal information (47.1% A, 18.8% SA); poor ability to connect to networks (37.5 % A, 20.7% SA); limited battery life of mobile device (39.5% A, 19.9% SA); physical security (42.5% A, 16.1 SA); heavy weight of laptops device (43.7% A, 17.2% SA); limited memory of mobile device (38.3% A, 16.9% SA); small screen of mobile device (40.2% A, 14.2% SA); usability of mobile's keyboard (36.4% A, 13.4% SA); need for training to use device (39.5% A, 9.6% SA); and poor portability of laptop (27.6% A, 10.7% SA).

Table 4.7
Students Views on the Limitations of Mobile Technology for Learning

Item	Percent (%)						
	SD	D	N	A	SA	M	StdD
Need for training to use device	3.8	14.9	32.2	39.5	9.6	3.36	.977
Physical security	1.5	7.7	32.2	42.5	16.1	3.64	.895
Concerns over confidentiality of personal information	1.5	4.6	28.0	47.1	18.8	3.77	.860
Poor ability to connect to networks	3.1	8.0	30.7	37.5	20.7	3.65	.995
Slow data exchange with networks	1.5	8.0	25.7	39.8	24.9	3.79	.961
Cost of transaction and connection	3.4	6.1	23.8	40.6	26.1	3.80	1.01
Laptops—heavy weight of device	3.8	10.0	25.3	43.7	17.2	3.61	1.01
Laptops—poor portability	6.5	17.2	37.9	27.6	10.7	3.19	1.05
Mobile Phone: small screen	4.6	9.6	31.4	40.2	14.2	3.50	1.00
Mobile Phone: small keyboard	4.2	11.1	33.7	38.7	12.3	3.44	.985
Mobile Phone: usability of keyboard	1.5	10.0	38.7	36.4	13.4	3.50	.901
Mobile Phone: limited memory	3.4	10.3	31.0	38.3	16.9	3.55	1.00
Mobile Phone: limited battery life	3.8	7.7	29.1	39.5	19.9	3.64	1.01

Table 4.8
The Important University Mobile Services

Services	Percent (%)						
	SD	D	N	A	SA	M	StdD
Library services (e.g., search and loans)	1.1	5.7	23.0	39.5	30.7	3.93	.932
Course Registration	1.1	6.5	15.3	45.6	31.4	4.00	.914
Calendar, Timetable, or Schedule services	.8	5.4	21.1	42.9	29.9	3.96	.891
Exam result	1.1	2.7	14.9	36.8	44.4	4.21	.874
Admission status	1.1	6.5	22.2	41.0	29.1	3.90	.934
Treasury (e.g., financial statement and balance)	1.9	6.1	22.6	39.1	30.3	3.90	.969
Campus Facilities	1.9	6.1	25.7	42.1	24.1	3.80	.939
International students' services	3.4	12.3	30.7	30.3	23.4	3.58	1.08
Alert system	2.7	8.8	23.8	35.2	29.5	3.80	1.04

Participants were also asked about the university mobile applications that they would like to use, individually, through mobile devices. As shown in Table 4.8 and Figure 4.2, the exam result (36.8% A, 44.8% SA) and course registration (45.6% A, 31.4% SA) were the highest rank, followed by Calendar and Schedule services (42.9% A, 29.9% SA), Library services (39.5% A, 30.7% SA), Treasury (39.1% A, 30.3% SA), and Admission status (41.0% A, 29.1% SA). Moreover, the International students' services (30.3% A, 23.4% SA) were the lowest rank.

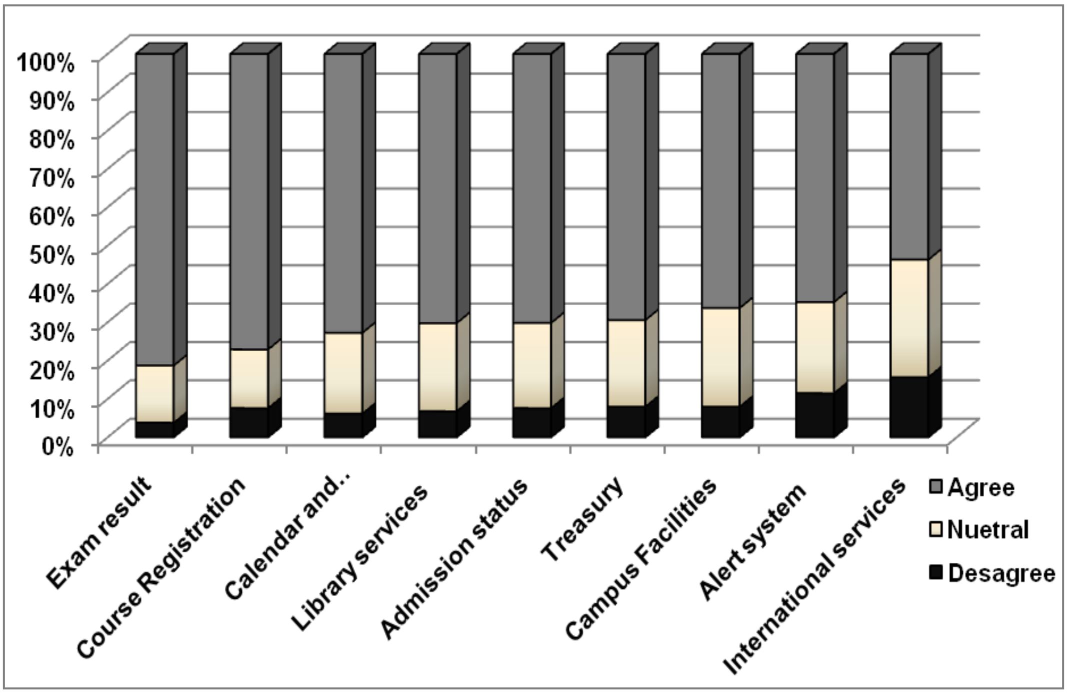

Figure 4.2: The Important University Mobile Services

4.3 Summary

Nowadays m-learning services are interesting and very recent addition as a new vital platform for the higher education environment. The higher education environment now has the necessary mobile technology infrastructure to utilize m-learning. Moreover, students have adequate knowledge and awareness to use such technology in education. The limitations of m-learning for education are concerned and it is going to be reduced by time. Mobile wirelesses technology that are used in the higher education will keep grow and will become the future choice of the learning environment.

CHAPTER FIVE

STUDENTS' ACCEPTANCE AND USE OF MOBILE LEARNING IN HIGHER EDUCATION ENVIRONMENT

5.1 Introduction

This chapter presents the results of data analysis for the main objective of this research which is "to identify the factors that determine students' acceptance and use of m-learning in the higher education environment". The chapter also provides an overview of data collection. Then it presents the profile of the respondents, followed by analysis on the goodness of measures to test the validity and reliability of the variables. Finally, the results of hypotheses testing are presented.

5.2 Data Overview

In this research, data collection for the model's questionnaire was undertaken during the first semester of the academic year 2009/2010. The details of data collection procedures for the model's questionnaire were presented in chapter three (refer to section 3.4). To increase the credibility of the response rate, the questionnaires were distributed to students during their stay in the classrooms. This way provided an opportunity to clarify the objective of the study, and encouraged them to be accurate in the questionnaire filling. Each respondent took approximately 20 minutes to complete the entire questionnaire. As expected, after conducting pilot test, there were some confusion on the sentences in the questionnaire, thus some amendments were made to the final version (refer to Appendix B).

For data collection purposes, 623 questionnaires were distributed to higher education students in five public Malaysian universities out of twenty universities (refer to Table 3.2 in chapter three). Out of this number, 28 questionnaires were excluded because they were incomplete. Thus, a total of 595 responses were usable and used for subsequent analysis, giving a response rate of 95.5 percent. The sample size appears to be adequate and response rate obtained from students as respondents in higher education environment (Walton, et al., 2005).

5.3 Profile of the Respondents

Table 5.1 presents the profile of the respondents. While majority (67.9%) of the respondents are females, (32.1%) of the respondents are males. This consistent with the current distribution of students in the Malaysian higher institutions MOHE (2009). It is reported that the majority of students (60.1%) are females while (39.9%) are males. Most of the respondents are young, where 73.1% are aged between 20 and 25 years, 21% are aged less than 20 years. However, only 5.9% are above 30 years old. Despite science background and business background made up the largest groups of respondents 31.4% and 44.2%, respectively, art studies were only 14.1% followed by Engineering (5.5%) and Arts (4.7%), respectively.

It is not surprising that majority (90.4%) of participants were in Bachelor level. This is reflecting the current practice of learning facilities in the higher education. However, master degree was 9.2% and PhD was 0.3% only. This result reflects the nature of the higher education environment that the Bachelor students who are the most interaction with the university daily services. Moreover, this is consistent with the distribution of students in the Malaysian higher education where MOHE (2009) reported that the majority of students in the public higher institutions are bachelor (84.8%) followed by Master degree (11.3%). The PhD is only 3.8%.

99.5% of the participants declared that they own a mobile device. Among those who own mobile devices, 90.8% own mobile phone and 6.4% own smart phone, while only 2.7% own PDA. In terms of mobile application experience 43.9% have less than 5 years of using the mobile application experience; 48.5% 9 have experience between 5 and 9 years; while only 7.2% have more than or equal 10 years. This indicates that the respondent experience, in terms of mobile application, is respectable and meet with results of a preliminary study is chapter four.

This study also examined the data on how participants connect through the wireless networks, 48.7% of participants are connecting through GPRS and 35.5% connecting through Wi-Fi, while 15.8% have no knowledge or experience before about the terms of wireless network connection. Regarding the mobile service provider, MAXIS (40.8%) was made up the highest rate followed by CELCOM (37.1%) and DIGI (22%). This consistent with the result of the preliminary study that found MAXIS (44.8%) users made up the highest rate followed by CELCOM (34.5%) and DIGI (20.7%)

To conclude, the above discussions indicate that the sample of this study does not deviate significantly from the general population of students in Malaysian higher education and the sample is therefore deemed representative of the population of interest.

Table 5.1
Profile of the Respondents (N=595)

Demographic Data	N	(%)	Cumulative (%)
Gender			
1. Male	191	32.1	32.1
2. Female	404	67.9	100.0
Age			
1. Under 20 Years	125	21.0	21.0
2. 20 – 25 Years	435	73.1	94.1
3. 26 – 30 Years	21	3.5	97.6
4. Above 30 Years	14	2.4	100.0
Education Background			
1. Science	187	31.4	31.4
2. Business	263	44.2	75.6
3. Arts	28	4.7	80.3
4. Engineering	33	5.5	85.9
5. Medical and Pharmacy	84	14.1	100.0
Study Program			
1. Bachelor	538	90.4	90.4
2. Master	55	9.2	99.7
3. PhD	2	.3	100.0
Own a Mobile			
1. Yes	592	99.5	99.5
2. No	3	.5	100.0

Demographic Data	N	(%)	Cumulative (%)
Mobile Device Type			
1. PDA	16	2.7	2.7
2. Smart Phone	28	6.4	9.1
3. Hand Phone	540	90.8	99.8
4. None	1	.2	100.0
Mobile Application Experience			
1. Less than 5 Years	261	43.9	43.9
2. 5 – 9	291	48.9	92.8
3. More than or equal 10	43	7.2	100.0
Wireless Connection Used			
1. GPRS	290	48.7	48.7
2. Wi-Fi	211	35.5	84.2
3. None	94	15.8	100.0
Mobile Service Provider			
1. CELCOM	221	37.1	37.1
2. MAXIS	243	40.8	78.0
3. DiGi	131	22.0	100.0
University			
UIAM	86	14.7	14.7
UM	73	12.5	27.2
UPM	87	14.9	42.1
USM	134	22.9	65.0
UUM	205	35.0	100.0

5.4 Validity Testing

As mentioned in chapter three, most of the items used to measure the variables have been adopted from the literature. Even though the adopted measurements have been confirmed of its discriminate and convergent validity, it is felt necessary to re-examine the validity of these measures. This is because this study is undertaken in the Malaysian context which may be different from other countries. The existing literatures on adoption and diffusion of technology have been done in other countries, particularly in the euro-countries where the environment and culture are entirely different from Malaysia.

In order to ascertain whether the measurements used in this study have construct validity, that is, measure what they are supposed to measure, exploratory factor analysis was conducted on all items measuring the constructs of Use Behavior, Behavior Intention to Use, Compatibility, Perceived Usefulness, Perceived Ease of Use, Perceived Service Quality, Perceived Trust, Cost of Service, and Facilitating Condition.

5.5 Result of Exploratory Factor Analysis

For factor analyses purposes, the items in the questionnaire are grouped into two components (see Appendix C). The first, component was *Use Behavior*, consisting of items of subsection 2 and 5 in section C of the questionnaire (see Appendix B). The second component comprised all the acceptance variables (subsections: 3, 4, 6, 7, 8, and 9) in section C of the questionnaire.

Factor Analysis can be sensitive to outliers (Pallant, 2007). The outliers were examined and indicated that observations number 160, 120, 99, 137, 320, 230, 539, 501, 277, and 545 were outliers and therefore filtered out in the next run of factor analysis. Factor analysis was based on Principal Component Method (PCA) with Varimax rotation for all components. The results for each factor analysis conducted are summarized in Table 5.2 and Table 5.3.

5.5.1 Use Behavior

The factor analysis conducted on *Use Behavior* shows the Kaiser-Meyer-Olkin value of .857, exceeding the recommended value of .50 (Hair, et al., 2009) and the recommended value of .60 (Pallant, 2007). The Barlett's test of sphericity was highly significant (p= .000), supporting the factorability of the correlation matrix. Therefore the assumptions of factor analysis were met and it is appropriate. PCA revealed the presence of only one component with an eigenvalue exceeding one. These two factors captured 69.057 percent of the total variance, with *Behavior Intention to Use* (Component 1) contributing 40.118 percent and *Facilitating Condition* (Component 2) contributing 28.94 percent.

As shown in Table 5.2, the factor loadings are between .717 and .901. Reliability (Cronbach's Alpha) for these factors are .918 and .748 respectively, which indicates high reliability. Item-to-total correlations revealed that removal of any item would not increase the alpha beyond .918 of *Behavior Intention to Use*, and would not increase the alpha beyond .748 of *Facilitating Condition*; thus supporting the inclusion of all scale items. Since all items of the each factor loaded on the original factor, their original names were retained.

Table 5.2
Factor and Reliability on Use Behavior

Item	Component 1	Component 2	Cronbach's Alpha
BI2	.901		
BI1	.892		.918
BI3	.887		
BI4	.817		
FC2		.743	
FC4		.741	.748
FC1		.729	
FC3		.717	
% of variance			69.057
Kaiser-Meyer-Olkin Measure of Sampling Adequacy			.857
Bartlett's Test of Sphericity: Approx. Chi-Square			2453.325
		df	28
		Sig	.000

5.5.2 Acceptance Factors

For the acceptance factors, factor analysis was conducted based on the three questions of the Compatibility, six questions of the Perceived Usefulness, six questions of the Perceived Ease of Use, twelve questions of the Perceived Service Quality, eight questions of the Perceived Trust, and three questions of the Cost of Service.

As shown in Table 5.3, for all the 38 items, the overall value of Kaiser-Meyer-Olkin (KMO) value was found to be .939. Furthermore, the result of the

Bartlett test was highly significant (p= .000), which indicates the assumptions of factor analysis were met.

From the output, measures of the acceptance factors produced 6 factors with eigenvalues more than 1. These 6 factors captured 63.814 percent of the total variance of the items. However, after Varimax rotation, three items had cross-loadings and themselves loaded on more than two factors. A common practice is to delete these items which reduce the inconsistent correlations among the factors and consequently, improve the scale reliability (Hair, et al., 2009). Therefore, these items were deleted.

There are also quit number of items had cross-loadings on two factors. Their loadings are between .315 and .329 on one factor meanwhile they had considering loadings between .650 and .755 on another factors. However, according to Hair *et al.* (2009), although factor loadings in the range ±.30 to ±.40 are minimally acceptable for a sample size 350 and above, values of ±.50 or greater are considered necessary for practical significance.

With five factors remaining, the factor loadings of the items were between .537 and .908. These loadings are considered practical significance. However, the five factors explained a total 60.864 percent of the variance. The reliability Cronpach's alpha analysis conducted for the 5 factors, shows that all factors have a high reliability and the results were .920, .900, .908, .890, and .895 respectively. On the basis of the factor loadings, all items of the each factor loaded on the original factor, so their original names were retained.

In general, results of the exploratory factor analysis on the main variables proposed in the conceptual framework indicate dimensions that are almost the same original dimension. Only one factor was eliminated during factor analysis.

Table 5.3
Factor and Reliability on Acceptance Factors

Item	Factor Loadings of the Components				
	1	2	3	4	5
The behavior of the m-learning services instills confidence in me	.750				
Overall, the service quality of the m-learning services is high	.724				
The m-learning services understand my specific needs	.703				
When the m-learning services promise to do something by a certain time, it does so	.686				
The m-learning services are never busy to respond to my requests	.684				
The m-learning services give me individual attention	.682				
I feel safe in my transactions with the m-learning services	.676				
The m-learning services give me prompt service	.671				
The m-learning services are dependable	.639				
The m-learning services tell me exactly when information will be delivered or performed	.635				
The m-learning services are visually appealing	.607				
The m-learning services have up-to-date hardware and software	.537				
I am concerned that the m-learning services will share my personal information with other universities or companies without my authorization		.834			

Item	Factor Loadings of the Components				
	1	2	3	4	5
I am concerned that unauthorized people have access to my personal information		.832			
I am concerned that the m-learning services will use my personal information for other purposes without my authorization		.830			
I am concerned my personal information in the m-learning services' database is not accurate		.788			
I am concerned about the security of my personal information during transmission		.774			
I am concerned that the m-learning services are collecting too much personal information from me		.684			
It bothers me when the m-learning services ask me for personal information		.577			
In general, I do not trust the m-learning services		.573			
Using the m-learning services would increase my productivity in education environment			.838		
Using the m-learning services would improve my performance in education environment			.821		
Using the m-learning services would enhance my effectiveness in education environment			.810		
Using the m-learning services would make it easier to engage in education environment			.728	.327	
I find the m-learning services useful in my education environment			.709	.329	
Using the m-learning services would enable me to accomplish tasks more quickly			.701		
My interaction with the m-learning services is clear and understandable	.328			.755	
Overall, I find the m-learning services easy to use				.723	

Item	Factor Loadings of the Components				
	1	2	3	4	5
Learning to use the m-learning services is easy for me				.709	
I find the m-learning services are flexible to interact with	.315			.704	
I find it easy to use the m-learning services to find what I want	.319			.670	
It is easy for me to become skillful in using the m-learning services			.324	.650	
I think the access cost for m-learning services is expensive					.908
I think the transaction fee for m-learning services is expensive					.894
I think the equipment for m-learning services cost is expensive					.845
% of variance	60.864				
Kaiser-Meyer-Olkin Measure of Sampling Adequacy	.939				
Bartlett's Test of Sphericity: Approx. Chi-Square	13779.838				
Df	703				
Sig	.000				

5.5.3 Reliability Test

Table 5.4 below summarizes the reliability test of all measures after factor analysis has been done; all items of Compatibility factor were eliminated (see Appendix C). The Cronpach Alphas of the measures were all comfortably above the lower limit of acceptability that is $\alpha >= .7$. Hence, all the measures were highly reliable.

Table 5.4
Reliability Coefficients for all the variables in the study

Variable	Number of items	Reliability
Use Behavior	2	.777
Behavior Intention to Use	4	.918
Perceived Usefulness	6	.920
Perceived Ease of Use	6	.900
Perceived Service Quality	12	.908
Perceived Trust	8	.890
Cost of Service	3	.895
Facilitating Condition	4	.748

5.6 Descriptive and Groups Analysis

5.6.1 Major Variables

Descriptive statistics for the final list of variables of the study are shown in Table 5.5. With the exception of second item of *User Behavior*, the scale measurements used is a five-point Likert scale. The ranges of five point Likert-scales were categorized into equal sized categories of low, moderate, and high. Therefore, scores of less than 2.33 [4/3 + lowest value (1)] is considered as low; scores of 3.67 [highest value (5) - 4/3] is considered high; and those in between considered moderate.

From Table 5.5, the mean values for all variables (i.e. Behavior Intention to Use, Perceived Usefulness, Perceived Ease of Use, Facilitating Condition, Perceived Service Quality, Perceived Trust, and Cost of Service) fall in the range of 2.98 and 3.53. Indeed, respondents are generally moderate in all variables towards the m-learning services use. However, with standard deviation of all variables are fall in the range .60 and .88, it indicates that statistically, the variation of Behavior Intention to Use, Perceived Usefulness, Perceived Ease of Use, Facilitating Condition, Perceived Service Quality, Perceived Trust, and Cost of Service among respondents are high.

Table 5.5
Descriptive Statistics for All Variables

variable	*M*	*SD*
Behavior Intention to Use	3.1791	.86509
Perceived Usefulness	3.4316	.76964
Perceived Ease of Use	3.3453	.70922
Facilitating Condition	2.9868	.69469
Perceived Service Quality	3.1754	.60999
Perceived Trust	3.3511	.73833
Cost of Service	3.5356	.88982

5.6.2 Level of All Variables across Profiles of the respondents

Although it is not stated as the objective of the present study, it is also interesting to explore if the level of all variables (i.e. Use behavior, Behavior Intention to Use, Perceived Usefulness, Perceived Ease of Use, Facilitating Condition, Perceived Service Quality, Perceived Trust, and Cost of Service) of m-learning services differs across profiles of the respondents. This is investigated in the following section to understand further the adoption of use behavior among Malaysian higher education students.

A one-way between-groups Analysis of variance (ANOVA) was conducted to explore the impact of Age, Education Background, and Mobile Experience on levels of Use Behavior, Behavior Intention to Use, Perceived Usefulness, Perceived Ease of Use, Facilitating Condition, Perceived Service Quality, Perceived Trust, and Cost of Service.

5.6.2.1 Level of All Variables by Age

Table 5.6 summarizes the results of the test of four age groups which are under 20 years, 20-25, 26-30, and above 30 years. It shows that there was a statistically significant difference at the $p<.05$ level on Behavior Intention to Use ($F= 5.28$; $p= .001$), Perceived Ease of Use ($F= 3.892$; $p= .009$), and Perceived Trust ($F= 5.348$; $p= .001$). However there was no statistically significant difference on Use Behavior ($F= 2.163$; $p= .091$), Perceived Usefulness ($F= .886$; $p= .448$), Facilitating Condition ($F= 3.493$; $p= .015$), Perceived Service Quality ($F= 3.478$; $p= .016$), and Cost of Service ($F= 1.244$; $p= .293$). The post-hoc comparisons using the Tukey's Honestly Significant Difference (HSD) test indicated that the mean score for analysis shows that respondents aged between 26-30 years adopt significantly more Behavior Intention than those aged under 20 years and respondents aged under 20 years adopt significantly more Behavior Intention than those aged between 20-25 years. However, respondents who are aged above 30 had no adopt significantly.

Regarding *Perceived Ease of Use,* the post-hoc comparisons using the Tukey’s HSB test indicated that the mean score for analysis shows that respondents aged between 20-25 years adopt significantly more *Perceived Ease of Use* than those aged less than 20 years. However, respondents who are aged between 26-30 years and who aged above 30 years had no adopt significantly.

Table 5.6
All Variables by Age

Variable		N	*M*	*SD*	*F* Value	Sig. (*P* value)
Use Behavior	Under 20	123	2.3008	1.01169	2.163	.091
	20 – 25	429	2.4231	1.04397		
	26 – 30	21	1.8810	1.05954		
	Above 30	12	2.2500	1.01130		
Behavior Intention to Use	Under 20	123	3.2622	.71707	5.281	.001*
	20 – 25	429	3.1970	.88071		
	26 – 30	21	2.5119	.91336		
	Above 30	12	2.8542	1.13046		
Perceived Usefulness	Under 20	585	3.4499	.66356	.886	.448
	20 – 25	123	3.4347	.78803		
	26 – 30	429	3.1825	.84147		
	Above 30	21	3.5694	.98591		
Perceived Ease of Use	Under 20	12	3.2033	.63142	3.892	.009*
	20 – 25	585	3.4040	.70779		
	26 – 30	123	3.0952	.74642		
	Above 30	429	3.1389	1.11879		
Facilitating Condition	Under 20	21	2.9126	.53368	3.493	.015*
	20 – 25	12	3.0326	.71314		
	26 – 30	585	2.6905	.75789		
	Above 30	123	2.6250	1.08450		
Perceived Service Quality	Under 20	429	3.0718	.43789	3.478	.016*
	20 – 25	21	3.2218	.63342		
	26 – 30	12	2.9405	.61075		
	Above 30	585	2.9861	.99483		
Perceived Trust	Under 20	123	3.2998	.62207	5.348	.001*
	20 – 25	429	3.3418	.75378		
	26 – 30	21	3.3690	.76186		
	Above 30	12	4.1771	.84184		
Cost of Service	Under 20	585	3.5041	.81355	1.244	.293
	20 – 25	123	3.5268	.88199		
	26 – 30	429	3.6349	1.15905		
	Above 30	21	4.0000	1.31041		

*. The mean difference is significant at the 0.05 level.

Consequently, the post-hoc comparisons using the Tukey's HSD test indicated that the mean score for analysis shows that respondents aged above 30 years adopt significantly more *Perceived Trust* than those aged under 20 years; respondents aged under 20 years adopt significantly more *Perceived Trust* than those aged between 20-25 years; and respondents those aged between 20-25 years adopt significantly more *Perceived Trust* than those aged between 26-30 years.

5.6.2.2 Level of All Variables by Education Background

Table 5.7 summarizes the results of the test of four Education Background groups, which are Science, Business, Art studies, Engineering, and Medical. It shows that there was no statistically significant difference in the mean of all variables (i.e. Use behavior, Behavior Intention to Use, Perceived Usefulness, Perceived Ease of Use, Facilitating Condition, Perceived Service Quality, Perceived Trust, and Cost of Service) by education backgrounds of all respondents.

Table 5.7
All Variables by Education Background

Variable		N	*M*	*SD*	*F* Value	Sig. (*P* value)
Use Behavior	Science	183	2.3142	1.04220	.953	.433
	Business	262	2.4332	1.03498		
	Art Studies	27	2.5741	1.08045		
	Engineering	32	2.4063	1.16700		
	Medical	81	2.2407	.98777		
Behavior Intention to Use	Science	183	3.1243	.92429	1.233	.296
	Business	262	3.1660	.86359		
	Art Studies	27	3.1111	.97402		
	Engineering	32	3.1719	.94493		
	Medical	81	3.3704	.62138		

Variable		N	*M*	*SD*	*F* Value	Sig. (*P* value)
Perceived Usefulness	Science	183	3.4818	.85893	1.335	.255
	Business	262	3.3569	.74620		
	Art Studies	27	3.3889	.66827		
	Engineering	32	3.5313	.89246		
	Medical	81	3.5350	.57958		
Perceived Ease of Use	Science	183	3.4463	.77171	1.978	.096
	Business	262	3.2920	.68624		
	Art Studies	27	3.3025	.68413		
	Engineering	32	3.4792	.81512		
	Medical	81	3.2510	.56711		
Facilitating Condition	Science	183	3.0697	.75747	.981	.417
	Business	262	2.9418	.67324		
	Art Studies	27	2.9444	.79158		
	Engineering	32	2.9844	.69832		
	Medical	81	2.9599	.56797		
Perceived Service Quality	Science	183	3.2650	.65006	2.335	.054
	Business	262	3.1221	.60444		
	Art Studies	27	3.2716	.62770		
	Engineering	32	3.2604	.75662		
	Medical	81	3.0792	.41225		
Perceived Trust	Science	183	3.3648	.75852	1.705	.147
	Business	262	3.3621	.71945		
	Art Studies	27	3.5000	.65413		
	Engineering	32	3.4922	.90191		
	Medical	81	3.1790	.69370		
Cost of Service	Science	183	3.6321	.94185	1.109	.351
	Business	262	3.4987	.89450		
	Art Studies	27	3.5556	.87706		
	Engineering	32	3.5938	.78851		
	Medical	81	3.4074	.78528		

*. The mean difference is significant at the 0.05 level.

5.6.2.3 Level of All Variables by Mobile Experience

A one-way between-groups Analysis of variance (ANOVA) was conducted to explore the impact of Mobile Experience on levels of Use Behavior, Behavior

Intention to Use, Perceived Usefulness, Perceived Ease of Use, Facilitating Condition, Perceived Service Quality, Perceived Trust, and Cost of Service.

Table 5.8 summarizes the results of the test of three mobile applications experience groups. Participants were categorized to three groups according to their mobile applications experience (Group 1: Less than 5 years; Group 2: between 5-9, and Group 3: more than 9 years). It shows that there was a statistically significant difference at the $p<.05$ level only on Perceived Trust ($F= 7.062$; $p= .001$). The post-hoc comparisons using the Tukey's Honestly Significant Difference (HSD) test indicated that the mean score for analysis shows that respondents with more than 9 years experience adopt significantly more *Perceived Trust* than those with less than 5 years experience and respondents with less than 5 years experience adopt significantly more *Perceived Trust* than those with 5-9 years experience.

Table 5.8
All Variables by Mobile Applications Experience

Variable		N	*M*	*SD*	*F* Value	Sig. (*P* value)
Use Behavior	< 5 Years	255	2.3333	1.01982	.468	.626
	5 - 9	288	2.4167	1.05840		
	> 9 Years	42	2.3333	1.05152		
Behavior Intention to Use	< 5 Years	255	3.1304	.80379	1.395	.249
	5 - 9	288	3.2378	.89000		
	> 9 Years	42	3.0714	1.03046		
Perceived Usefulness	< 5 Years	255	3.3791	.75778	1.337	.263
	5 - 9	288	3.4601	.76613		
	> 9 Years	42	3.5556	.85593		
Perceived Ease of Use	< 5 Years	255	3.3144	.73350	1.106	.331
	5 - 9	288	3.3519	.67707		
	> 9 Years	42	3.4881	.77161		

Variable		N	*M*	*SD*	*F* Value	Sig. (*P* value)
Facilitating Condition	< 5 Years	255	2.9755	.67516	.140	.870
	5 - 9	288	2.9896	.69146		
	> 9 Years	42	3.0357	.83661		
Perceived Service Quality	< 5 Years	255	3.1833	.63056	.271	.762
	5 - 9	288	3.1780	.57843		
	> 9 Years	42	3.1091	.69976		
Perceived Trust	< 5 Years	255	3.2520	.70702	7.062	.001*
	5 - 9	288	3.3906	.70893		
	> 9 Years	42	3.6815	.98278		
Cost of Service	< 5 Years	255	3.5059	.86480	2.175	.115
	5 - 9	288	3.5220	.89407		
	> 9 Years	42	3.8095	.98262		

*. The mean difference is significant at the 0.05 level.

5.6.2.4 Level of All Variables by Gender

Independent t-test is used to evaluate the differences in the level of Use Behavior, Behavior Intention to Use, Perceived Usefulness, Perceived Ease of Use, Facilitating Condition, Perceived Service Quality, Perceived Trust, and Cost of Service in terms of Gender. A summary test of the differences is tabulated in Table 5.9. As shown in Table 5.10 the significant Levene's Test values for all measures, except the Perceived Usefulness, are greater than the cut-off .05. This means that the assumption of equal variance has not been violated (Pallant, 2007). Consequently, the values of Sig. (2-tailed) for all measures are not equal or less than .5 (Pallant, 2007), so there is no statistically significant different in the mean Use Behavior, Behavior Intention to Use, Perceived Usefulness, Perceived Ease of Use, Facilitating Condition, Perceived Service Quality, Perceived Trust, and Cost of Service on two groups of participant gender.

Table 5.9
Group Statistics in Terms of Gender

Variable	N	*M*	*SD*	Std. Error Mean	
Use Behavior	Male	187	2.4332	1.07867	.07888
	Female	398	2.3467	1.02199	.05123
Behavior Intention to Use	Male	187	3.1885	.92470	.06762
	Female	398	3.1746	.83679	.04194
Perceived Usefulness	Male	187	3.4421	.83748	.06124
	Female	398	3.4267	.73667	.03693
Perceived Ease of Use	Male	187	3.4198	.75340	.05509
	Female	398	3.3103	.68568	.03437
Facilitating Condition	Male	187	3.0441	.69444	.05078
	Female	398	2.9598	.69404	.03479
Perceived Service Quality	Male	187	3.1992	.67916	.04967
	Female	398	3.1642	.57519	.02883
Perceived Trust	Male	187	3.4245	.77407	.05661
	Female	398	3.3166	.71933	.03606
Cost of Service	Male	187	3.4759	.95408	.06977
	Female	398	3.5637	.85778	.04300

Table 5.10
Independent Sample Test of Gender

Measure	Levene's Test for Equality of Variances		t-test for Equality of Means
	F	Sig.	Sig. (2-tailed)
Use Behavior	1.577	.210	.349
Behavior Intention to Use	3.561	.060	.857
Perceived Usefulness	4.401	.036	.830
Perceived Ease of Use	1.800	.180	.082
Facilitating Condition	.001	.979	.171
Perceived Service Quality	2.197	.139	.517
Perceived Trust	1.231	.268	.099
Use Behavior	3.194	.074	.267

To summarize, the level of Use Behavior, Behavior Intention to Use, Perceived Usefulness, Perceived Ease of Use, Facilitating Condition, Perceived Service Quality, Perceived Trust, and Cost of Service among Malaysian students in the higher education environment. The study found that respondents with different gender and education Background are found to perform similar level of all adoption variables.

Respondents aged between 26-30 years adopt significantly more Behavior Intention than those aged less than 20 years and respondents aged less than 20 years adopt significantly more Behavior Intention than those aged between 20-25 years. However, respondents who are aged above 30 had no adopt significantly.

Regarding Perceived Ease of Use, the post-hoc comparisons using the Tukey's HSB test indicated that the mean score for analysis shows that respondents aged between 20-25 years adopt significantly more Perceived Ease of Use than those aged less than 20 years. However, respondents who are aged between 26-30 years and who aged above 30 years had no adopt significantly.

Consequently, the post-hoc comparisons using the Tukey's HSD test indicated that the mean score for analysis shows that respondents aged above 30 years adopt significantly more Perceived Trust than those aged under 20 years; respondents aged under 20 years adopt significantly more Perceived Trust than those aged between 20-25 years; and respondents those aged between 20-25 years adopt significantly more Perceived Trust than those aged between 26-30 years.

Respondents with more than 9 years experience adopt significantly more *Perceived Trust* than those with less than 5 years experience and respondents with less than 5 years experience adopt significantly more *Perceived Trust* than those with 5-9 years experience. The following sections discuss the findings of hypothesis testing.

5.7 Correlation Analysis

The values of the correlation coefficients (r) indicate the strength of the relationship between variables. The computation of the Pearson product-moment correlation coefficients was performed to obtain an understanding of the relationship between all the variables in the study. Preliminary analyses were performed to ensure no violation of assumptions of normality, linearity, and homoscedasticity (Hair, et al., 2009; Pallant, 2007). As shown in Table 5.11, overall correlation values of the variables showed significant correlations coefficients.

Furthermore, correlations amongst the measures of Use Behavior, Behavior Intention to Use, Perceived Usefulness, Perceived Ease of Use, Facilitating Condition, and Perceived Service Quality significantly correlated. However, the strong correlation were between *Behavior Intention to Use* and *Perceived Usefulness* (r=.617); *Perceived Ease of Use* and *Perceived Usefulness* (r=.653); *Behavior Intention to Use* and *Facilitating Condition* (r=.609); and *Perceived Service Quality* and *Facilitating Condition* (r=.551).

Despite Perceived Trust had significant correlation between all variables except Use Behavior, the strength was weak and fall in the range (r=.13) and (r=.26). However, the significant correlation between Perceived Trust and Cost of Service was medium (r=.301). With regards to Cost of Services and Behavior intention to Use; and Cost of Services and Use Behavior, the correlation is negative but also not significant.

Table 5.11
Pearson Product-Moment Correlation between All Study Variables

	USE	BI	PU	PEOU	FC	SQ	T	CS
USE	1							
BI	.451**	1						
PU	.370**	.617**	1					
PEOU	.389**	.468**	.653**	1				
FC	.435**	.451**	.497**	.609**	1			
SQ	.289**	.408**	.535**	.609**	.551**	1		
PT	.066	.131**	.192**	.264**	.192**	.186**	1	
CS	-.013	-.007	.075	.034	.027	.057	.301**	1

**. Correlation is significant at the 0.01 level (2-tailed).

5.8 Re-statement of Hypotheses

In light of the factor analysis results, some amendments have to be made to the statement of hypotheses stated earlier. The hypotheses tested in this study are as follow:

(i) Relationship between behavioral intention to use and use behavior

H1a: A student's behavioral intention to use an m-learning service has effect on use behavior of the m-learning services (BI → USE).

H1b: the facilitating condition of m-learning service has a direct effect on actual use of the m-learning services (FC → USE).

(ii) Relationship between Adoption Factors and behavioral intention to use

H2a: A student's perceived ease of use of an m-learning service has a direct effect on behavioral intention to use the m-learning service (PEOU → BI).

H2b: A student's perceived ease of use of an m-learning service has a direct effect on perceived usefulness of the m-learning service (PEOU → PU).

H3: A student's perceived usefulness of an m-learning service has a direct effect on behavioral intention to use the m-learning service (PU → BI).

H4: A student's perceived service quality of m-learning service has a direct effect on behavioral intention to use the m-learning service (SQ → BI).

H5: A student's perceived Trust has a direct effect on behavioral intention to use the m-learning service (T → BI).

H6: The cost of m-learning service has a direct effect on behavioral intention to use the m-learning service (CS → BI).

5.9 Hypothesis Testing

In order to answer the third research questions, that determine the factors those determine students' acceptance and use of m-learning in the higher education, regression analyses were conducted. However, before conducting the analysis, the data were first examined to detect whether there is any serious violations from the basic assumptions underlying the regression analysis, namely linearity, normality and homoscedasticity (Hair, et al., 2009; Pallant, 2007).

The first assumption, linearity is assessed through an analysis of partial plots. The plots in Appendix G show the relationship between a single independent variable to the dependent variable. A visual examination of the plots indicated that there was no obvious U-shaped or other curvilinear relationship. Indeed, meeting the assumption of linearity for each independent variable.

The next assumption deals with homoscedasticity. As suggested by Hair *et al.* (2009) and Pallant (2007), to show the existence of homoscedasticity, diagnosis is made by plotting the residuals (studentized) against the predicted dependent values and comparing them to the null plot. The scatter plots in Appendix G show no discernible patterns, thus, indicating homoscedasticity in the multivariate (the set of independent variables) case.

The final assumption that is normality is examined by normal Probability-plot (P-P) of the residuals. From the normal p-p plot in Appendix H, the values fall along the diagonal with no substantial or systematic departures, seating that the residuals are about normal distributed. Overall, inspection on data revealed that there was no serious violation of the basic assumptions. Therefore, the use of regression for subsequent analysis is appropriate.

The interpretation of the regression analysis is based on the standardized coefficient beta (β) and R2 which provides evidence whether to support the hypotheses stated earlier in the chapter or not.

5.9.1 Regression Analysis on the Influence of Behavior Intention to Use on Use Behavior

In order to answer the third research question that is, "What are the factors that influence the acceptance and use of m-learning in the higher education environment?" regression analyses were conducted to test the hypotheses. In this analysis, *Behavior Intention to Use* and *Facilitating Condition* are treated as the independent variables, whereas *Use Behavior* as the dependent variable. Through regression analysis procedure, the model (*Behavior Intention* to Use and *Facilitating Condition*) explain 27.1 percent (R^2 = .271) of the variance in *Use Behavior*. Moreover, the model reaches statistical significance (Sig. = .000, this really means $p<.0005$). Table 5.12 shows that *Behavior Intention* positively influences *Use Behavior* (β= .321). Consequently, *Facilitating Condition* positively influences *Use Behavior* (β= .290). Therefore, Hypothesis H1a and H1b are supported.

Table 5.12
The Influence of Behavior Intention to Use; and Facilitating Condition on Use Behavior

	Unstandardized Coefficients		Standardized Coefficients	
	B	SE B	β	Sig.
BI	.193	.024	.321	.000
FC	.217	.030	.290	.000

F= 75.6; Sig. F= .000; N= 585; Dependant Variable: USE

5.9.2 Regression Analysis on Factors Influencing Behavior Intention to Use

Multiple regression analyses were conducted to test the hypotheses H2a, H2b, H3, H4, H5, and H6. In this analysis, the adoption factors: *Perceived Usefulness*, *Perceived Ease of Use*, *Perceived Service Quality*, *Perceived Trust*, and *Cost of Service* are treated as the independent variables, whereas *Behavior Intention to Use* as the dependent variable. Through regression analysis procedure, the model of adoption factors explain around 40 percent (R^2 = .395) of the variance in *Behavior Intention to Use*. Moreover, the model reaches statistical significance (Sig. = .000, this really means $p<.0005$). Table 5.13 shows that of all the variables included in the regression equation, only two variables emerged as significant predictors of *Behavior Intention to Use*. These are *Perceived Usefulness* (β= .528) and *Perceived Service Quality* (β= .083). As being hypothesized, *Perceived Usefulness* and *Perceived Service Quality* are found to have a positive influence on *Behavior Intention to Use*. Therefore, Hypothesis H3 and H4 are supported.

The variables *Perceived Ease of Use*, *Perceived Trust*, and *Cost of service* are found have no significant effect with *Behavior Intention to Use*. Therefore, Hypothesis H12a, H12b, H5, and H6 were rejected.

To investigate which factors that have the most influence on *Behavior Intention to Use*, we used the beta values. Of the two significant variables, based on the size of their beta, the predictor variables exercising the most influence on *Behavior Intention to Use* was *perceived Usefulness* (β= .528).

In order to test hypothesis H2b, multiple regression analyses were conducted. The *Perceived Ease of Use* is treated as the independent variable, whereas *Perceived Usefulness* as the dependent variable. Through regression analysis procedure, the model of adoption factors explain 43 percent (R^2 = .426) of the variance in *Perceived Usefulness*. Moreover, the model reaches statistical significance (Sig. = .000, this really means p<.0005). Table 5.14 shows that *Perceived Ease of Use* (β= .65) is found has a significant effect with *Perceived Usefulness*. As being hypothesized, *Perceived Ease of Use is* found to have a positive influence on *Perceived Usefulness*. Therefore, Hypothesis H2b is supported.

For the regression of independent variables on *Behavior Intention to Use*, the tolerance values, the variance inflation factor (VIF) and the condition index for all the independent variables are examined to detect multicollinearity. The VIF should be close to 1.00 to indicate little or no multicollinearity. Hair *et al.* (2009) suggest a cutoff value of 10.00 as an acceptable VIF. From the tolerance and VIF values shown in the output indicates no multicollinearity effect among independent variables on dependent variables.

Table 5.13
The Influence of Adoption Factors on Behavior Intention to Use

	Unstandardized Coefficients		Standardized Coefficients	
	B	SE B	β	Sig.
PU	.396	.033	.528	.000***
PEOU	.058	.039	.071	.135
SQ	.039	.020	.083	.048***
T	.008	.021	.013	.705
CS	-.075	.044	-.058	.091

F= 108.2; Sig. F= .000; N= 585; Dependant Variable: BI

Table 5.14
The Influence of Perceived Ease of Use on Perceived Usefulness

	Unstandardized Coefficients		Standardized Coefficients	
	B	SE B	β	Sig.
PEOU	.708	.034	.653	.000

F= 432.493; Sig. F= .000; N= 585; Dependant Variable: PU

5.10 Summary

Descriptive statistics showed that in general, respondents perform moderate level of *Use Behavior*. However, the standard deviation demonstrated that statistically the variation of *Behavior Intention to Use* among respondents were high.

To examine the relationship between *Behavior Intention to Use* and *Use Behavior* as well as the factors influencing respondents to *Behavior Intention to Use* in their m-learning activities, regression analyses were conducted. Table 5.15 is presented below the summary of the findings from hypotheses testing:

Table 5.15
Summary of the Findings from Hypotheses Testing

Hypothesis	Accept / Reject
H1a: A student's behavioral intention to use an m-learning service has effect on use behavior of the m-learning services (BI → USE).	Accept
H1b: the facilitating condition of m-learning service has a direct effect on actual use of the m-learning services (FC → USE).	Accept
H2a: A student's perceived ease of use of an m-learning service has a direct effect on behavioral intention to use the m-learning service (PEOU → BI).	Reject

H2b: A student's perceived ease of use of an m-learning service has a direct effect on perceived usefulness of the m-learning service (PEOU → PU).	Accept
H3: A student's perceived usefulness of an m-learning service has a direct effect on behavioral intention to use the m-learning service (PU → BI).	Accept
H4: A student's perceived service quality of m-learning service has a direct effect on behavioral intention to use the m-learning service (SQ → BI).	Accept
H5: A student's perceived Trust has a direct effect on behavioral intention to use the m-learning service (T → BI).	Reject
H6: The cost of m-learning service has a direct effect on behavioral intention to use the m-learning service (CS → BI).	Reject

CHAPTER SIX

DEVELOPING M-LEARNING PROTOTYPE SYSTEM

6.1 Introduction

This chapter describes the research methodology that used for developing the m-learning prototype system. The development method is adapted from Design Science Research Methodology (DSRM). Finally, user evaluation is discussed and presented.

6.2 The Design Science Research Methodology

There are numerous methodologies that use in process of design science research in IS (Vaishnavi & Kuechler, 2008). The Design Science Research Methodology (DSRM) is chosen to precede the research since it emphasizes the knowledge generation inherent in the method of development. DSRM was proposed by Vaishnavi and Kuechler (2008). It consists of five phases which are awareness of problem, suggestion, development, evaluation, and conclusion. Figure 6.1 shows methodology phases, knowledge flows, outputs, and deliverable parts of the research methodology that adapted from DSRM.

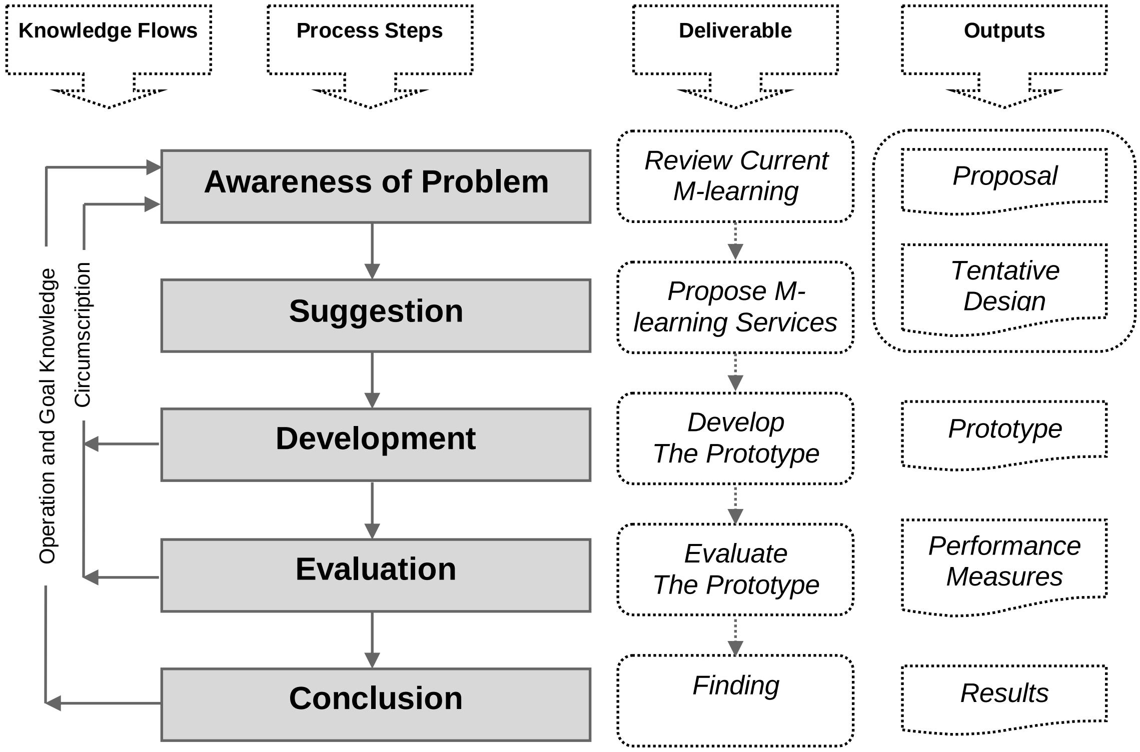

Figure 6.1: Framework of the Research Methodology

6.2.1 Awareness of Problem Phase

The first phase of DSRM is aware of community of the research which comprises the mobile technology; m-learning in higher education environment, and mobile services; and then defined the output of the research. According to Hoffer, George, and Valacich (2002), gathering of information could be done through direct interview. Besides that, literature review from the available sources such as books, proceedings, journals, white papers, reports, and news in order to gather knowledge of the services that were utilized. Through the literature review and investigation of the higher education, the researcher found that there is a lake in the mobile services provided by the universities.

In the preliminary study in chapter four, students asked about the university m-learning services that they would like to be available in their education environment. The study results show that the exam result and course registration were the highest rank, followed by Calendar and Schedule services, Library services, Treasury, Admission status, Campus Facilities, Alert system, and International students' services. Moreover, the survey that conducted to answer research questions two and three investigated the university m-learning services that students would like to use through mobile technologies, found that students have the same wishes towards the mobile services. The outputs of this phase are grasp knowledge of e-learning services and w-learning services that are the base of m-learning services; and investigation the m-learning environment.

6.2.2 Suggestion Phase

The suggestion phase follows immediately after the awareness of problem phase. Based on the result of the preliminary study and the awareness phase, this phase was focused on the administrative services which comprise the exam result, course registration, Calendar, Library services, Treasury. However, this study suggests developing the Student’s Mobile Information Prototype (SMIP) to provide the administrative services that could meet the students need. The output of this phase is the tentative design of the SMIP. Figure 6.2 illustrate the SMIP architecture. However, student can access the SMIP through the wireless media using his/here mobile phone, PDA, or smart phone. The development of the suggested prototype will discuss in the next phase.

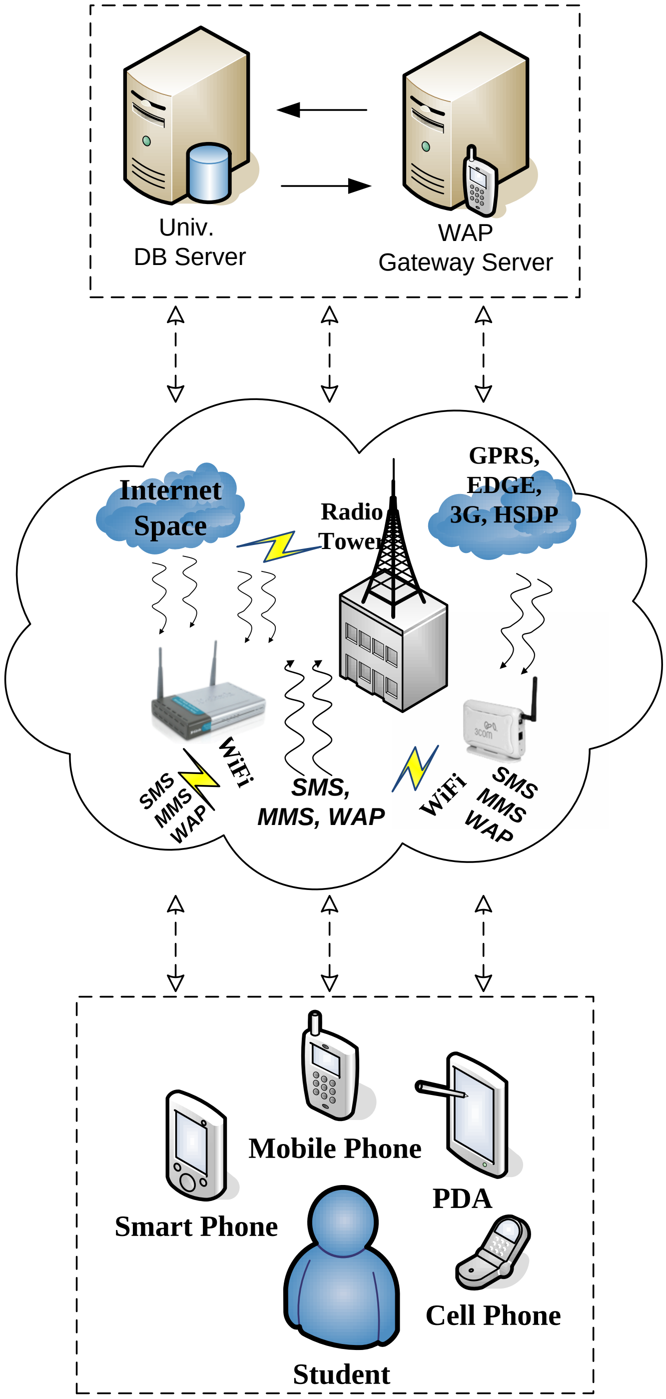

Figure 6.2: Student's Mobile Information Prototype (SMIP) Architecture

6.2.3 Development Phase

The third phase involves the development of the prototype SMIP. The tentative design was implemented in this phase. The limitation of mobile phones and communication were considered when designing the SMIP.

Furthermore, the navigation hyperlinks were anchored in the bottom of each page; information displays were selected carefully, to meet the small screen of mobile phones and to reduce the scrolling down; size of the header image is less than 3.5 bytes to reduce the download cost and to avoid the low speed of network connectivity; in addition, list boxes, radio buttons, and hyperlinks were used to reduce the key-in inputs and to avoid the weakness of mobile phones input capabilities. As in Figure 6.3 which shows the SMIP UML's Use Case Diagram, student can access several services, such as course info, access library, and course registration.

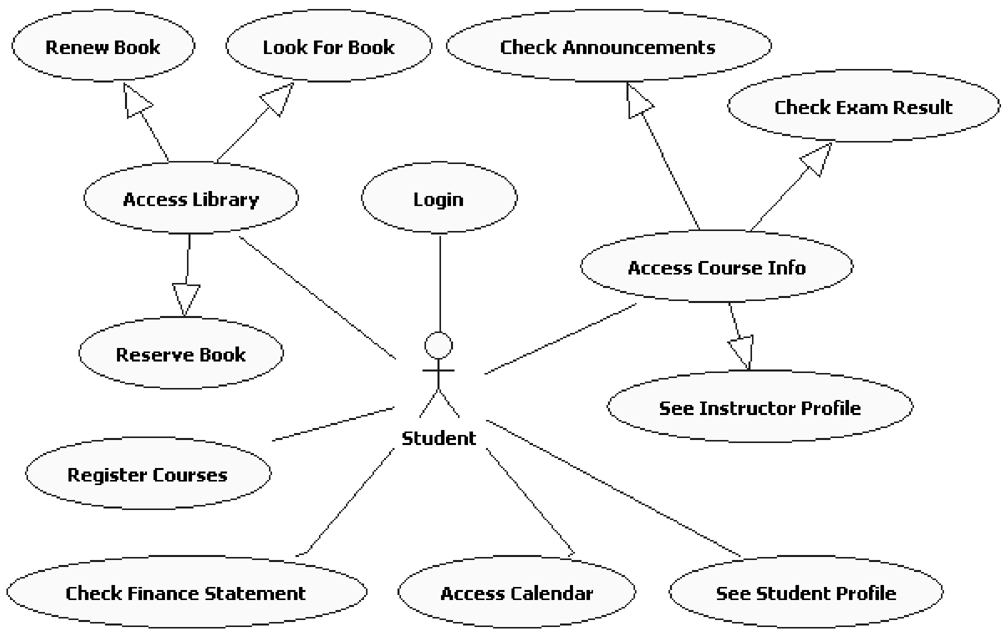

Figure 6.3: SMIP UML's Use Case Diagram

Consequently, the design was translated into program code. SMIP was developed based on the Wireless Application Protocol (WAP) using Microsoft Visual C#.NET. It was completely developed under .NET Framework using ASP.NET 2.0 as Integrated Development Environment (IDE). The development of the prototype follows the Prototyping Approach methodology. The prototyping process comprises three steps which are adapted from Prototyping Process (Laudon & Laudon, 1995), as shown in Figure 6.4. Prototyping provides end users with artifacts that allow them to gain insight into the behavior of the system before the final delivery.

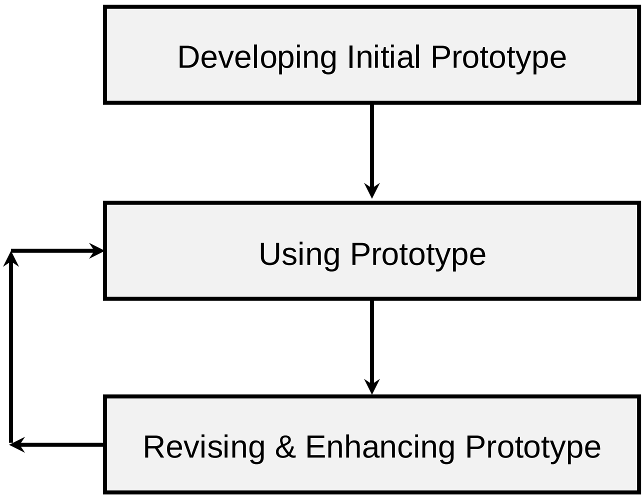

Figure 6.4: Prototyping Process

SMIP provides eight main services comprises course announcement, exam result, instructor profile, course registration, finance statement, calendar, student profile, and library loan services. The navigation hyperlink button of each page enables student to navigate easily, through and between, SMIP pages.

Figure 6.5: Snapshot of Home Page of SMIP

The snapshot in Figure 6.4 shows the home page of SMIP. This screen is the start point for logging SMIP services. Firstly, student has to hit Login link to redirect him/her to login page. Secondly, user has to key-in his/her username and password as shown in Figure 6.6.

In case of user being approved, the welcome page will show the student welcome message. Otherwise, invalid message will be shown for user tells him/her to retype the username and password.

Figure 6.6: Snapshot of Login Page

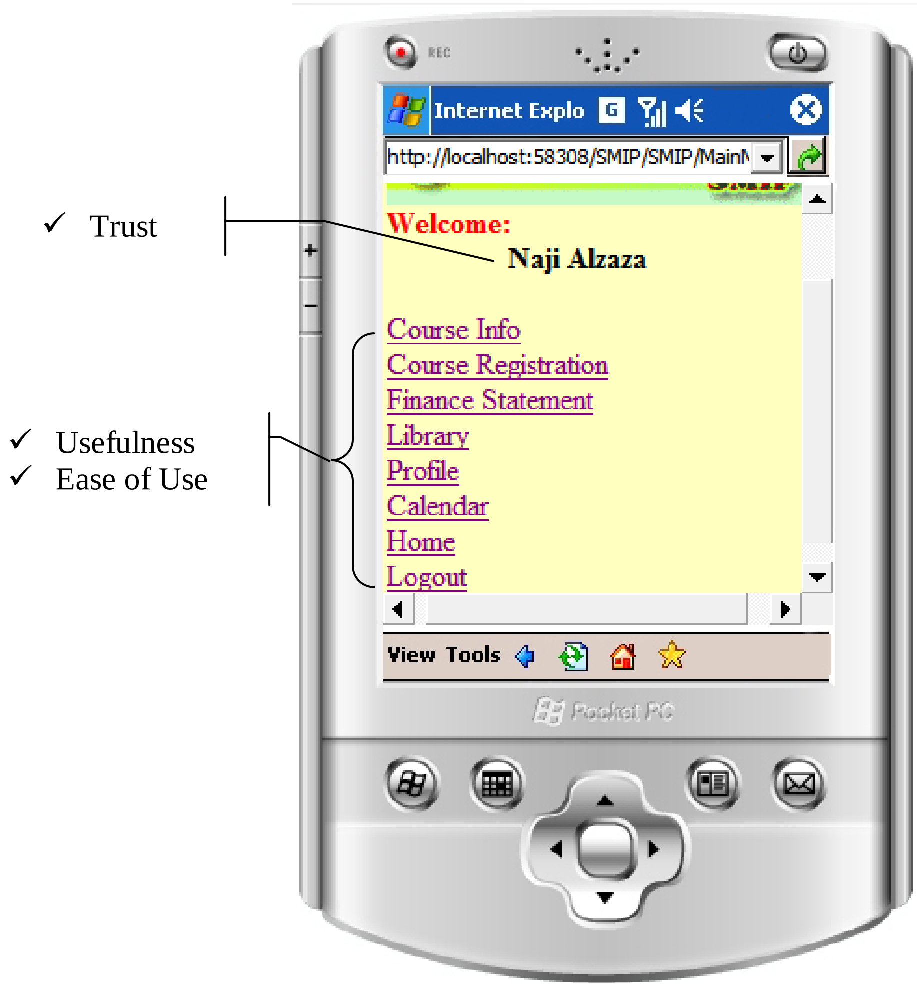

Figure 6.7: Snapshot of Main Page “Welcome Page”

Snapshot of welcome page shown in Figure 6.8 is the main page that enables student to navigate all SMIP services. By hitting the course info link, student will be directed to course info page.

Figure 6.8: Snapshot of Course Info Page

Snapshot in Figure 6.8 shows the services are related to the certain course. To use any services, student has to select the subject course first. By pressing the announcements button, the related active announcements will be displayed as shown in snapshot in Figure 6.9. Then student has to select the certain announcement. Next, student has to press button display details to see the announcement details as in Figure 6.10.

✓ Ease of Use
✓ Service Quality

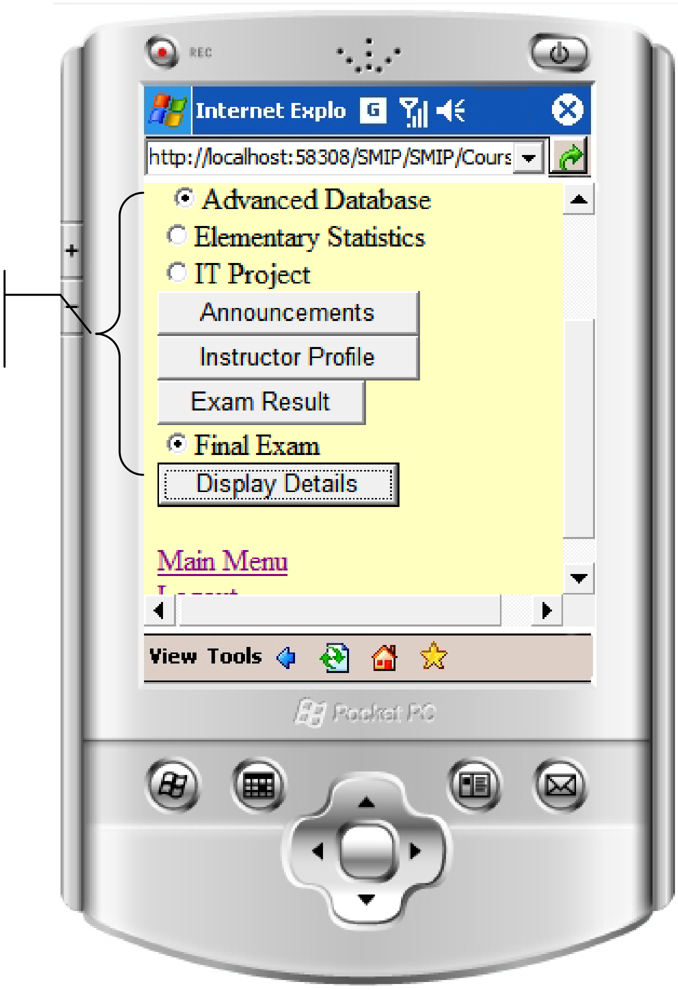

Figure 6.9: Snapshot of Course Announcement (A)

Figure 6.10: Snapshot of Course Announcement (B)

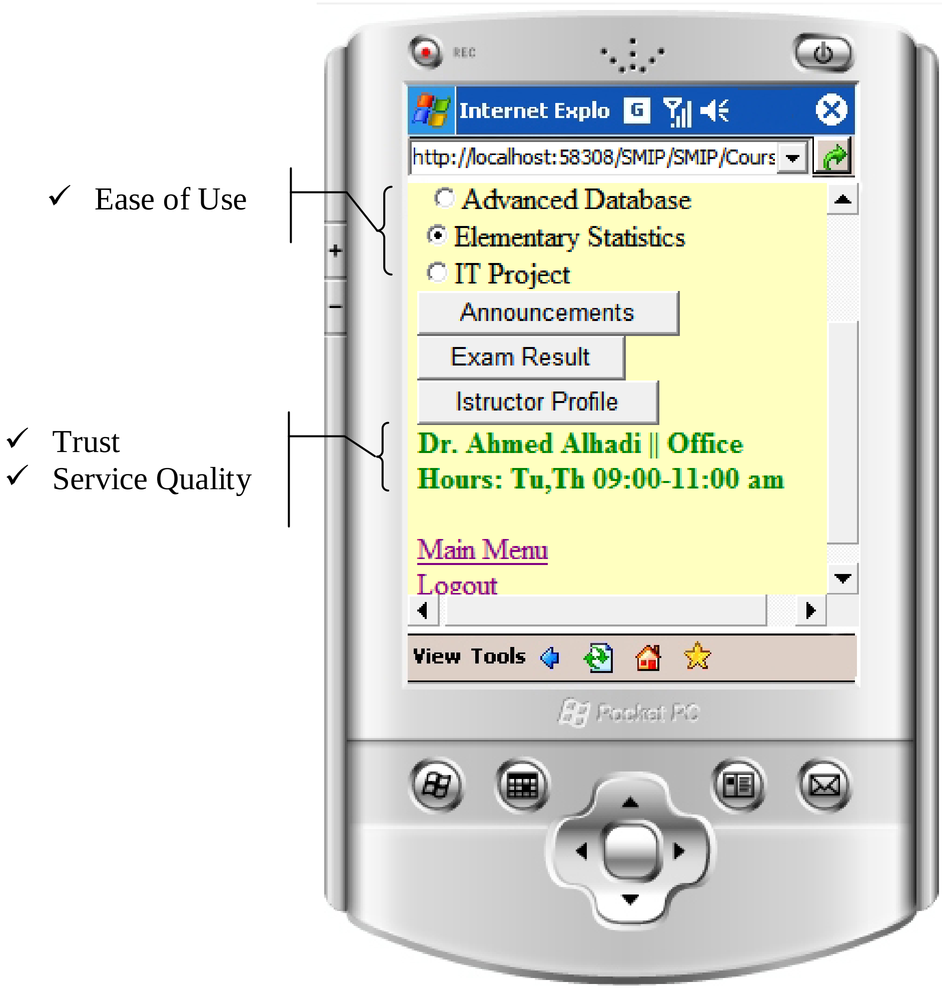

Figure 6.11: Snapshot of Instructor Profile

To see the instructor profile for the selected course, student has to press the instructor profile button as shown in Figure 6.11. The screen previews the instructor name, office hours, and the academic position of instructor.

Similarly, to check the exam result for selected course, student has to press the exam result button as shown in Figure 6.12. In case the result is not released, information message will be displayed to inform student about that.

Figure 6.12: Snapshot of Course Exam Result Service

Figure 6.13: Snapshot of Course Registration Services (A)

Snapshot in Figure 6.13 shows the course registration service. SMIP listed the subjects that are allowed for registration based on student's academic plan and the current semester schedule. To register subject, student has to select the specific subject from the listed subjects. Then student has to press select group button to retrieve the available groups of the subject that has been selected. After that, student has to select the proper group. Finally, to save current transaction, student has to press add button to submit his course registration. To register another course, student has to do the same procedure that has just mentioned above. When the course registers successfully, message will be displayed to confirm the registration as in Figure 6.14.

Figure 6.14: Snapshot of Course Registration Services (B)

- ✓ Usefulness
- ✓ Service Quality
- ✓ Cost of Service

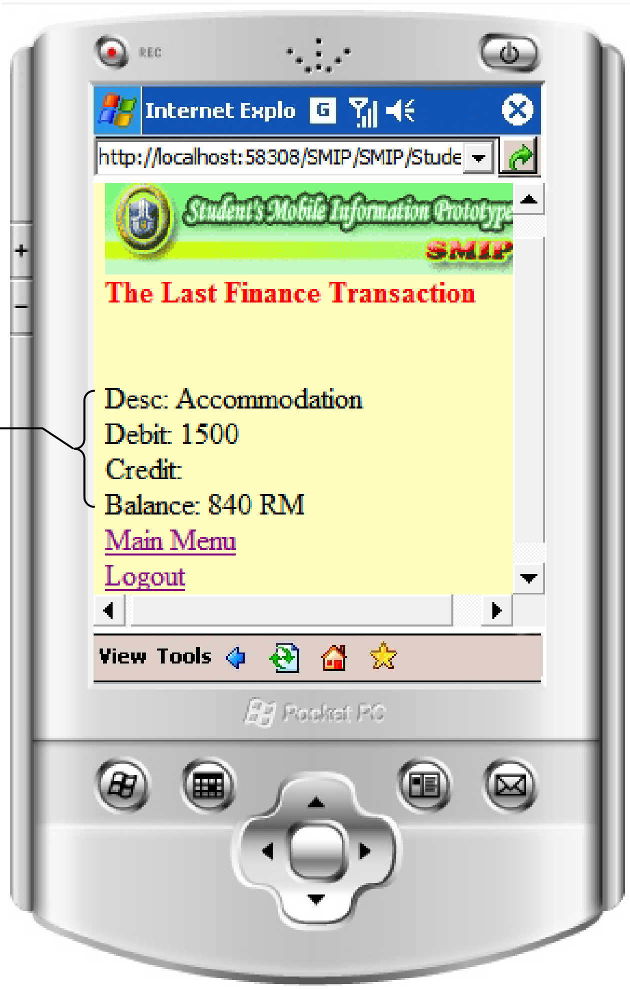

Figure 6.15: Snapshot of Finance Transaction Service

SMIP enables student to check his/her finance transaction and the balance, as well. Snapshot in Figure 6.15 shows the transaction description, transaction type (debit or credit), and the current balance of the last finance transaction for the student.

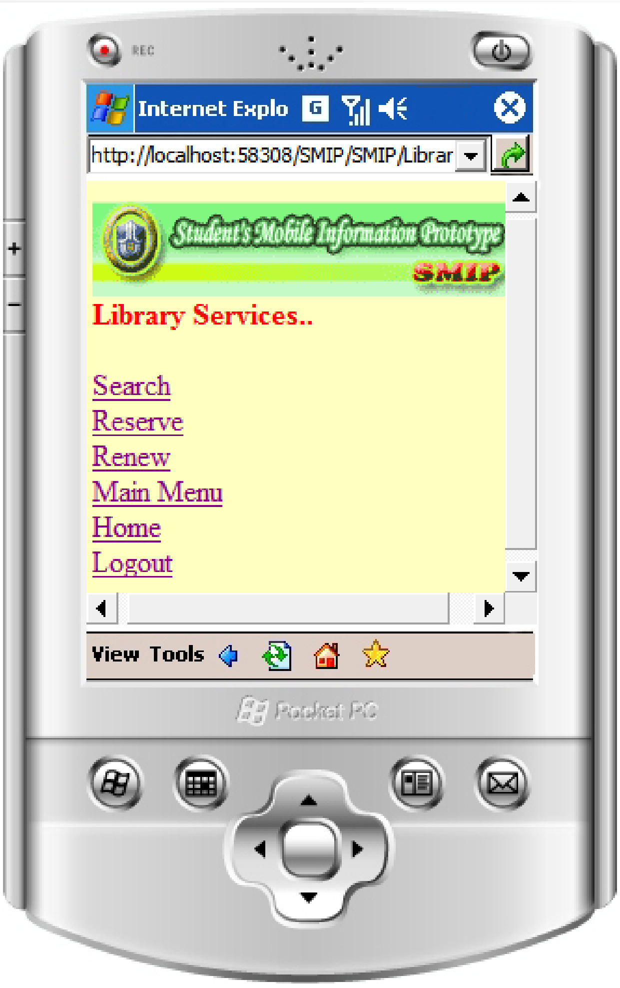

Figure 6.16: Snapshot of Library Loan Services

Snapshot in Figure 6.16 shows the main page of the library loan services that provided by SMIP. The services comprise searching, book reservation, and book renewing. As shown in Figure 6.18, search service gives student the ability to search for books using title or author name.

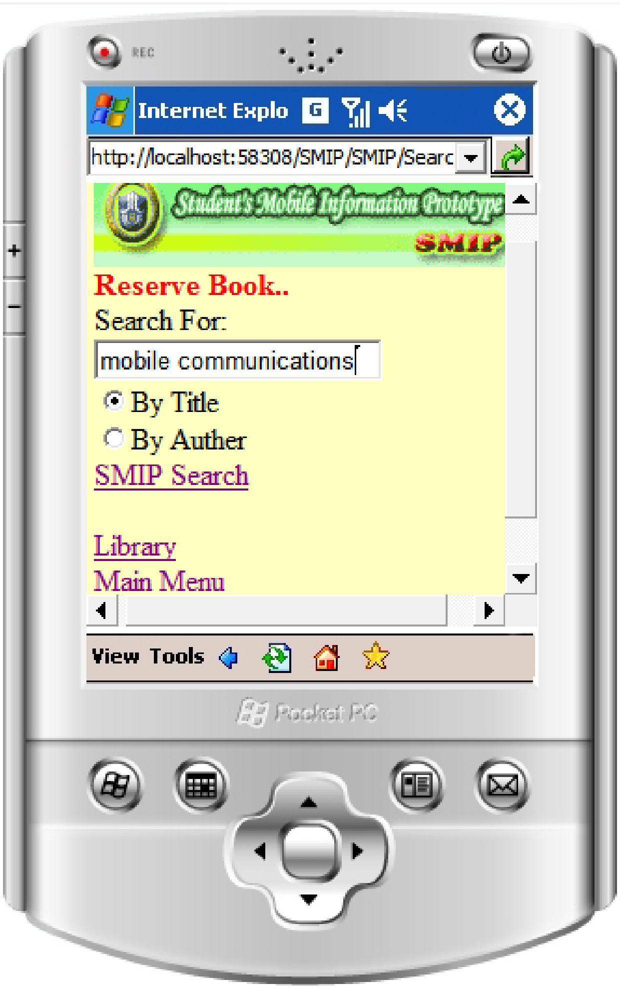

Figure 6.17: Snapshot of Library Search Service Page

After key-in the search criteria (i.e. book title or author name), student has to hit SMIP search link to run the search engine. Search result will be displayed in different page as shown in Figure 6.18. Search result enables student to reserve a certain book by hit reserve link after explore the book details.

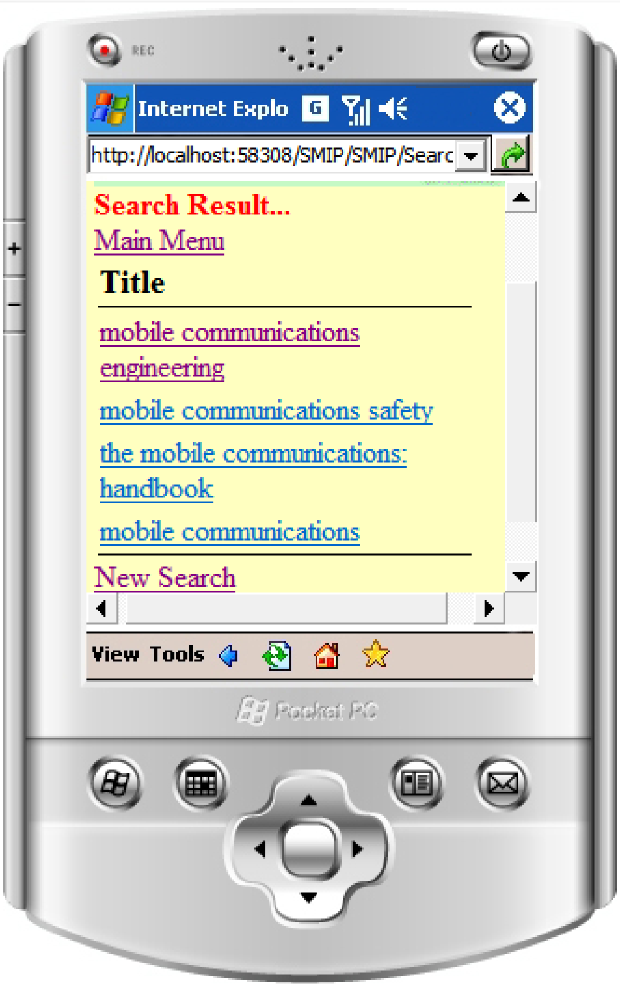

Figure 6.18: Snapshot of Library Search Result Page

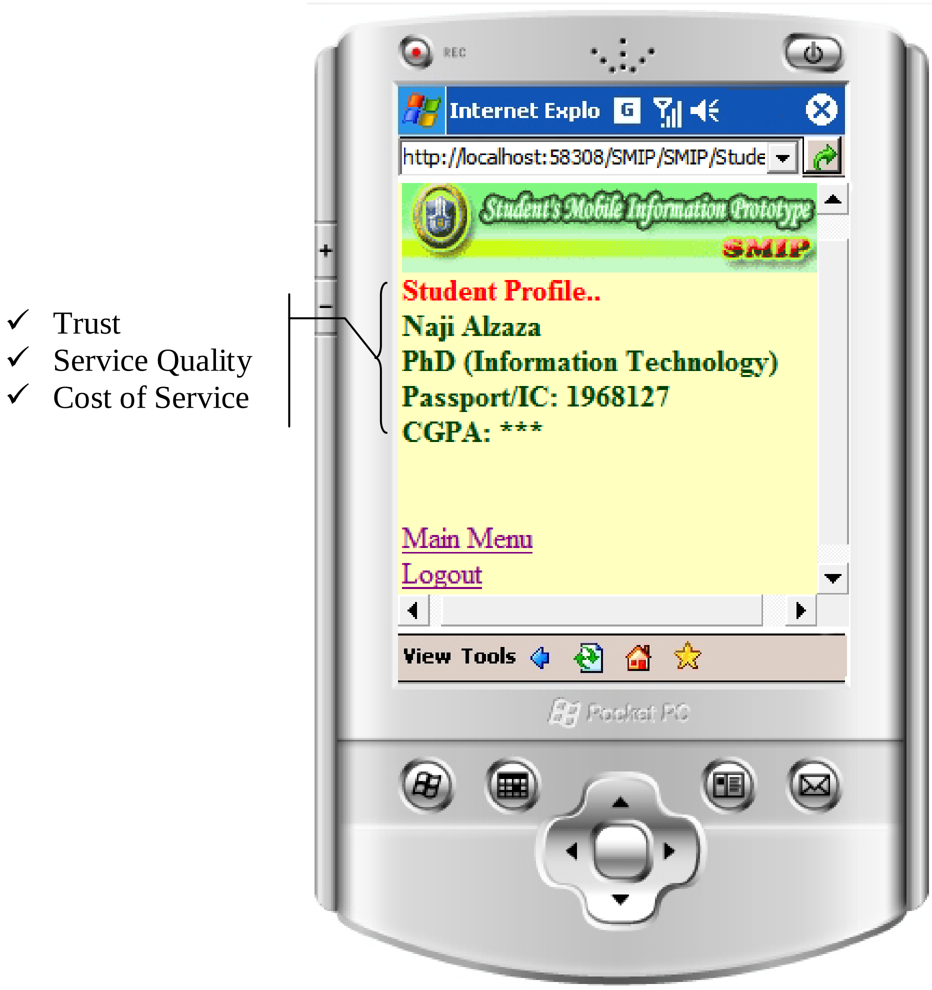

Figure 6.19: Snapshot of Student Profile Page

SMIP allows student to check his/her profile. As shown in Figure 6.19, student profile page displays student name, academic program, Identification number (IC) or passport, and the cumulative grade point average (CGPA) for coursework students.

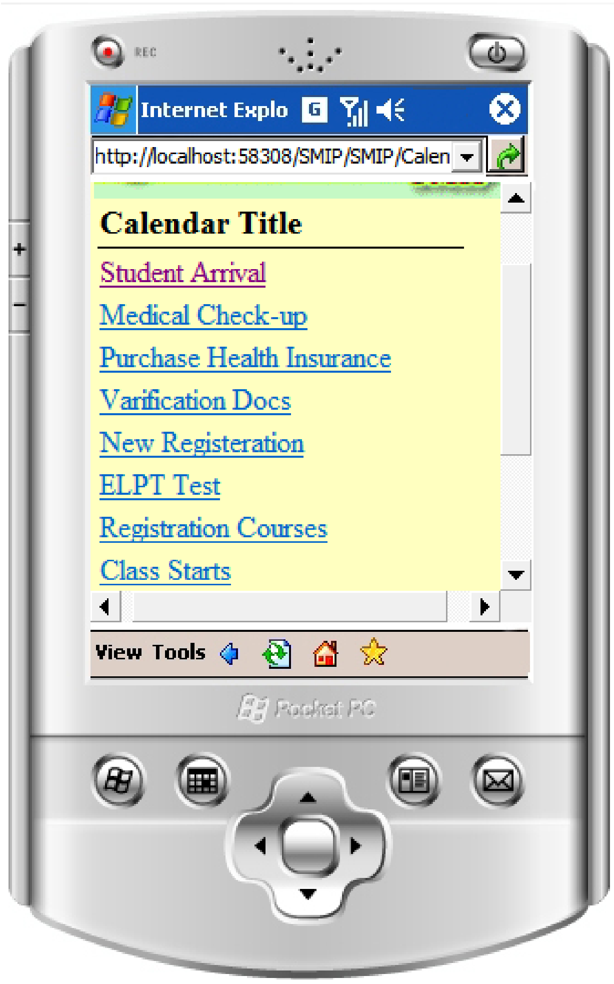

Figure 6.20: Snapshot of Calendar Page (A)

The last service is academic calendar for the current semester. Snapshot in Figure 6.20 shows the titles of the academic events or activities that are scheduled by university for the current semester. To display the details of certain calendar, student has to hit the link of the calendar title. SMIP will preview the details in different page as shown in Figure 6.21. Calendar details comprise title of the event, start date, end date, and the activity/event descriptions.

Figure 6.21: Snapshot of Calendar Page (B)

6.2.4 Evaluation Phase

The evaluation was conducted to determine users' perception on the usability aspects of the prototype. The instrument was adapted from Davis (1989) and Lewis (1995). The instrument was assessed the performance of MSIC and it covered four dimensions: *Usefulness, information quality, interface quality, and Efficiency.* According to Davis (1989), the Perceived Usefulness and Ease of Use (PUEU) is a strong correlation of users acceptance. So it should not be ignored by those attempting to design or implement successful systems.

6.2.4.1 Usability Evaluation

The usability is considered an important attribute of software quality. It is concerned with making systems easy to learn and easy to use. The term is used to describe the quality of a user's experience when interacting with a system whether a website, a software application, mobile technology, or any other human operated device. However, a usable system enables users to perform their job effectively and efficiently.

Usability can defined as term used to denote the ease with which people that can employ a particular tool or other human-made object in order to achieve a particular goal. Usability can also refer to the methods of measuring usability and the study of the principles behind an object's perceived efficiency or elegance (Nielsen, 1994). International Organization for Standardization (ISO) 9126, defined usability as: the set of attributes that bear on the effort needed for use, and on the individual assessment of such use, by stated or implied set of users (International Organization for Standardization [ISO], 1991).

The importance of usability study in information technology has considered widely. GOMS (Goals, Operators, Methods, Selection rules) models, for example, has been in place since the early 1980s and has gone through many successive iterations in the meantime (John & Kieras, 1996). This model provides software engineers with quantifiable data and computationally relevant models of user information processing that can be used to pinpoint inefficiencies in existing systems and provide baseline measures to compare alternate iterations of a product (Jones, Rieger, Treadwell, & Gay, 2000).

GOMS tends to focus on formal derivations of user mental models and measurements of individual user performance in discrete, bounded tasks. Furthermore, GOMS-based models are effective tools to create abstract models of user behavior and predict potential future behavior.

Researchers in the digital library community have indicated the need for development such multifaceted, user-centered approaches (Computer Science and Telecommunications Board [CSTB], 1998; Missingham, 1999) and have begun to integrate user feedback into the design process (Collections & Efforts, 1999; Plaisant, Marchionini, Bruns, Komlodi, & Campbell, 1997). Moreover, Jones *et al.* (2000) argued that such focusing on user context and activity is especially relevant when mobile computing technologies are the focus of attention.

Mobile computing challenges the status quo by forcing designers to make moderation of a new set of abilities and limitations brought forth by small and lower-fidelity screens, small amounts of memory and storage, slow network connectivity, and alternative forms of input. Successful designs tend to be simple, elegant, stable and functional, albeit within a tightly constrained range of potential usage contexts. Designing within the limitations of these "information appliances" requires a solid and broad understanding of user behaviors and tasks in order to be effective in practice (Norman, 1998). Therefore, two studies Nielsen (1994) and Shneiderman (1980) introduced a framework of system acceptability, where usability is a part of "usefulness", they list five attributes of usability that are learnability, efficiency, memorability, errors and Subjective satisfaction.

Several of usability researches have documented about user interface issues with mobile devices. Some research is published about using services with mobile devices. Kaikkonen and Tormanen (2000) reported about user experiences with mobile banking services. Scholars concluded that with the observation that the critical aspect in service development is that, the usability issues are taken seriously in consideration during the design process. This means that a good mobile service provides the content in the right form.

Several WAP usability problems appear during the early stages of system development (Ramsay & Nielsen, 2000). Furthermore, usability issue is critical to the adoption of mobile applications (Chan, et al., 2002). However, good user interface design can reduce some of the usability problems for WAP phone users. Colafigli, Inverard, and Martriccian (2001) recommended several design guidelines for WAP applications, including: use short links, include backward navigation on every card, minimize the level of menu hierarchy, reduce the amount of vertical scrolling and include headlines for each card.

Usability evaluation includes two types: Formative Evaluation and summative evaluation. A summative evaluation is a test that occurs at the end of a mission such lesson or schooling semester. Formative evaluation is a method of judging the worth of a program while the program activities are forming or happening (Bhola, 1990). It can be used to assess training course or workshop as it in progresses, to find out the extent of program implementation or to determine improvements and adjustments needed to attain the educational objectives. However, summative evaluation is a method of judging the worth of a program at the end of its activities (Bhola, 1990). Moreover, it can be used to find out the extent to which educational objectives were achieved or to help you decide whether an educational activity, or any of its parts, should be revised, continued, or terminated.

While formative evaluation focuses on the process, the summative evaluation focuses on the outcome. Formative evaluation can use focus group testing, interviews or Small group testing. And summative evaluation can use testing, full-field studies. However, both of them can use surveys as a tool to acquire and evaluate the user perspective towards the system or prototype. However, this study uses summative type of usability evaluation.

6.2.4.2 User Evaluation

User evaluation conducts to determine user's perception on the usability aspects of the prototype. Despite user evaluation based on the scores of evaluation instrument, the success results not from high post test scores but from effective behavior (Allen, 2007).

However, Post Study Satisfaction User Questionnaire (PSSUQ) enables to obtain the subjective data from students. The PSSUQ introduced by Lewis (1995) and modified by Zins, Bauernfeind, Del Missier, and Rumetshofer (2004). Figure 6.22 shows the whole dimensions of the PSSUQ which suggested by Lewis (1995).

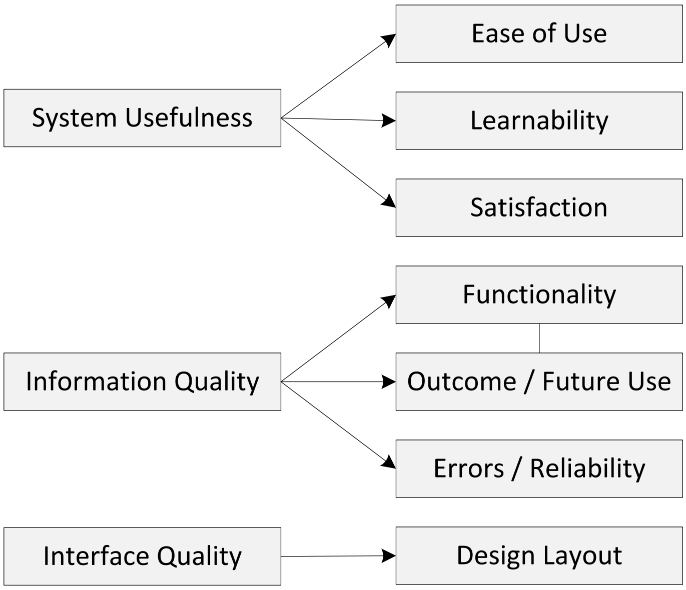

Figure 6.22: Dimensions of the User Evaluation Based On PSSUQ

Caladine (2008) state that any tool that assists designers of learning to select technologies that is appropriate to the students, objectives, and the budget. Moreover, it must be able to operate within the designer's choice of designing for student's learning preferences. Moreover, Rekkedal and Dye (2007) used user friendliness, didactic efficiency, technical feasibility, cost efficiency, functionality, and quality dimensions to evaluate their m-learning system.

Pramongkit, Muangthanya, & Chaikiart (2002) conducted a survey about the WAP service of Thailand in an attempt to promote the WAP service and the future 3G with effective means. The results of this investigation show that the major impediments of the WAP service are due to the slow speed of data transfer and lacking usability. The authors summarize the key success factors as speed of data transfer; content and application; payment method; price of handset; customer awareness and education; and marketing and promotion.

6.2.4.3 The Implication of Usability Evaluation on the Research

From the literature there is evidence that the evaluation of the mobile learning system should be conducted to measure the usability elements that could affect on it. This reviewing gave the researcher a clear view about the elements and the instruments that should be used to conduct the usability evaluation in terms of user (student) evaluation.

6.2.4.4 SMIP Evaluation Results

The instrument was adapted from Rekkedal and Dye (2007), Lewis (1995), Zins *et al.* (2004), and Davis (1989). The survey was piloted and some minor changes were made. Data collection for this research part (SMIP evaluation) was undertaken during the second semester of academic year 2009/2010. The instrument comprises two sections: general information and dimensions of user evaluation (see Appendix I). General information section works as a mechanism to collect users' demographic data, users' experience and knowledge with the mobile applications.

As shown in Figure 6.23, the instrument dimensions of adaptive user evaluation comprise four dimensions that are system usefulness, information quality, interface quality, and system efficiency. A 5-point Likert scale anchored by "Strongly Disagree" (1) and Strongly Agree (5) was used.

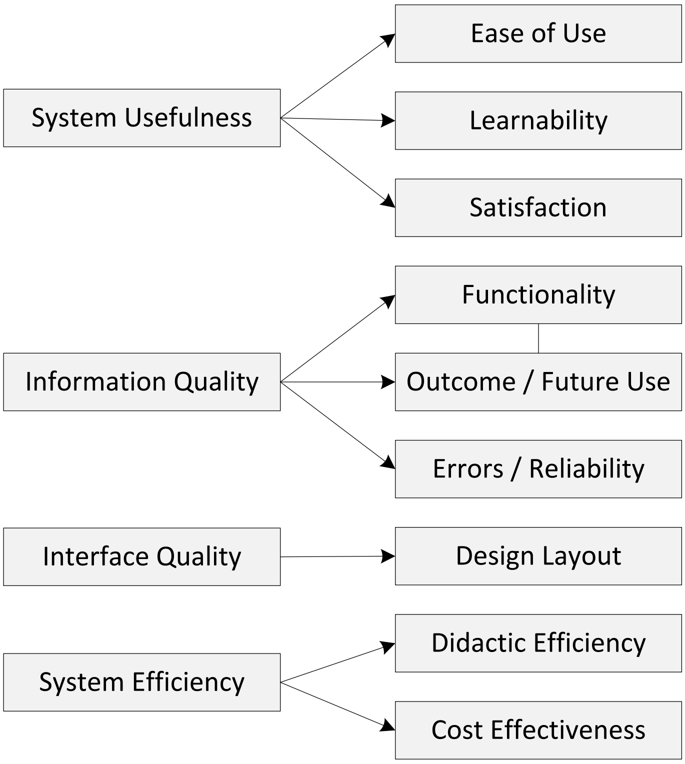

Figure 6.23: Dimensions of the Adapted User Evaluation

The SMIP user evaluation was conducted on 105 respondents, however, Nielsen (2006) has recommended 20 users for usability in quantitative studies. Each of them was given brief explanation regarding the usage and user interface of the prototype. Each user was allocated a proper time to use and explore the content of the prototype. Once they were done, users were given a questionnaire for user evaluation. Descriptive statistics, reliability analysis and t-test were used. SPSS version 14 was used to analyze the data. Results from the descriptive, reliability, and t-test analyses will be discussed in the following sections.

6.2.4.5 Demographic Data

A sample of 105 random selected bachelor students' response. As shown in the Table 6.1, 45.7% of respondents were male and 54.3% were female, majority of respondents (94.3%) were aged between 20 and 25 years old. In terms of education background, 46.7% were from business studies, 45.7% were from science studies, and art studies were only 7.6%. 90.5% of the participants declared that they own mobile phone, 8.6% own smart phone, and only 1% own PDA. Regarding mobile application experience, 48.6% have less than 5 years of use the mobile application and 44.8% have experience between 5 and 9 years; while only 6.7% have more than 9 years. This indicates that the respondents are quite respectable in terms of mobile application usage.

Table 6.2 presents the Cronbach's alpha (α) value for each measure. It should be noted that all the negative worded items in the questionnaire were first be reversed coded before the items were submitted for reliability test. In the case of *Learnability's* coefficient alpha was .547, which is smaller than .70, the item with the lowest corrected item-to-total correlation was removed until the .7 level was met (Pallant, 2007). All measures have Cronbach's alpha of greater than 0.7, thus, these measures satisfy the internal reliability criterion (Pallant, 2007).

Table 6.1
Demographic Data of Respondents

Measure	Item	N	(%)	Cumulative %
Gender	Male	48	45.7	45.7
	Female	57	54.3	100.0
Age	Below 20	5	4.8	4.8
	20-25	99	94.3	99.0
	26-30	1	1.0	100.0
Education	Science	49	46.7	46.7
	Business	48	45.7	92.4
	Art Studies	8	7.6	100.0
Mobile Devise Type	PDA	1	1.0	1.0
	Smart Phone	9	8.6	9.5
	Hand Phone	95	90.5	100.0
Mobile Application Experience	< 5 Years	51	48.6	48.6
	5 - 9	47	44.8	93.3
	>= 10 Years	7	6.7	100.0

The ranges of five point Likert-scales were categorized into equal sized categories of low, moderate, and high. Therefore, score of less than 2.33 [4/3 +

lowest value (1)] are considered low; scores of 3.67 [highest value (5) - 4/3] are considered high; and those in between are considered moderate. As shown in Table 6.2, six of measures with high means are bolded which indicate that most of the participants highly agreed on *Perceived Usefulness*, *Perceived Ease of Use, Learnability, Functionality, Outcome/Future Use*, *and Didactic Efficiency*. Overall, the results indicate that the participants agreed that SMIP has appropriate usability level. However, all other dimensions are moderated.

Table 6.2
Cronbach's Alpha Values for All Dimensions (n=105)

Variable	Number of items	Mean	Alpha (α)
Perceived Usefulness	6	**3.886**	.929
Perceived Ease of Use	6	**3.942**	.927
Learnability	3	**3.924**	.867
Information Quality	7	3.657	.904
Functionality	4	**3.745**	.890
Errors/System Reliability	2	3.300	.806
Outcome/Future Use	6	**3.733**	.926
Interface Quality	4	3.660	.899
Design/Layout	3	3.648	.908
Didactic Efficiency	4	**3.802**	.875
Cost Effectiveness	3	3.603	.808

6.2.4.6 Impact of Mobile Experience on Levels of Measurements

A one-way Analysis of variance (ANOVA) between groups was conducted to explore the impact of *Mobile Experience* on levels of perceived usefulness, perceived ease of use, learnability, information quality, functionality, errors/system reliability, outcome/future use, interface quality, design/layout, didactic efficiency, and cost effectiveness. The results of the test of three mobile applications experience groups indicated that there was no statistically significant difference in the mean of all measurements by mobile experience of respondents.

6.2.5 Conclusion Phase

Conclusion phase is the final phase of the DSRM. Student's Mobile Information Prototype (SMIP) was developed to facilitate education for students of the higher education environment, using mobile technology anywhere and anytime. The prototype was evaluated and the results confirm that it is useful for users to make their transactions easy, direct and successful, regardless of location and time. It is hoped that the findings of this study will encourage students in the higher education institutions to keep in touch with their education environment anywhere and anytime.

6.3 Reflecting Factors of Students' Acceptance Model

The fourth objective of this research is to develop and implement an m-learning prototype system for the higher education environment reflecting factors identified in the students' acceptance model. Furthermore, SMIP take care these factors during the DSRM phases such as *Awareness of Problem Phase* and *Suggestion Phase*.

However, the model factors that are accepted are Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Perceived Service Quality (SQ), Perceived Trust (T), and Cost of Service (CS). Table 6.3 shows that how SMIP reflects the factors of students' acceptance model that identified and accepted.

Table 6.3
Reflection Factors of Students' Acceptance Model

Factor	Reflection Issues
Perceived Usefulness (PU)	✓ Student can easily choose the interested service by hitting its hyperlink name. ✓ SMIP utilizes *List Boxes*, *Radio Buttons*, and *Hyperlinks* to reduce the key-in inputs and to avoid the weakness of mobile phones input capabilities. ✓ SMIP Provides the useful Sub-Options of each service in the same window.
Perceived Ease of Use (PEOU)	✓ Student can easily Logout from any page. ✓ Student can easily navigate through the SMIP using the *Main Menu* and *Home* hyperlinks. ✓ Popular graphical tools such as Buttons, List Boxes, *Radio Buttons,* and *Text Boxes* are utilized to enable student easily interact and accomplish his/her tasks.

Factor	Reflection Issues
Perceived Service Quality (SQ)	✓ To reduce the scrolling down, SMIP care about small screen of mobile phones and limitations of keypad. ✓ SMIP gives student up-to-date info such as last *Announcements* and *Exam Results*. ✓ SMIP prompts info and services to student such the available courses and groups to register. ✓ Login screen, University Logo, and welcome message provide confidential services. ✓ SMIP provides the services that meet the student need, this based on the preliminary study (refer to chapter four).
Perceived Trust (T)	✓ SMIP provide a welcome message to the student who successfully logged in by his name. ✓ For each window, SMIP show the unified header image which include University logo. ✓ SMIP does not ask or collect any personal information, it just require login info.
Cost of Service (CS)	✓ SMIP uses header image with size less than 3.5 bytes to reduce the download cost and to avoid the low

Factor	Reflection Issues
	speed of network connectivity. ✓ Using SMIP can be used via any mobile phone, smart phone, or PDA has a connection to internet, so it does not need any new equipment from student's side. ✓ Transactions can be accomplished via Wi-Fi zone anywhere or via GPRS of any mobile service providers.

6.4 Summary

This chapter elaborates the detail aspects of the approach that will be undertaken by this research. Four important aspects- the research design, data collection, data analysis, and developing of m-learning prototype have been discussed. The reflection of the factors of students' acceptance model is stated.

CHAPTER SEVEN

DISCUSSION AND CONCLUSION

7.1 Introduction

This chapter recapitulates the findings, followed by a discussion of them. The limitations and future research directions are explained. This chapter ends with study contributions and conclusion.

7.2 Recapitulation of the Study Findings

This study investigates the students' acceptance of behavior intention to use m-learning and its effect on usage behavior in the higher education environment. Specifically, the first objective of this study is to review the technology capabilities and limitations of the current mobile learning services in the higher education environment. The second objective is to investigate students' awareness and requirements regarding mobile learning services in the higher education environment. The third objective is to identify the factors those determine students' acceptance and use of m-learning in the higher education environment. Finally, the fourth is to develop and implement an m-learning prototype system in the higher education environment.

Revisiting the study's objectives, this study was undertaken to seek answers to several research questions (i) what are the technology capabilities and limitations of m-learning services in the higher education environment? (ii) what are the user requirements towards the use of m-learning in the higher education environment? (iii) what are the factors that influence the acceptance and use of m-learning in the higher education environment? and (iv) how can the identified m-learning acceptance factors be considered into the development of m-learning system in higher education environment?

As noted in chapter five, data were gathered from five of Malaysian public Universities. Out of 623 questionnaires were distributed, 595 were useable. Thus, the effective response rate is 95.5 percent.

Exploratory principal component factor analyses were utilized to test the factorial validity of the measures in this study. The analyses undertaken produced various dimensions of the acceptance factors. The hypotheses were then reformulated using these new dimensions. The internal consistency of the measures was then tested by computing the reliability coefficient. Finally, the data were analyzed using regression analyses to test the hypotheses of the study. The .05 level of significance was used as the critical level for decision making regarding the hypotheses.

7.3 Discussion

Responding to the first research question, literature and research were reviewed. The research was focused on the current mobile technology and its aspects. From the literature, there is evidence that e-learning services have been utilized successfully in the higher education as a vital platform of conventional learning media. Wireless technology could be increase the accessibility of e-learning. Furthermore, such technology and its elements are suitable to be utilized in the education on-campus and off-campus, as well. Literature shows that the limitations of mobile technology are reduce by the time and the capabilities are going on.

However, after reviewing the mobile technology and its elements, it becomes much clearer to the researcher that such technology can be utilized effectively in the higher education environment to provide vital services of education for students anywhere and anytime. Moreover, both of the environment and the infrastructure are appropriate to diffuse m-learning in the higher education environment.

After reviewing the m-learning services in the higher education environment, some obstacles of m-learning that are preventing students' motivation to use such technology need to tackle and concern such as mobile devices capabilities and media communications. Furthermore, it becomes much clearer to the researcher that there is indeed a need to identify the factors that should be considered when utilizing such technology in the higher education environment and the factors that should be considered when adopt it among student in the higher education environment

To answer the second research question, the preliminary study was conducted. The survey was utilized to investigate students' awareness and requirements regarding m-learning services in the higher education environment. The study provided the knowledge base about the current state of students' awareness about m-learning services. The study found that the present higher education environment has the necessary mobile technology infrastructure to utilize m-learning effectively. Moreover, the results of the survey show that students have adequate knowledge and valuable awareness to use such technology in their education environment. Regarding the university mobile applications that students would like to use individually through mobile technologies, the exam result and course registration were the highest rank, followed by Calendar and Schedule services. The highest limitations were the cost of transaction and slow data exchange with wireless networks, followed by concerns over confidentiality of personal information.

To answer the third research question, hypothesized model was developed and regression analysis undertaken revealed that out of the nine hypotheses tested; only five hypotheses were supported. These include Perceived Usefulness, Perceived Ease of Use, Facilitating Condition, Perceived Service Quality, Perceived Trust, and Cost of Service (see Figure 7.1). Despite *Perceived Trust* had significant correlation between all variables, except Use Behavior, the strength was weak. The significant correlation between *Perceived Trust* and *Cost of Service* was medium. With regards to *Cost of Services* and *Behavior intention to Use;* and *Cost of Services* and *Use Behavior,* the correlation is negative but not significant.

T-test was conducted to explore the impact of Age, Education Background, mobile Experience, and Gender groups on levels of all measurements. Results indicate that respondents with different gender and education Background are found to perform similar level of all adoption variables.

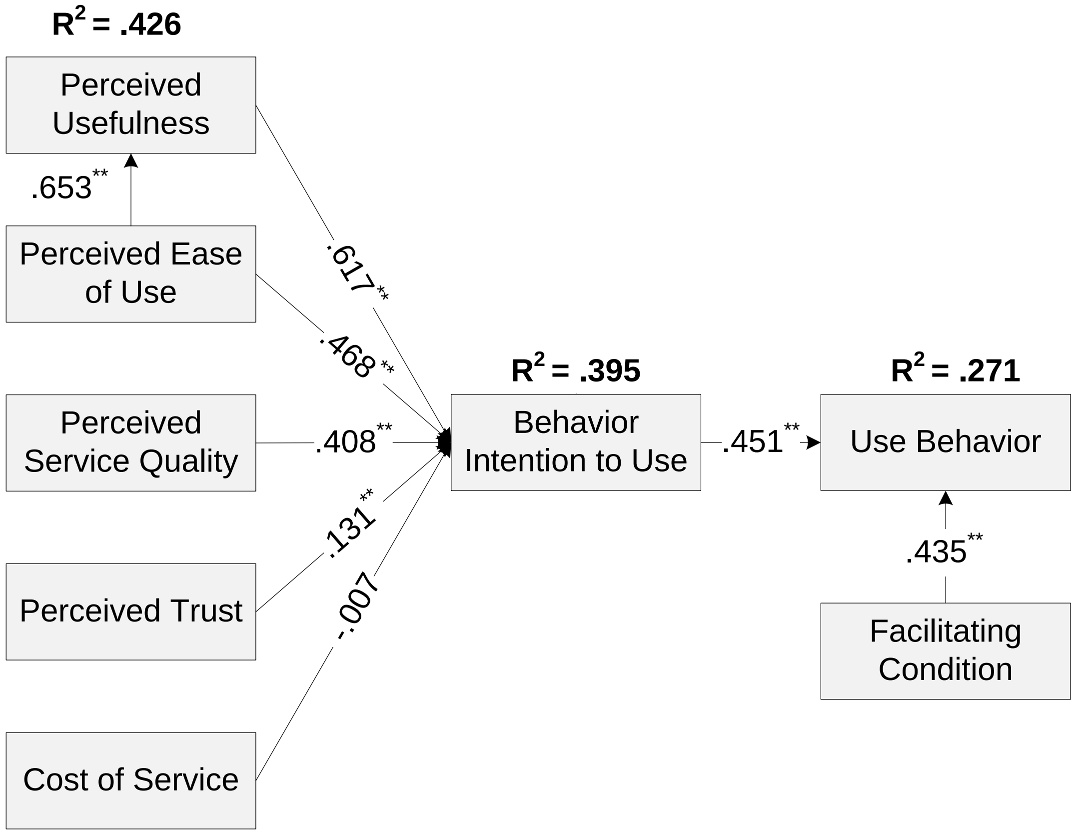

Figure 7.1: Research Model with Correlation Coefficients and Squared Multiple Regressions

To answer the fourth research question, a Student's Mobile Information Prototype (SMIP) was developed. The Design Science Research Methodology (DSRM) was adapted to develop SMIP. DSRM consists of five phases which are awareness of problem, suggestion, development, evaluation, and conclusion. User evaluation was conducted to evaluate SMIP. Results of user evaluation indicate that most of the participants were highly agreed on Perceived Usefulness, Perceived Ease of Use, Learnability, Functionality, and Didactic Efficiency.

7.4 Contributions of the Research

This research and its findings have several contributions and significant implications. In terms of contribution for education, the study demonstrated the practice of using m-learning prototype in the higher education environment. Furthermore, the study's model contributes to the education environment in terms of the critical factors that influence the acceptance and use of m-learning. The outcome of the study would encourage researchers to conduct similar studies and investigations, more m-learning factors that could influence the education environment. Some factors could be adapted based on the increase innovational mobile technology.

With regards to the theoretical Contribution, from the theoretical perspective, the study can be an evidence of success utilizing of m-learning in the higher education environment. The study contributes to the body of diffusion and innovation literature. Furthermore, the study provides a justification for m-learning acceptance factors.

The present research contributes to the literature by investigating the issue of m-learning acceptance within the context of students of the higher education environment, it gives an indication how students perspective can influence behavior of actual use of the m-learning. This study helps to build theory concerning students' acceptance and provide some insights toward effective utilizing the m-learning in the higher education environment. The study also validates the importance of perceived usefulness, perceived ease of use, perceived service quality, perceived trust, and cost of service in influencing behavior intention to use the m-learning. Furthermore, the study validates the importance of behavior intention to use and the facilitating condition in influencing the use behavior. On the other hand, when the facilitating conditions are poor and the intention to use is lack, these will diminish the actual use of m-learning services. While prior works on acceptance factors are carried out in Western countries, the present study proved that these factors hold true in Malaysian higher education. Therefore, it would appear that some findings obtained in the west can be generalized to Asian settings as well (at least to Malaysia), thus lending credence to efforts to test western findings using local samples. However, the study fail to support the influence of compatibility on the behavior intention to use, this lead to conclude that engaging IDT with TAM could not contribute the acceptance models.

7.5 Limitations and Future Research Directions

This research has some limitations based on geographical, financial, and logistic issues. The limitations can be summarized as follow:

1. The participants were taken from public higher education. The results of this study cannot be generalized to all higher education, such as private and open higher education. Consequently, it cannot be generalized to other industry.
2. All students were from regular universities. Students of online learning or open learning should be evolved to make more comprehensive study based on education type, i.e. regular or open.
3. The study focused on informative services as m-learning services that provided to the student. Extended researches should engage the learning materials and involve the learning contents to the learning services.

4. Administrative m-learning services were limited based on the most available services. More education services should be evolved, such as learning process in-class and off-campus environment.
5. This study focused on human-centered to measure the diffusion of m-learning. Value-Centered and Learning-Centered should be engaged to rich the knowledge of research.
6. Model's factors were adapted from closed environments. Further research should be conducted to formulate the factors based on the mobility and wireless environments.
7. Statistical Package for the Social Sciences (SPSS) was utilized to test the hypnotized model. Utilizing Structural Equation Modeling (SEM) technique could contribute to gain more accurate model. However, this could contribute to the body of knowledge when get the confirmatory modeling.
8. User evaluation of the prototype system was conducted among the students of full-time study in the selected university. It would be useful to obtain a broader sample of part-time students in future studies. This would minimize any potential bias in the data resulting from the level of informants.

7.6 Conclusion

Nowadays, m-learning services are interesting and very recent addition as a new vital platform for the higher education environment. This study explored the requirement for utilizing m-learning services in the higher education environment. The study found that both of the environment and the infrastructure are appropriate to diffuse m-learning in the higher education environment. Moreover, it provided the knowledge base about the current state of students' awareness about m-learning services.

The results indicate that the higher education environment has the required infrastructure to utilize m-learning services. Furthermore, students have adequate knowledge and awareness to use such technology in their education environment. However, the barriers and obstacles that could be faced during the actual use of mobile learning should be considered. Literature shows that while the limitations of mobile technology are reducing over time, the capabilities are going on increasingly. This study shows that the limitations of m-learning for education are well concerned by students.

Nevertheless, Student's perspective is very important to investigate the use behavior of m-learning in the higher education environment. Combination of education channels and alternatives helps students to be in touch with their educational environment anywhere and anytime.

Despite the low R^2 obtained, findings of the study suggest that the behavior intention to use the m-learning by students in the higher education environment have positive influence on the use behavior. Consequently, the availability of facilitating conditions is an important to influence students' use behavior. This suggesting that the higher education institutions should pay more attention to develop and support the infrastructure to facilitate their m-learning services more easily.

With regards to the factors that influencing the behavior intension to use, several inferences can be concluded from these findings. The present study suggests several factors as important determinants of the behavior intention to use m-learning in the higher education environment. Specifically, behavior intension to use appears to be adopted and facilitated by the usefulness of m-learning services, so more usefulness of m-learning lead to more adopt among students in the higher education. Consequently, the perceived service quality is important role in determining the level of behavior intention to use.

Student’s Mobile Information Prototype (SMIP) was developed to facilitate m-learning services for students of higher education environment, anywhere and anytime. The prototype was evaluated and the results confirm that it is useful for users to make their transactions easy, direct and successful, regardless of location and time. It is hoped that the findings of this study will encourage students in the higher education institutions to keep in touch with their education environment anywhere and anytime.

However, M-learning is the future of education, with its own characteristics, that make it capable of rapid evolution in information technology. Moreover, using mobile wireless technology in higher education will keep growing and will become the choice of the future learning environment.

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APPENDICES

APPENDIX A

QUESTIONNAIRE OF STUDENTS' AWARENESS AND REQUIREMENTS OF MOBILE LEARNING SERVICES

Universiti Utara Malaysia (UUM)
College of Arts and Sciences (CAS)

QUESTIONNAIRE

Dear student,

This study aims to investigate **Students' Awareness and Requirements of Mobile Learning (m-learning) Services in the Higher Education Environment**. It will help fellow practitioners and academicians to better understand what aspects of the m-learning services are particularly concerned about, and which aspects satisfy them the most. Your participation in answering this questionnaire is very much significant and appreciated to ensure the success of this study. Information provided by you will be handled with utmost confidentiality.

Thank you very much for your cooperation. For further enquiries, please contact:

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This questionnaire consists of two sections that are awareness of m-learning services aspects and general information. Please answer **ALL** questions from each section.

Section A: Awareness of Mobile Learning Service Aspects

Please circle the appropriate response for each of the following questions using the scale below:

1= Not Aware, 2= Somewhat Aware, 3= Not Sure, 4= Aware, 5= Very Aware

A) Your Awareness of The Following Mobile Technologies Names

1.	Personal digital assistant (PDA)	1	2	3	4	5
2.	Tablet PC	1	2	3	4	5
3.	WAP mobile phone (wireless application protocol)	1	2	3	4	5
4.	Laptop/Notebook	1	2	3	4	5
5.	Smart phone	1	2	3	4	5
6.	Wireless connection such as Wi-Fi and GPRS	1	2	3	4	5

Please circle the appropriate response for each of the following questions using the scale below:

1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree

B) Your Access to Learning Resources (Online Learning Care)

7.	Access to learning resources while placement is important to me	1	2	3	4	5
8.	Distance access to the University learning resources is important for my studies	1	2	3	4	5
9.	I have difficulty in visiting the University learning resources	1	2	3	4	5
10.	I am not aware of how to access the University learning resources by distance means	1	2	3	4	5
11.	I have difficulty in accessing electronically the University learning resources from my workplace	1	2	3	4	5
12.	I do not have access to a University academic service by distance means	1	2	3	4	5

C) The Mobile Technologies For Learning Services will:

13.	Give me current information	1	2	3	4	5
14.	Provide me with increased contact with my place of study	1	2	3	4	5
15.	Increase my contact with other students	1	2	3	4	5
16.	Increase my contact with my lecturers	1	2	3	4	5
17.	Give me immediate access to information	1	2	3	4	5
18.	Improve my ability to study	1	2	3	4	5

D) What Applications Would You Like to Use Through Mobile Technologies

19.	Word processing	1	2	3	4	5
20.	Calendar	1	2	3	4	5
21.	Internet access	1	2	3	4	5
22.	Mobile phone (Calling, SMS, MMS)	1	2	3	4	5
23.	Database access	1	2	3	4	5
24.	Intranet access (Local network)	1	2	3	4	5

E) Your View on Limitations of Mobile Technologies

25.	Need for training to use device	1	2	3	4	5
26.	Physical security (e.g., loss of device)	1	2	3	4	5
27.	Concerns over confidentiality of personal information	1	2	3	4	5
28.	Poor ability to connect to networks	1	2	3	4	5
29.	Slow data exchange with networks	1	2	3	4	5
30.	Cost of transaction and connection (e.g., GPRS download per Bytes)	1	2	3	4	5
31.	Laptops—heavy weight of device	1	2	3	4	5
32.	Laptops—poor portability of device	1	2	3	4	5
33.	Mobile Phone or PDA: small screen	1	2	3	4	5
34.	Mobile Phone or PDA: small keyboard	1	2	3	4	5
35.	Mobile Phone or PDA: usability of keyboard	1	2	3	4	5
36.	Mobile Phone or PDA: limited memory	1	2	3	4	5
37.	Mobile Phone or PDA: limited battery life	1	2	3	4	5

Please circle the appropriate response for each of the following questions using this scale

1= Lowly, ---, 5= Highly

F) What University Mobile Services Would You Like to Use Through Mobile Technologies

38.	Library services (e.g., search and loans)	1	2	3	4	5
39.	Course Registration	1	2	3	4	5
40.	Calendar, Timetable, or Schedule services	1	2	3	4	5

3

41.	Exam result	1	2	3	4	5
42.	Admission status	1	2	3	4	5
43.	Treasury (e.g., financial statement and balance)	1	2	3	4	5
44.	Campus Facilities (e.g. Accommodation, Clinic, Sport facilities)	1	2	3	4	5
45.	International students' services (e.g., Visa rules, Accommodation, Language Course).	1	2	3	4	5
46.	Alert system (e.g., Announcement)	1	2	3	4	5
47.	Others (*Please Identify*):	1	2	3	4	5

Section B: General Information

This section is about your background information. *Please fill up the blanks and mark [√] the most appropriate (please tick one only).*

1. What is your gender: [ ] Male [ ] Female
2. What is your age: _______________ Years.
3. Your Education background (*Please Tick one only*):
   [ ] Science (*e.g., IT, ICT, Math, Engineering*)
   [ ] Business (*e.g., Accounting, Finance, Management*)
   [ ] Art Studies (*e.g., Languages, Law, History*)
   [ ] Other (*Please identify*) ____
4. Your current study program:
   [ ] Bachelor [ ] Master [ ] PhD
5. Do you own a mobile Device [ ] Yes [ ] No
6. What is your Mobile device type [ ] PDA [ ] Smart Phone
   [ ] Hand Phone [ ] Other (*Please Identify*) ___________________
7. Your mobile applications experience (e.g., Game, Calendar, Calculator) _____ Years.
8. Wireless connections used [ ] GPRS [ ] Wi-Fi [ ] None
   [ ] Other (*Please Identify*) ____________________
9. Your mobile service provider [ ] CELCOM [ ] MAXIS [ ] DIGI
   [ ] Other (*Please Identify*) ____________________
10. Briefly, do you have any other comments about mobile technologies?
    ____
    ____
    ____

Thanks for Your Cooperation and Efforts

4

APPENDIX B

QUESTIONNAIRE OF RESEARCH MODEL

Universiti Utara Malaysia (UUM)
College of Arts and Sciences (CAS)

A Questionnaire Survey on Acceptance and Use of Mobile Learning (M-learning) Services among Malaysian Higher Education Students

Dear student,

This study aims to investigate students' acceptance of m-learning in the higher education environment. The specific objective is "To identify the factors that determine students' acceptance and use of m-learning in the higher education environment".

Your feedback will help fellow practitioners and academicians to better understand the factors that determine students' acceptance and use of m-learning in the higher education environment, and the ones that make them extremely satisfied. Your participation in answering this questionnaire is very significant to ensure the success of this study. The information provided by you will be handled with utmost confidentiality.

Thank you very much for your cooperation. For further enquiries, please contact:

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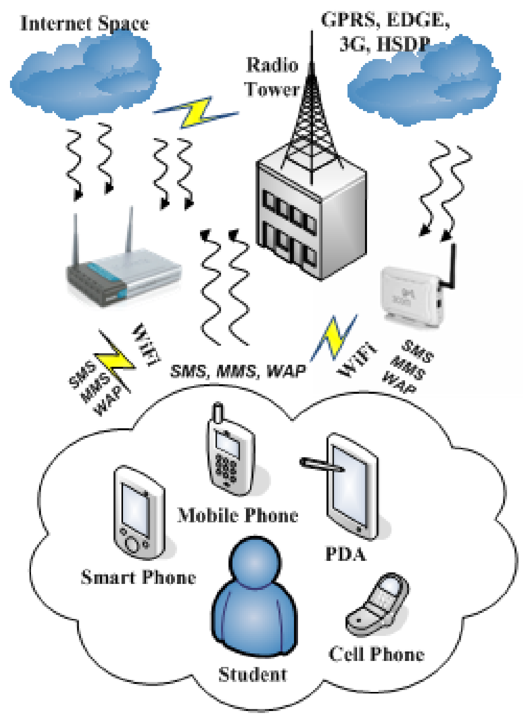
1

Mobile Learning (m-learning)

is considered as the **next form of e-learning** using **mobile technologies** to **facilitate education** for teachers and learners **anywhere and anytime**.



Mobile learning (m-learning) infrastructure

2

A. GENERAL INFORMATION

This section is about your background information. *Please fill up the blanks and mark [√] the most appropriate (please tick one only).*

1. What is your gender [ ] Male [ ] Female
2. What is your age ______________ Years.
3. Your education background (*Please tick One only*).
   [ ] Science (*e.g. IT, ICT, Math, Engineering*)
   [ ] Business (*e.g., Accounting, Finance, Management*)
   [ ] Art Studies (*e.g., Languages, Law, History*)
   [ ] Other (*Please identify*) ____
4. Your current study program:
   [ ] Bachelor [ ] Master [ ] PhD
5. Do you own a mobile Device [ ] Yes [ ] No
6. What is the type of your mobile device [ ] PDA [ ] Smart Phone
   [ ] Hand Phone [ ] Other (*Please Identify*) ________________
7. Your mobile applications experience (e.g., Game, Calendar, Calculator) _____ Years.
8. Wireless connections used [ ] GPRS [ ] Wi-Fi [ ] None
   [ ] Other (*Please Identify*) __________________
9. Your mobile service provider [ ] CELCOM [ ] MAXIS [ ] DIGI
   [ ] Other (*Please Identify*) __________________

B. USING MOBILE LEARNING (M- LEARNING) SERVICES

Please indicate how often do you use the mobile learning (m-learning) services that are available at your university (e.g., using SMS, MMS, or WAP (Wireless Application Protocol)). *Circle the most appropriate choice using this scale below:*

1= Lowly, ---, 5= Highly

1.	Library services (e.g., search and loans)	1	2	3	4	5
2.	Course registration	1	2	3	4	5
3.	Calendar, timetable, or schedule services	1	2	3	4	5
4.	Exam result	1	2	3	4	5
5.	Admission status	1	2	3	4	5
6.	Treasury (e.g., financial statement and balance)	1	2	3	4	5
7.	Campus facilities (e.g. accommodation, clinic, sport facilities)	1	2	3	4	5
8.	International students' services (e.g., visa rules, accommodation, language course).	1	2	3	4	5
9.	Alert system (e.g., announcement)	1	2	3	4	5
10.	Others (*Please Identify*):	1	2	3	4	5

3

C. M- LEARNING SERVICES ACCEPTANCE FACTORS

The following set of sections and statements relate to your perception towards the mobile learning (m-learning) services.

Your answer should be based on the m-learning services that you have chosen in section B. *Please indicate your degree of agreement on the following statement, by circling or tick the most appropriate choice using the scale below.*

1= Strongly Disagree, 2= Disagree, 3= Neutral, 4= Agree, 5= Strongly Agree

1. This section aims to understand the *Use Behavior (USE)* of mobile learning (m-learning) services

1.	I often use m-learning service frequently.	1	2	3	4	5
2.	How often do you use the m-learning services? [ ] Daily [ ] Weekly [ ] Monthly [ ] Few times a semester					

2. This section aims to understand the *Behavioral Intention (BI)* to use mobile learning (m-learning) services

1.	I intend to use the m-learning services in the next semester.	1	2	3	4	5
2.	I think I would use the m-learning services in the next semester.	1	2	3	4	5
3.	I plan to use the m-learning services in the next semester.	1	2	3	4	5
4.	I will definitely use the m-learning services in the next semester.	1	2	3	4	5

4

3. This section aims to understand the *Perceived Usefulness (PU)* of mobile learning (m-learning) services

1.	Using the m-learning services would enable me to accomplish tasks more quickly.	1	2	3	4	5
2.	Using the m-learning services would improve my performance in education environment.	1	2	3	4	5
3.	Using the m-learning services would increase my productivity in education environment.	1	2	3	4	5
4.	Using the m-learning services would enhance my effectiveness in education environment.	1	2	3	4	5
5.	Using the m-learning services would make it easier for me to engage in education environment.	1	2	3	4	5
6.	M-learning services are useful in my education environment.	1	2	3	4	5

4. This section aims to understand the *Perceived Ease of Use (PEOU)* of mobile learning (m-learning) services

1.	Learning to use the m-learning services is easy for me.	1	2	3	4	5
2.	I find it easy to use the m-learning services to get what I want.	1	2	3	4	5
3.	My interaction with the m-learning services is clear and understandable.	1	2	3	4	5
4.	I find the m-learning services are flexible to interact with.	1	2	3	4	5
5.	It is easy for me to become skillful in using the m-learning services.	1	2	3	4	5
6.	Overall, I find the m-learning services easy to use.	1	2	3	4	5

5. This section aims to understand the *Facilitating Conditions (FC)* of mobile learning (m-learning) services

1.	I have the resources necessary to use the m-learning services.	1	2	3	4	5
2.	I have the knowledge necessary to use the m-learning services.	1	2	3	4	5
3.	The m-learning services are not compatible with other e-learning services I use.	1	2	3	4	5
4.	A specific person (or group) is available for assistance with m-learning services difficulties.	1	2	3	4	5

5

6. This section aims to understand the *Compatibility (C)* of mobile learning (m-learning) services

1.	Using the m-learning services is compatible with most aspects of my education environment.	1	2	3	4	5
2.	Using the m-learning services fit my lifestyle.	1	2	3	4	5
3.	Using the m-learning services fit well with the way I like to engage in education environment.	1	2	3	4	5

7. This section aims to understand the *Perceived Service Quality (SQ)* of mobile learning (m-learning) services

1.	The m-learning services have up-to-date hardware and software.	1	2	3	4	5
2.	The m-learning services are visually appealing.	1	2	3	4	5
3.	When the m-learning services promise to do something by a certain time, it does so.	1	2	3	4	5
4.	The m-learning services are dependable.	1	2	3	4	5
5.	The m-learning services tell me exactly when information will be delivered or performed.	1	2	3	4	5
6.	The m-learning services give me prompt service.	1	2	3	4	5
7.	The m-learning services are never busy to respond to my requests.	1	2	3	4	5
8.	The behavior of the m-learning services instills confidence in me.	1	2	3	4	5
9.	I feel safe in my transactions with the m-learning services.	1	2	3	4	5
10.	The m-learning services give me individual attention.	1	2	3	4	5
11.	The m-learning services understand my specific needs.	1	2	3	4	5
12.	Overall, the service quality of the m-learning services is high.	1	2	3	4	5

8. This section aims to understand the *Perceived Trust (T)* of mobile learning (m-learning) services

1.	It annoys me when the m-learning services ask me for personal information.	1	2	3	4	5
2.	I am concerned that the m-learning services collect too much personal information from me.	1	2	3	4	5

6

3.	I am concerned that the m-learning services may use my personal information for other purposes without my authorization.	1	2	3	4	5
4.	I am concerned that the m-learning services may share my personal information with other universities or companies without my authorization.	1	2	3	4	5
5.	I am concerned my personal information in the m-learning services database is not accurate.	1	2	3	4	5
6.	I am concerned that unauthorized people (i.e. hackers) may access to my personal information.	1	2	3	4	5
7.	I am concerned about the security of my personal information during transmission.	1	2	3	4	5
8.	In general, I do not trust the m-learning services.	1	2	3	4	5

9. This section aims to understand the *Cost of Service (CS)* of mobile learning (m-learning) services

1.	I think the cost of equipments (e.g., mobile device) for m-learning services cost are expensive.	1	2	3	4	5
2.	I think the cost of access for m-learning services is expensive.	1	2	3	4	5
3.	I think the transaction fee for m-learning services is expensive.	1	2	3	4	5

D. MOBILE LEARNING (M- LEARNING) SERVICES

Please indicate how you would like to use the mobile learning (m-learning) services at your university (e.g., using SMS, MMS, or WAP (Wireless Application Protocol) *Circle the most appropriate choice using the scale below:*

1= Lowly, --, 5= Highly

1.	Library services (e.g., search and loans)	1	2	3	4	5
2.	Course registration	1	2	3	4	5
3.	Calendar, timetable, or schedule services	1	2	3	4	5
4.	Exam result	1	2	3	4	5
5.	Admission status	1	2	3	4	5

6.	Treasury (e.g., financial statement and balance)	1	2	3	4	5
7.	Campus facilities (e.g. accommodation, clinic, sport facilities)	1	2	3	4	5
8.	International students' services (e.g., visa rules, accommodation, language course).	1	2	3	4	5
9.	Alert system (e.g., announcement)	1	2	3	4	5
10.	Others (*Please Identify*): ………………………………	1	2	3	4	5

Do you have any comments about m-learning services?

____

____

____

____

____

____

____

____

____

Thanks for Your Cooperation and Efforts

APPENDIX C

FACTOR ANALYSIS

Results of Factor Analysis on Behavior Intention to Use

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.939
Bartlett's Test of Sphericity	Approx. Chi-Square	13779.838
	df	703
	Sig.	.000

Communalities

	Initial	Extraction
PU1	1.000	.611
PU2	1.000	.762
PU3	1.000	.784
PU4	1.000	.759
PU5	1.000	.707
PU6	1.000	.678
PEOU1	1.000	.649
PEOU2	1.000	.640
PEOU3	1.000	.740
PEOU4	1.000	.680
PEOU5	1.000	.596
PEOU6	1.000	.689
SQ1	1.000	.586
SQ2	1.000	.625
SQ3	1.000	.541
SQ4	1.000	.464
SQ5	1.000	.574
SQ6	1.000	.571
SQ7	1.000	.546
SQ8	1.000	.659
SQ9	1.000	.586
SQ10	1.000	.603
SQ11	1.000	.605
SQ12	1.000	.636
T1	1.000	.387
T2	1.000	.511
T3	1.000	.697
T4	1.000	.722

Communalities

T5	1.000	.637
T6	1.000	.715
T7	1.000	.621
T8	1.000	.372
CS1	1.000	.776
CS2	1.000	.858
CS3	1.000	.831
C1	1.000	.593
C2	1.000	.599
C3	1.000	.641

Extraction Method: Principal Component Analysis.

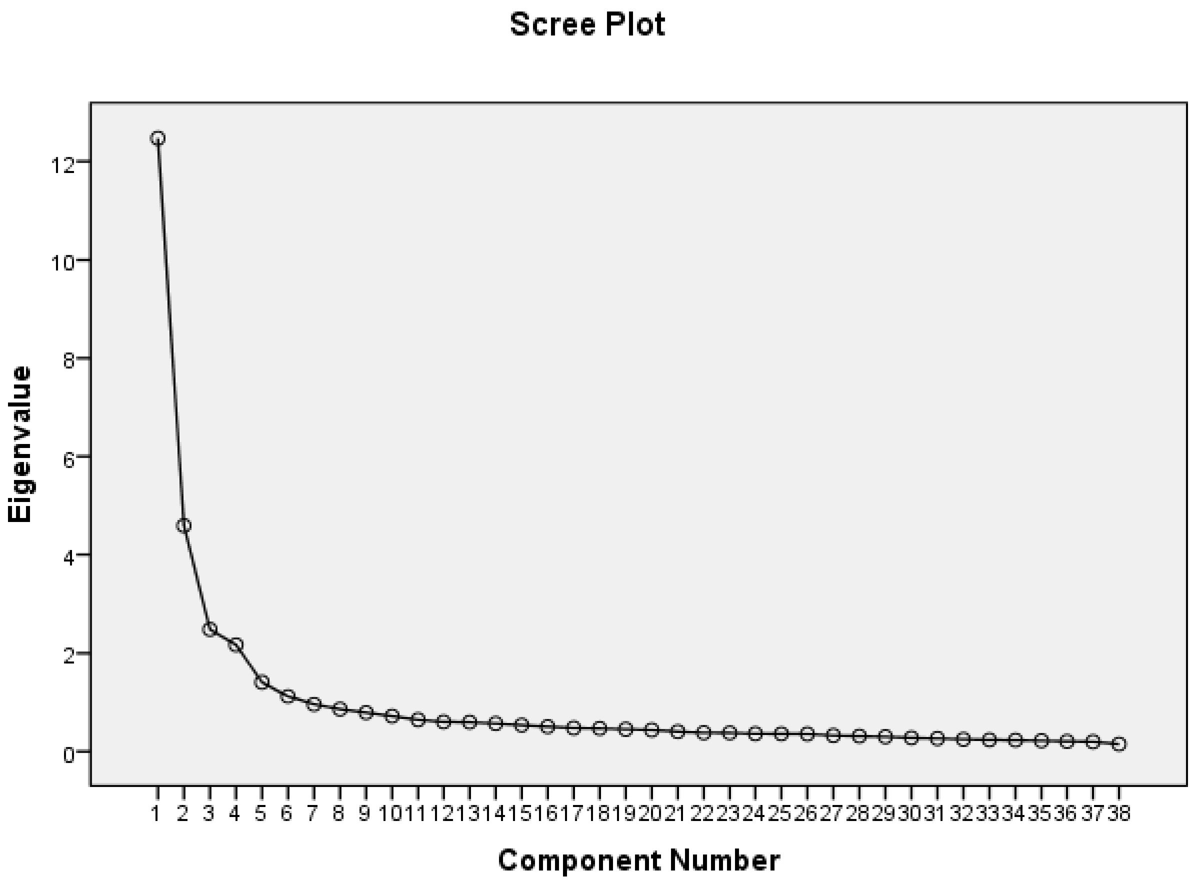
Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.467	32.808	32.808	12.467	32.808	32.808
2	4.595	12.093	44.901	4.595	12.093	44.901
3	2.482	6.533	51.434	2.482	6.533	51.434
4	2.171	5.712	57.146	2.171	5.712	57.146
5	1.413	3.718	60.864	1.413	3.718	60.864
6	1.121	2.950	63.814	1.121	2.950	63.814
7	.955	2.514	66.328			
8	.858	2.257	68.585			
9	.788	2.072	70.658			
10	.716	1.884	72.542			
11	.643	1.692	74.234			
12	.599	1.576	75.810			
13	.593	1.561	77.370			
14	.566	1.489	78.860			
15	.535	1.407	80.266			
16	.502	1.322	81.589			
17	.474	1.248	82.837			
18	.467	1.230	84.067			
19	.450	1.185	85.252			
20	.434	1.143	86.395			
21	.403	1.059	87.454			
22	.379	.998	88.452			

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
23	.375	.987	89.440			
24	.359	.945	90.384			
25	.357	.939	91.324			
26	.354	.932	92.255			
27	.323	.849	93.105			
28	.312	.820	93.925			
29	.297	.782	94.706			
30	.276	.726	95.432			
31	.262	.689	96.121			
32	.246	.648	96.769			
33	.233	.614	97.384			
34	.228	.601	97.985			
35	.217	.570	98.554			
36	.204	.536	99.090			
37	.196	.517	99.606			
38	.150	.394	100.000			

Extraction Method: Principal Component Analysis.



Component Matrix[a]

	Component					
	1	2	3	4	5	6
C3	.734					
C2	.723					
PU5	.718		-.380			
PEOU4	.712				-.357	
PEOU3	.712				-.415	
PEOU2	.711				-.317	
PEOU6	.707				-.403	

Component Matrix[a]

	Component					
	1	2	3	4	5	6
PU6	.706		-.356			
C1	.690					-.301
PU4	.689		-.400		.303	
PU3	.683		-.422		.330	
PU2	.675		-.423			
SQ8	.674		.361			
PEOU5	.672				-.309	
SQ6	.662					
PEOU1	.662				-.362	
PU1	.650		-.354			
SQ12	.636		.352			
SQ5	.632		.308			
SQ10	.629					
SQ3	.620		.360			
SQ2	.614					-.401
SQ9	.609		.311			
SQ11	.602		.370			
SQ1	.574					-.437
SQ4	.530		.384			
SQ7	.478		.459			
T3		.736				
T4	.353	.723				
T6	.350	.714				
T7	.311	.693				
T5		.683				
T2	.333	.605				
T8		.603				
T1	.303	.529				
CS2		.479		.774		
CS3		.476		.752		
CS1		.504		.696		

Extraction Method: Principal Component Analysis.

a. 6 components extracted.

Rotated Component Matrix[a]

	Component				
	1	2	3	4	5

Component Matrix[a]

	Component					
	1	2	3	4	5	6
SQ8	.747					
SQ12	.721					
SQ11	.700					
SQ7	.683					
SQ3	.681					
SQ10	.679					
SQ9	.671					
SQ6	.665					
SQ4	.633					
SQ5	.626			.323		
SQ2	.601					
SQ1	.529					
C2	.434	.399		.424		
PU3		.837				
PU2		.819				
PU4		.811				
PU5		.731		.335		
PU6		.703		.323		
PU1		.698				
C3	.405	.463		.423		
T4			.834			
T6			.831			
T3			.829			
T5			.788			
T7			.774			
T2			.684			
T1			.577			
T8			.574			
PEOU3	.314			.751		
PEOU6				.726		
PEOU1				.706		
PEOU4	.300			.704		
PEOU2	.304			.668		
PEOU5		.321		.651		
C1	.359	.426		.431		
CS2					.908	
CS3					.893	

Component Matrix[a]

	Component					
	1	2	3	4	5	6
CS1					.845	

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.

APPENDIX D

CRONBACH'S ALPHA (α) RELIABILITY TESTS

Reliability
Perceived Usefulness (PU)

Reliability Statistics

Cronbach's Alpha	N of Items
.920	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PU1	17.13	15.498	.694	.917
PU2	17.21	14.765	.808	.901
PU3	17.22	14.790	.816	.900
PU4	17.18	14.984	.799	.902
PU5	17.11	15.235	.774	.906
PU6	17.11	14.995	.746	.910

Reliability
Perceived Ease of Use (PEOU)

Reliability Statistics

Cronbach's Alpha	N of Items
.900	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
PEOU1	16.69	12.761	.709	.885
PEOU2	16.72	12.607	.725	.883
PEOU3	16.84	12.619	.781	.874
PEOU4	16.71	12.887	.739	.881
PEOU5	16.73	13.305	.677	.890
PEOU6	16.67	12.780	.739	.881

Reliability
Perceived Service Quality (SQ)

Reliability Statistics

Cronbach's Alpha	N of Items
.908	12

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
SQ1	34.70	46.230	.540	.905
SQ2	34.83	46.126	.605	.902
SQ3	34.92	45.178	.664	.899
SQ4	34.86	46.507	.585	.903
SQ5	34.74	45.699	.634	.900
SQ6	34.86	45.896	.670	.899
SQ7	35.19	45.361	.578	.903
SQ8	35.00	44.349	.727	.896
SQ9	35.15	44.554	.650	.900
SQ10	34.88	45.160	.657	.899
SQ11	35.05	45.095	.656	.899
SQ12	34.97	44.639	.695	.897

Reliability
Trust (T)

Reliability Statistics

Cronbach's Alpha	N of Items
.890	8

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
T1	23.51	28.511	.520	.890
T2	23.48	27.890	.635	.879
T3	23.45	26.237	.756	.867
T4	23.44	25.726	.770	.865
T5	23.50	26.959	.700	.873
T6	23.34	25.889	.759	.866
T7	23.24	26.602	.699	.873
T8	23.71	29.232	.475	.893

Reliability
Cost of Service (CS)

Reliability Statistics

Cronbach's Alpha	N of Items
.895	3

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
CS1	7.02	3.431	.754	.884
CS2	7.09	3.292	.834	.816
CS3	7.11	3.276	.794	.850

APPENDIX E

T-TEST AND ANOVA

T-Test between Gender and All Variables

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
mUSE	Male	187	2.4332	1.07867	.07888
	Female	398	2.3467	1.02199	.05123
mBI	Male	187	3.1885	.92470	.06762
	Female	398	3.1746	.83679	.04194
mPU	Male	187	3.4421	.83748	.06124
	Female	398	3.4267	.73667	.03693
mPEOU	Male	187	3.4198	.75340	.05509
	Female	398	3.3103	.68568	.03437
mFC	Male	187	3.0441	.69444	.05078
	Female	398	2.9598	.69404	.03479
mSQ	Male	187	3.1992	.67916	.04967
	Female	398	3.1642	.57519	.02883
mT	Male	187	3.4245	.77407	.05661
	Female	398	3.3166	.71933	.03606
mCS	Male	187	3.4759	.95408	.06977
	Female	398	3.5637	.85778	.04300

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	df
mUSE	Equal variances assumed	1.577	.210	.937	583
	Equal variances not assumed			.919	347.061
mBI	Equal variances assumed	3.561	.060	.181	583
	Equal variances not assumed			.174	333.534
mPU	Equal variances assumed	4.401	.036	.225	583
	Equal variances not assumed			.215	325.656
mPEOU	Equal variances assumed	1.800	.180	1.744	583
	Equal variances not assumed			1.686	335.163
mFC	Equal variances assumed	.001	.979	1.370	583
	Equal variances not assumed			1.370	363.988

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	df
mSQ	Equal variances assumed	2.197	.139	.648	583
	Equal variances not assumed			.610	315.691
mT	Equal variances assumed	1.231	.268	1.651	583
	Equal variances not assumed			1.607	341.239
mCS	Equal variances assumed	3.194	.074	-1.112	583
	Equal variances not assumed			-1.070	331.697

Independent Samples Test

		t-test for Equality of Means		
		Sig. (2-tailed)	Mean Difference	Std. Error Difference
mUSE	Equal variances assumed	.349	.08642	.09224
	Equal variances not assumed	.359	.08642	.09405
mBI	Equal variances assumed	.857	.01388	.07676
	Equal variances not assumed	.862	.01388	.07957
mPU	Equal variances assumed	.822	.01535	.06829
	Equal variances not assumed	.830	.01535	.07151
mPEOU	Equal variances assumed	.082	.10948	.06277
	Equal variances not assumed	.093	.10948	.06494
mFC	Equal variances assumed	.171	.08432	.06154
	Equal variances not assumed	.172	.08432	.06156
mSQ	Equal variances assumed	.517	.03504	.05411
	Equal variances not assumed	.542	.03504	.05743
mT	Equal variances assumed	.099	.10788	.06536
	Equal variances not assumed	.109	.10788	.06711
mCS	Equal variances assumed	.267	-.08772	.07887
	Equal variances not assumed	.285	-.08772	.08195

Independent Samples Test

		t-test for Equality of Means 95% Confidence Interval of the Difference Lower	Upper
mUSE	Equal variances assumed	-.09474	.26758
	Equal variances not assumed	-.09857	.27141
mBI	Equal variances assumed	-.13688	.16464
	Equal variances not assumed	-.14265	.17041
mPU	Equal variances assumed	-.11877	.14948
	Equal variances not assumed	-.12534	.15604
mPEOU	Equal variances assumed	-.01379	.23276
	Equal variances not assumed	-.01825	.23722
mFC	Equal variances assumed	-.03655	.20519
	Equal variances not assumed	-.03673	.20537
mSQ	Equal variances assumed	-.07122	.14131
	Equal variances not assumed	-.07795	.14803
mT	Equal variances assumed	-.02049	.23626
	Equal variances not assumed	-.02413	.23989
mCS	Equal variances assumed	-.24263	.06719
	Equal variances not assumed	-.24893	.07350

T-Test between Age and All Variables

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound
mUSE	Under 20	123	2.3008	1.01169	.09122	2.1202	2.4814
	20 - 25	429	2.4231	1.04397	.05040	2.3240	2.5221
	26 - 30	21	1.8810	1.05954	.23121	1.3987	2.3632
	Above 30	12	2.2500	1.01130	.29194	1.6075	2.8925
	Total	585	2.3744	1.04030	.04301	2.2899	2.4588
mBI	Under 20	123	3.2622	.71707	.06466	3.1342	3.3902
	20 - 25	429	3.1970	.88071	.04252	3.1134	3.2805
	26 - 30	21	2.5119	.91336	.19931	2.0961	2.9277
	Above 30	12	2.8542	1.13046	.32634	2.1359	3.5724
	Total	585	3.1791	.86509	.03577	3.1088	3.2493
mPU	Under 20	123	3.4499	.66356	.05983	3.3314	3.5683
	20 - 25	429	3.4347	.78803	.03805	3.3600	3.5095
	26 - 30	21	3.1825	.84147	.18362	2.7995	3.5656
	Above 30	12	3.5694	.98591	.28461	2.9430	4.1959
	Total	585	3.4316	.76964	.03182	3.3691	3.4941
mPEOU	Under 20	123	3.2033	.63142	.05693	3.0905	3.3160
	20 - 25	429	3.4040	.70779	.03417	3.3369	3.4712
	26 - 30	21	3.0952	.74642	.16288	2.7555	3.4350
	Above 30	12	3.1389	1.11879	.32297	2.4280	3.8497
	Total	585	3.3453	.70922	.02932	3.2877	3.4029
mFC	Under 20	123	2.9126	.53368	.04812	2.8173	3.0079
	20 - 25	429	3.0326	.71314	.03443	2.9650	3.1003
	26 - 30	21	2.6905	.75789	.16539	2.3455	3.0355
	Above 30	12	2.6250	1.08450	.31307	1.9359	3.3141
	Total	585	2.9868	.69469	.02872	2.9303	3.0432
mSQ	Under 20	123	3.0718	.43789	.03948	2.9937	3.1500
	20 - 25	429	3.2218	.63342	.03058	3.1617	3.2819
	26 - 30	21	2.9405	.61075	.13328	2.6625	3.2185
	Above 30	12	2.9861	.99483	.28718	2.3540	3.6182
	Total	585	3.1754	.60999	.02522	3.1258	3.2249
mT	Under 20	123	3.2998	.62207	.05609	3.1888	3.4108

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound
	20 - 25	429	3.3418	.75378	.03639	3.2703	3.4133
	26 - 30	21	3.3690	.76186	.16625	3.0223	3.7158
	Above 30	12	4.1771	.84184	.24302	3.6422	4.7120
	Total	585	3.3511	.73833	.03053	3.2911	3.4110
mCS	Under 20	123	3.5041	.81355	.07336	3.3589	3.6493
	20 - 25	429	3.5268	.88199	.04258	3.4431	3.6105
	26 - 30	21	3.6349	1.15905	.25292	3.1073	4.1625
	Above 30	12	4.0000	1.31041	.37828	3.1674	4.8326
	Total	585	3.5356	.88982	.03679	3.4634	3.6079

Descriptives

		Minimum	Maximum
mUSE	Under 20	1.00	4.50
	20 - 25	1.00	4.50
	26 - 30	1.00	4.00
	Above 30	1.00	4.00
	Total	1.00	4.50
mBI	Under 20	1.25	5.00
	20 - 25	1.00	5.00
	26 - 30	1.00	4.00
	Above 30	1.50	5.00
	Total	1.00	5.00
mPU	Under 20	1.50	5.00
	20 - 25	1.00	5.00
	26 - 30	1.67	4.67
	Above 30	2.00	5.00
	Total	1.00	5.00
mPEOU	Under 20	1.50	5.00
	20 - 25	1.00	5.00
	26 - 30	1.67	5.00
	Above 30	1.17	5.00
	Total	1.00	5.00
mFC	Under 20	1.50	4.00
	20 - 25	1.00	5.00
	26 - 30	1.50	4.00
	Above 30	1.00	5.00
	Total	1.00	5.00
mSQ	Under 20	1.50	4.00
	20 - 25	1.00	5.00
	26 - 30	1.58	3.83
	Above 30	1.83	4.67
	Total	1.00	5.00
mT	Under 20	2.00	4.88
	20 - 25	1.00	5.00
	26 - 30	1.75	4.38
	Above 30	2.25	5.00
	Total	1.00	5.00

Descriptives

		Minimum	Maximum
mCS	Under 20	1.67	5.00
	20 - 25	1.00	5.00
	26 - 30	1.67	5.00
	Above 30	1.00	5.00
	Total	1.00	5.00

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
mUSE	.282	3	581	.839
mBI	2.093	3	581	.100
mPU	2.726	3	581	.043
mPEOU	3.454	3	581	.016
mFC	4.307	3	581	.005
mSQ	7.715	3	581	.000
mT	2.578	3	581	.053
mCS	4.241	3	581	.006

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
mUSE	Between Groups	6.982	3	2.327	2.163	.091
	Within Groups	625.034	581	1.076		
	Total	632.015	584			
mBI	Between Groups	11.601	3	3.867	5.281	.001
	Within Groups	425.455	581	.732		
	Total	437.056	584			
mPU	Between Groups	1.576	3	.525	.886	.448
	Within Groups	344.356	581	.593		
	Total	345.932	584			
mPEOU	Between Groups	5.787	3	1.929	3.892	.009
	Within Groups	287.963	581	.496		
	Total	293.750	584			
mFC	Between Groups	4.993	3	1.664	3.493	.015
	Within Groups	276.842	581	.476		
	Total	281.835	584			
mSQ	Between Groups	3.834	3	1.278	3.478	.016
	Within Groups	213.462	581	.367		
	Total	217.296	584			
mT	Between Groups	8.555	3	2.852	5.348	.001
	Within Groups	309.798	581	.533		
	Total	318.352	584			
mCS	Between Groups	2.951	3	.984	1.244	.293
	Within Groups	459.446	581	.791		
	Total	462.397	584			

Post Hoc Tests

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
mUSE	Under 20	20 - 25	-.12226	.10608	.657	-.3956	.1511
		26 - 30	.41986	.24490	.317	-.2111	1.0508
		Above 30	.05081	.31368	.998	-.7574	.8590
	20 - 25	Under 20	.12226	.10608	.657	-.1511	.3956
		26 - 30	.54212	.23181	.091	-.0551	1.1394
		Above 30	.17308	.30357	.941	-.6091	.9552
	26 - 30	Under 20	-.41986	.24490	.317	-1.0508	.2111
		20 - 25	-.54212	.23181	.091	-1.1394	.0551
		Above 30	-.36905	.37534	.759	-1.3361	.5980
	Above 30	Under 20	-.05081	.31368	.998	-.8590	.7574
		20 - 25	-.17308	.30357	.941	-.9552	.6091
		26 - 30	.36905	.37534	.759	-.5980	1.3361
mBI	Under 20	20 - 25	.06523	.08752	.879	-.1603	.2907
		26 - 30	.75029*	.20205	.001	.2297	1.2709
		Above 30	.40803	.25880	.393	-.2588	1.0748
	20 - 25	Under 20	-.06523	.08752	.879	-.2907	.1603
		26 - 30	.68506*	.19125	.002	.1923	1.1778
		Above 30	.34280	.25046	.520	-.3025	.9881
	26 - 30	Under 20	-.75029*	.20205	.001	-1.2709	-.2297
		20 - 25	-.68506*	.19125	.002	-1.1778	-.1923
		Above 30	-.34226	.30967	.686	-1.1401	.4556
	Above 30	Under 20	-.40803	.25880	.393	-1.0748	.2588
		20 - 25	-.34280	.25046	.520	-.9881	.3025
		26 - 30	.34226	.30967	.686	-.4556	1.1401
mPU	Under 20	20 - 25	.01513	.07874	.997	-.1877	.2180
		26 - 30	.26732	.18178	.456	-.2010	.7357
		Above 30	-.11958	.23283	.956	-.7195	.4803
	20 - 25	Under 20	-.01513	.07874	.997	-.2180	.1877
		26 - 30	.25219	.17206	.459	-.1911	.6955
		Above 30	-.13471	.22533	.933	-.7153	.4458

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
	26 - 30	Under 20	-.26732	.18178	.456	-.7357	.2010
		20 - 25	-.25219	.17206	.459	-.6955	.1911
		Above 30	-.38690	.27859	.507	-1.1047	.3309
	Above 30	Under 20	.11958	.23283	.956	-.4803	.7195
		20 - 25	.13471	.22533	.933	-.4458	.7153
		26 - 30	.38690	.27859	.507	-.3309	1.1047
mPEOU	Under 20	20 - 25	-.20079*	.07201	.028	-.3863	-.0153
		26 - 30	.10801	.16623	.916	-.3203	.5363
		Above 30	.06436	.21291	.990	-.4842	.6129
	20 - 25	Under 20	.20079*	.07201	.028	.0153	.3863
		26 - 30	.30880	.15734	.203	-.0966	.7142
		Above 30	.26515	.20605	.572	-.2657	.7960
	26 - 30	Under 20	-.10801	.16623	.916	-.5363	.3203
		20 - 25	-.30880	.15734	.203	-.7142	.0966
		Above 30	-.04365	.25476	.998	-.7000	.6127
	Above 30	Under 20	-.06436	.21291	.990	-.6129	.4842
		20 - 25	-.26515	.20605	.572	-.7960	.2657
		26 - 30	.04365	.25476	.998	-.6127	.7000
mFC	Under 20	20 - 25	-.12003	.07060	.325	-.3019	.0619
		26 - 30	.22213	.16298	.523	-.1978	.6421
		Above 30	.28760	.20876	.514	-.2503	.8255
	20 - 25	Under 20	.12003	.07060	.325	-.0619	.3019
		26 - 30	.34216	.15428	.120	-.0553	.7396
		Above 30	.40763	.20204	.183	-.1129	.9282
	26 - 30	Under 20	-.22213	.16298	.523	-.6421	.1978
		20 - 25	-.34216	.15428	.120	-.7396	.0553
		Above 30	.06548	.24980	.994	-.5781	.7091
	Above 30	Under 20	-.28760	.20876	.514	-.8255	.2503
		20 - 25	-.40763	.20204	.183	-.9282	.1129
		26 - 30	-.06548	.24980	.994	-.7091	.5781
mSQ	Under 20	20 - 25	-.15002	.06200	.074	-.3097	.0097
		26 - 30	.13134	.14312	.795	-.2374	.5001
		Above 30	.08570	.18331	.966	-.3866	.5580
	20 - 25	Under 20	.15002	.06200	.074	-.0097	.3097

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Age	(J) Age	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
		26 - 30	.28136	.13547	.162	-.0677	.6304
		Above 30	.23572	.17741	.545	-.2214	.6928
	26 - 30	Under 20	-.13134	.14312	.795	-.5001	.2374
		20 - 25	-.28136	.13547	.162	-.6304	.0677
		Above 30	-.04563	.21935	.997	-.6108	.5195
	Above 30	Under 20	-.08570	.18331	.966	-.5580	.3866
		20 - 25	-.23572	.17741	.545	-.6928	.2214
		26 - 30	.04563	.21935	.997	-.5195	.6108
mT	Under 20	20 - 25	-.04199	.07469	.943	-.2344	.1504
		26 - 30	-.06925	.17241	.978	-.5135	.3750
		Above 30	-.87729*	.22084	.000	-1.4463	-.3083
	20 - 25	Under 20	.04199	.07469	.943	-.1504	.2344
		26 - 30	-.02726	.16320	.998	-.4477	.3932
		Above 30	-.83530*	.21372	.001	-1.3860	-.2846
	26 - 30	Under 20	.06925	.17241	.978	-.3750	.5135
		20 - 25	.02726	.16320	.998	-.3932	.4477
		Above 30	-.80804*	.26425	.012	-1.4889	-.1272
	Above 30	Under 20	.87729*	.22084	.000	.3083	1.4463
		20 - 25	.83530*	.21372	.001	.2846	1.3860
		26 - 30	.80804*	.26425	.012	.1272	1.4889
mCS	Under 20	20 - 25	-.02274	.09095	.995	-.2571	.2116
		26 - 30	-.13086	.20997	.925	-.6718	.4101
		Above 30	-.49593	.26894	.254	-1.1889	.1970
	20 - 25	Under 20	.02274	.09095	.995	-.2116	.2571
		26 - 30	-.10811	.19875	.948	-.6202	.4039
		Above 30	-.47319	.26027	.266	-1.1438	.1974
	26 - 30	Under 20	.13086	.20997	.925	-.4101	.6718
		20 - 25	.10811	.19875	.948	-.4039	.6202
		Above 30	-.36508	.32180	.668	-1.1942	.4640
	Above 30	Under 20	.49593	.26894	.254	-.1970	1.1889
		20 - 25	.47319	.26027	.266	-.1974	1.1438
		26 - 30	.36508	.32180	.668	-.4640	1.1942

*. The mean difference is significant at the 0.05 level.

T-Test between Education Background and All Variables

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
mUSE	Science (e.g. IT, ICT, Math)	183	2.3142	1.04220	.07704	2.1622	2.4662	1.00	4.50
	Business (e.g. Accounting, Finance, Managment)	262	2.4332	1.03498	.06394	2.3073	2.5591	1.00	4.50
	Art Studies (e.g. Linguistic, Law, History, Tourism)	27	2.5741	1.08045	.20793	2.1467	3.0015	1.00	4.00
	Engineering	32	2.4063	1.16700	.20630	1.9855	2.8270	1.00	4.50
	Medical or Pharmacy	81	2.2407	.98777	.10975	2.0223	2.4592	1.00	4.50
	Total	585	2.3744	1.04030	.04301	2.2899	2.4588	1.00	4.50
mBI	Science (e.g. IT, ICT, Math)	183	3.1243	.92429	.06833	2.9895	3.2591	1.00	5.00
	Business (e.g. Accounting, Finance, Managment)	262	3.1660	.86359	.05335	3.0610	3.2711	1.00	5.00
	Art Studies (e.g. Linguistic, Law, History, Tourism)	27	3.1111	.97402	.18745	2.7258	3.4964	1.00	5.00
	Engineering	32	3.1719	.94493	.16704	2.8312	3.5126	1.50	5.00
	Medical or Pharmacy	81	3.3704	.62138	.06904	3.2330	3.5078	1.50	5.00
	Total	585	3.1791	.86509	.03577	3.1088	3.2493	1.00	5.00
mPU	Science (e.g. IT, ICT, Math)	183	3.4818	.85893	.06349	3.3565	3.6071	1.00	5.00
	Business (e.g. Accounting, Finance, Managment)	262	3.3569	.74620	.04610	3.2661	3.4476	1.50	5.00
	Art Studies (e.g. Linguistic, Law, History, Tourism)	27	3.3889	.66827	.12861	3.1245	3.6532	2.17	5.00
	Engineering	32	3.5313	.89246	.15777	3.2095	3.8530	1.00	5.00

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
	Medical or Pharmacy	81	3.5350	.57958	.06440	3.4068	3.6631	1.83	5.00
	Total	585	3.4316	.76964	.03182	3.3691	3.4941	1.00	5.00
mPEOU	Science (e.g. IT, ICT, Math)	183	3.4463	.77171	.05705	3.3337	3.5588	1.33	5.00
	Business (e.g. Accounting, Finance, Managment)	262	3.2920	.68624	.04240	3.2085	3.3755	1.00	5.00
	Art Studies (e.g. Linguistic, Law, History, Tourism)	27	3.3025	.68413	.13166	3.0318	3.5731	2.00	5.00
	Engineering	32	3.4792	.81512	.14409	3.1853	3.7731	1.50	5.00
	Medical or Pharmacy	81	3.2510	.56711	.06301	3.1256	3.3764	2.00	4.50
	Total	585	3.3453	.70922	.02932	3.2877	3.4029	1.00	5.00
mFC	Science (e.g. IT, ICT, Math)	183	3.0697	.75747	.05599	2.9592	3.1802	1.00	5.00
	Business (e.g. Accounting, Finance, Managment)	262	2.9418	.67324	.04159	2.8599	3.0237	1.00	5.00
	Art Studies (e.g. Linguistic, Law, History, Tourism)	27	2.9444	.79158	.15234	2.6313	3.2576	1.00	5.00
	Engineering	32	2.9844	.69832	.12345	2.7326	3.2361	1.25	4.50
	Medical or Pharmacy	81	2.9599	.56797	.06311	2.8343	3.0855	1.25	4.00
	Total	585	2.9868	.69469	.02872	2.9303	3.0432	1.00	5.00
mSQ	Science (e.g. IT, ICT, Math)	183	3.2650	.65006	.04805	3.1702	3.3598	1.00	5.00
	Business (e.g. Accounting, Finance, Managment)	262	3.1221	.60444	.03734	3.0486	3.1957	1.50	4.67
	Art Studies (e.g. Linguistic, Law, History, Tourism)	27	3.2716	.62770	.12080	3.0233	3.5199	1.75	4.67
	Engineering	32	3.2604	.75662	.13375	2.9876	3.5332	1.50	5.00
	Medical or Pharmacy	81	3.0792	.41225	.04581	2.9881	3.1704	1.42	3.92

Descriptives

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
	Total	585	3.1754	.60999	.02522	3.1258	3.2249	1.00	5.00
mT	Science (e.g. IT, ICT, Math)	183	3.3648	.75852	.05607	3.2541	3.4754	1.00	5.00
	Business (e.g. Accounting, Finance, Managment)	262	3.3621	.71945	.04445	3.2746	3.4496	1.63	5.00
	Art Studies (e.g. Linguistic, Law, History, Tourism)	27	3.5000	.65413	.12589	3.2412	3.7588	2.13	4.75
	Engineering	32	3.4922	.90191	.15944	3.1670	3.8174	1.38	4.88
	Medical or Pharmacy	81	3.1790	.69370	.07708	3.0256	3.3324	1.00	4.88
	Total	585	3.3511	.73833	.03053	3.2911	3.4110	1.00	5.00
mCS	Science (e.g. IT, ICT, Math)	183	3.6321	.94185	.06962	3.4947	3.7694	1.00	5.00
	Business (e.g. Accounting, Finance, Managment)	262	3.4987	.89450	.05526	3.3899	3.6075	1.00	5.00
	Art Studies (e.g. Linguistic, Law, History, Tourism)	27	3.5556	.87706	.16879	3.2086	3.9025	1.00	5.00
	Engineering	32	3.5938	.78851	.13939	3.3095	3.8780	1.67	5.00
	Medical or Pharmacy	81	3.4074	.78528	.08725	3.2338	3.5810	1.00	5.00
	Total	585	3.5356	.88982	.03679	3.4634	3.6079	1.00	5.00

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
mUSE	.818	4	580	.514
mBI	2.040	4	580	.087
mPU	4.503	4	580	.001
mPEOU	2.276	4	580	.060
mFC	1.031	4	580	.391
mSQ	4.422	4	580	.002
mT	1.151	4	580	.332

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
mUSE	.818	4	580	.514
mBI	2.040	4	580	.087
mPU	4.503	4	580	.001
mPEOU	2.276	4	580	.060
mFC	1.031	4	580	.391
mSQ	4.422	4	580	.002
mT	1.151	4	580	.332
mCS	1.538	4	580	.190

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
mUSE	Between Groups	4.125	4	1.031	.953	.433
	Within Groups	627.890	580	1.083		
	Total	632.015	584			
mBI	Between Groups	3.684	4	.921	1.233	.296
	Within Groups	433.372	580	.747		
	Total	437.056	584			
mPU	Between Groups	3.157	4	.789	1.335	.255
	Within Groups	342.775	580	.591		
	Total	345.932	584			
mPEOU	Between Groups	3.953	4	.988	1.978	.096
	Within Groups	289.796	580	.500		
	Total	293.750	584			
mFC	Between Groups	1.895	4	.474	.981	.417
	Within Groups	279.940	580	.483		
	Total	281.835	584			
mSQ	Between Groups	3.444	4	.861	2.335	.054
	Within Groups	213.852	580	.369		
	Total	217.296	584			
mT	Between Groups	3.700	4	.925	1.705	.147
	Within Groups	314.652	580	.543		
	Total	318.352	584			
mCS	Between Groups	3.509	4	.877	1.109	.351
	Within Groups	458.888	580	.791		
	Total	462.397	584			

Post Hoc Tests

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Education	(J) Education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
mUSE	Science (e.g. IT, ICT, Math)	Business (e.g. Accounting, Finance, Managment)	-.11900	.10024	.759	-.3933	.1553
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.25987	.21450	.745	-.8468	.3271
		Engineering	-.09204	.19936	.991	-.6376	.4535
		Medical or Pharmacy	.07347	.13886	.984	-.3065	.4534
	Business (e.g. Accounting, Finance, Managment)	Science (e.g. IT, ICT, Math)	.11900	.10024	.759	-.1553	.3933
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.14087	.21030	.963	-.7163	.4346
		Engineering	.02696	.19484	1.000	-.5062	.5601
		Medical or Pharmacy	.19247	.13228	.592	-.1695	.5544
	Art Studies (e.g. Linguistic, Law, History, Tourism)	Science (e.g. IT, ICT, Math)	.25987	.21450	.745	-.3271	.8468
		Business (e.g. Accounting, Finance, Managment)	.14087	.21030	.963	-.4346	.7163
		Engineering	.16782	.27189	.972	-.5762	.9118
		Medical or Pharmacy	.33333	.23121	.601	-.2994	.9660
	Engineering	Science (e.g. IT, ICT, Math)	.09204	.19936	.991	-.4535	.6376
		Business (e.g. Accounting, Finance, Managment)	-.02696	.19484	1.000	-.5601	.5062

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Education	(J) Education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.16782	.27189	.972	-.9118	.5762
		Medical or Pharmacy	.16551	.21724	.941	-.4290	.7600
	Medical or Pharmacy	Science (e.g. IT, ICT, Math)	-.07347	.13886	.984	-.4534	.3065
		Business (e.g. Accounting, Finance, Managment)	-.19247	.13228	.592	-.5544	.1695
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.33333	.23121	.601	-.9660	.2994
		Engineering	-.16551	.21724	.941	-.7600	.4290
mBI	Science (e.g. IT, ICT, Math)	Business (e.g. Accounting, Finance, Managment)	-.04171	.08328	.987	-.2696	.1862
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.01321	.17820	1.000	-.4744	.5008
		Engineering	-.04756	.16563	.999	-.5008	.4057
		Medical or Pharmacy	-.24605	.11536	.208	-.5617	.0696
	Business (e.g. Accounting, Finance, Managment)	Science (e.g. IT, ICT, Math)	.04171	.08328	.987	-.1862	.2696
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.05492	.17472	.998	-.4232	.5330
		Engineering	-.00584	.16187	1.000	-.4488	.4371
		Medical or Pharmacy	-.20434	.10989	.341	-.5050	.0964
	Art Studies (e.g. Linguistic, Law, History, Tourism)	Science (e.g. IT, ICT, Math)	-.01321	.17820	1.000	-.5008	.4744
		Business (e.g. Accounting, Finance, Managment)	-.05492	.17472	.998	-.5330	.4232

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Education	(J) Education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
		Engineering	-.06076	.22588	.999	-.6789	.5573
		Medical or Pharmacy	-.25926	.19209	.660	-.7849	.2664
	Engineering	Science (e.g. IT, ICT, Math)	.04756	.16563	.999	-.4057	.5008
		Business (e.g. Accounting, Finance, Managment)	.00584	.16187	1.000	-.4371	.4488
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.06076	.22588	.999	-.5573	.6789
		Medical or Pharmacy	-.19850	.18048	.807	-.6924	.2954
	Medical or Pharmacy	Science (e.g. IT, ICT, Math)	.24605	.11536	.208	-.0696	.5617
		Business (e.g. Accounting, Finance, Managment)	.20434	.10989	.341	-.0964	.5050
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.25926	.19209	.660	-.2664	.7849
		Engineering	.19850	.18048	.807	-.2954	.6924
mPU	Science (e.g. IT, ICT, Math)	Business (e.g. Accounting, Finance, Managment)	.12491	.07406	.443	-.0777	.3276
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.09290	.15849	.977	-.3408	.5266
		Engineering	-.04946	.14730	.997	-.4525	.3536
		Medical or Pharmacy	-.05319	.10259	.986	-.3339	.2275
	Business (e.g. Accounting, Finance, Managment)	Science (e.g. IT, ICT, Math)	-.12491	.07406	.443	-.3276	.0777
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.03202	.15538	1.000	-.4572	.3932

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Education	(J) Education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
		Engineering	-.17438	.14396	.745	-.5683	.2195
		Medical or Pharmacy	-.17811	.09773	.362	-.4455	.0893
	Art Studies (e.g. Linguistic, Law, History, Tourism)	Science (e.g. IT, ICT, Math)	-.09290	.15849	.977	-.5266	.3408
		Business (e.g. Accounting, Finance, Managment)	.03202	.15538	1.000	-.3932	.4572
		Engineering	-.14236	.20089	.955	-.6921	.4074
		Medical or Pharmacy	-.14609	.17084	.913	-.6136	.3214
	Engineering	Science (e.g. IT, ICT, Math)	.04946	.14730	.997	-.3536	.4525
		Business (e.g. Accounting, Finance, Managment)	.17438	.14396	.745	-.2195	.5683
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.14236	.20089	.955	-.4074	.6921
		Medical or Pharmacy	-.00373	.16051	1.000	-.4430	.4355
	Medical or Pharmacy	Science (e.g. IT, ICT, Math)	.05319	.10259	.986	-.2275	.3339
		Business (e.g. Accounting, Finance, Managment)	.17811	.09773	.362	-.0893	.4455
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.14609	.17084	.913	-.3214	.6136
		Engineering	.00373	.16051	1.000	-.4355	.4430
mPEOU	Science (e.g. IT, ICT, Math)	Business (e.g. Accounting, Finance, Managment)	.15428	.06810	.158	-.0321	.3406
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.14380	.14573	.861	-.2550	.5426

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Education	(J) Education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
		Engineering	-.03290	.13544	.999	-.4035	.3377
		Medical or Pharmacy	.19524	.09433	.235	-.0629	.4534
	Business (e.g. Accounting, Finance, Managment)	Science (e.g. IT, ICT, Math)	-.15428	.06810	.158	-.3406	.0321
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.01048	.14287	1.000	-.4014	.3805
		Engineering	-.18718	.13237	.619	-.5494	.1750
		Medical or Pharmacy	.04096	.08986	.991	-.2049	.2869
	Art Studies (e.g. Linguistic, Law, History, Tourism)	Science (e.g. IT, ICT, Math)	-.14380	.14573	.861	-.5426	.2550
		Business (e.g. Accounting, Finance, Managment)	.01048	.14287	1.000	-.3805	.4014
		Engineering	-.17670	.18471	.874	-.6821	.3288
		Medical or Pharmacy	.05144	.15708	.998	-.3784	.4813
	Engineering	Science (e.g. IT, ICT, Math)	.03290	.13544	.999	-.3377	.4035
		Business (e.g. Accounting, Finance, Managment)	.18718	.13237	.619	-.1750	.5494
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.17670	.18471	.874	-.3288	.6821
		Medical or Pharmacy	.22814	.14759	.533	-.1757	.6320
	Medical or Pharmacy	Science (e.g. IT, ICT, Math)	-.19524	.09433	.235	-.4534	.0629
		Business (e.g. Accounting, Finance, Managment)	-.04096	.08986	.991	-.2869	.2049
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.05144	.15708	.998	-.4813	.3784

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Education	(J) Education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
		Engineering	-.22814	.14759	.533	-.6320	.1757
mFC	Science (e.g. IT, ICT, Math)	Business (e.g. Accounting, Finance, Managment)	.12788	.06693	.313	-.0553	.3110
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.12523	.14323	.906	-.2667	.5171
		Engineering	.08530	.13312	.968	-.2790	.4496
		Medical or Pharmacy	.10980	.09272	.760	-.1439	.3635
	Business (e.g. Accounting, Finance, Managment)	Science (e.g. IT, ICT, Math)	-.12788	.06693	.313	-.3110	.0553
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.00265	.14042	1.000	-.3869	.3816
		Engineering	-.04258	.13010	.998	-.3986	.3134
		Medical or Pharmacy	-.01808	.08832	1.000	-.2598	.2236
	Art Studies (e.g. Linguistic, Law, History, Tourism)	Science (e.g. IT, ICT, Math)	-.12523	.14323	.906	-.5171	.2667
		Business (e.g. Accounting, Finance, Managment)	.00265	.14042	1.000	-.3816	.3869
		Engineering	-.03993	.18155	.999	-.5367	.4568
		Medical or Pharmacy	-.01543	.15439	1.000	-.4379	.4070
	Engineering	Science (e.g. IT, ICT, Math)	-.08530	.13312	.968	-.4496	.2790
		Business (e.g. Accounting, Finance, Managment)	.04258	.13010	.998	-.3134	.3986
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.03993	.18155	.999	-.4568	.5367
		Medical or Pharmacy	.02450	.14506	1.000	-.3724	.4214

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Education	(J) Education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
	Medical or Pharmacy	Science (e.g. IT, ICT, Math)	-.10980	.09272	.760	-.3635	.1439
		Business (e.g. Accounting, Finance, Managment)	.01808	.08832	1.000	-.2236	.2598
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.01543	.15439	1.000	-.4070	.4379
		Engineering	-.02450	.14506	1.000	-.4214	.3724
mSQ	Science (e.g. IT, ICT, Math)	Business (e.g. Accounting, Finance, Managment)	.14289	.05850	.106	-.0172	.3030
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.00658	.12518	1.000	-.3491	.3360
		Engineering	.00461	.11635	1.000	-.3138	.3230
		Medical or Pharmacy	.18581	.08104	.149	-.0359	.4076
	Business (e.g. Accounting, Finance, Managment)	Science (e.g. IT, ICT, Math)	-.14289	.05850	.106	-.3030	.0172
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.14947	.12273	.741	-.4853	.1864
		Engineering	-.13828	.11371	.742	-.4494	.1729
		Medical or Pharmacy	.04292	.07720	.981	-.1683	.2542
	Art Studies (e.g. Linguistic, Law, History, Tourism)	Science (e.g. IT, ICT, Math)	.00658	.12518	1.000	-.3360	.3491
		Business (e.g. Accounting, Finance, Managment)	.14947	.12273	.741	-.1864	.4853
		Engineering	.01119	.15868	1.000	-.4230	.4454
		Medical or Pharmacy	.19239	.13494	.611	-.1769	.5616
	Engineering	Science (e.g. IT, ICT, Math)	-.00461	.11635	1.000	-.3230	.3138

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Education	(J) Education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
		Business (e.g. Accounting, Finance, Managment)	.13828	.11371	.742	-.1729	.4494
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.01119	.15868	1.000	-.4454	.4230
		Medical or Pharmacy	.18120	.12678	.609	-.1657	.5281
	Medical or Pharmacy	Science (e.g. IT, ICT, Math)	-.18581	.08104	.149	-.4076	.0359
		Business (e.g. Accounting, Finance, Managment)	-.04292	.07720	.981	-.2542	.1683
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.19239	.13494	.611	-.5616	.1769
		Engineering	-.18120	.12678	.609	-.5281	.1657
mT	Science (e.g. IT, ICT, Math)	Business (e.g. Accounting, Finance, Managment)	.00264	.07096	1.000	-.1915	.1968
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.13525	.15185	.900	-.5508	.2803
		Engineering	-.12743	.14113	.896	-.5136	.2588
		Medical or Pharmacy	.18574	.09830	.324	-.0832	.4547
	Business (e.g. Accounting, Finance, Managment)	Science (e.g. IT, ICT, Math)	-.00264	.07096	1.000	-.1968	.1915
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.13788	.14887	.887	-.5453	.2695
		Engineering	-.13007	.13793	.880	-.5075	.2474
		Medical or Pharmacy	.18311	.09364	.289	-.0731	.4393
	Art Studies (e.g. Linguistic, Law,	Science (e.g. IT, ICT, Math)	.13525	.15185	.900	-.2803	.5508

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Education	(J) Education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
	History, Tourism)	Business (e.g. Accounting, Finance, Managment)	.13788	.14887	.887	-.2695	.5453
		Engineering	.00781	.19247	1.000	-.5189	.5345
		Medical or Pharmacy	.32099	.16368	.287	-.1269	.7689
	Engineering	Science (e.g. IT, ICT, Math)	.12743	.14113	.896	-.2588	.5136
		Business (e.g. Accounting, Finance, Managment)	.13007	.13793	.880	-.2474	.5075
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.00781	.19247	1.000	-.5345	.5189
		Medical or Pharmacy	.31318	.15379	.250	-.1076	.7340
	Medical or Pharmacy	Science (e.g. IT, ICT, Math)	-.18574	.09830	.324	-.4547	.0832
		Business (e.g. Accounting, Finance, Managment)	-.18311	.09364	.289	-.4393	.0731
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.32099	.16368	.287	-.7689	.1269
		Engineering	-.31318	.15379	.250	-.7340	.1076
mCS	Science (e.g. IT, ICT, Math)	Business (e.g. Accounting, Finance, Managment)	.13333	.08569	.526	-.1012	.3678
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.07650	.18338	.994	-.4253	.5783
		Engineering	.03831	.17043	.999	-.4281	.5047
		Medical or Pharmacy	.22465	.11871	.322	-.1002	.5495
	Business (e.g. Accounting, Finance,	Science (e.g. IT, ICT, Math)	-.13333	.08569	.526	-.3678	.1012

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) Education	(J) Education	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
	Managment)	Art Studies (e.g. Linguistic, Law, History, Tourism)	-.05683	.17979	.998	-.5488	.4351
		Engineering	-.09502	.16657	.979	-.5508	.3608
		Medical or Pharmacy	.09132	.11308	.928	-.2181	.4008
	Art Studies (e.g. Linguistic, Law, History, Tourism)	Science (e.g. IT, ICT, Math)	-.07650	.18338	.994	-.5783	.4253
		Business (e.g. Accounting, Finance, Managment)	.05683	.17979	.998	-.4351	.5488
		Engineering	-.03819	.23244	1.000	-.6742	.5978
		Medical or Pharmacy	.14815	.19766	.945	-.3927	.6890
	Engineering	Science (e.g. IT, ICT, Math)	-.03831	.17043	.999	-.5047	.4281
		Business (e.g. Accounting, Finance, Managment)	.09502	.16657	.979	-.3608	.5508
		Art Studies (e.g. Linguistic, Law, History, Tourism)	.03819	.23244	1.000	-.5978	.6742
		Medical or Pharmacy	.18634	.18572	.854	-.3219	.6945
	Medical or Pharmacy	Science (e.g. IT, ICT, Math)	-.22465	.11871	.322	-.5495	.1002
		Business (e.g. Accounting, Finance, Managment)	-.09132	.11308	.928	-.4008	.2181
		Art Studies (e.g. Linguistic, Law, History, Tourism)	-.14815	.19766	.945	-.6890	.3927
		Engineering	-.18634	.18572	.854	-.6945	.3219

T-Test between Mobile Experience and All Variables

Descriptives

		N	Mean	Std. Deviation	Std. Error
mUSE	< 5 Years	255	2.3333	1.01982	.06386
	5 - 9	288	2.4167	1.05840	.06237
	> 9 Years	42	2.3333	1.05152	.16225
	Total	585	2.3744	1.04030	.04301
mBI	< 5 Years	255	3.1304	.80379	.05033
	5 - 9	288	3.2378	.89000	.05244
	> 9 Years	42	3.0714	1.03046	.15900
	Total	585	3.1791	.86509	.03577
mPU	< 5 Years	255	3.3791	.75778	.04745
	5 - 9	288	3.4601	.76613	.04514
	> 9 Years	42	3.5556	.85593	.13207
	Total	585	3.4316	.76964	.03182
mPEOU	< 5 Years	255	3.3144	.73350	.04593
	5 - 9	288	3.3519	.67707	.03990
	> 9 Years	42	3.4881	.77161	.11906
	Total	585	3.3453	.70922	.02932
mFC	< 5 Years	255	2.9755	.67516	.04228
	5 - 9	288	2.9896	.69146	.04074
	> 9 Years	42	3.0357	.83661	.12909
	Total	585	2.9868	.69469	.02872
mSQ	< 5 Years	255	3.1833	.63056	.03949
	5 - 9	288	3.1780	.57843	.03408
	> 9 Years	42	3.1091	.69976	.10798
	Total	585	3.1754	.60999	.02522
mT	< 5 Years	255	3.2520	.70702	.04428
	5 - 9	288	3.3906	.70893	.04177
	> 9 Years	42	3.6815	.98278	.15165
	Total	585	3.3511	.73833	.03053
mCS	< 5 Years	255	3.5059	.86480	.05416
	5 - 9	288	3.5220	.89407	.05268
	> 9 Years	42	3.8095	.98262	.15162
	Total	585	3.5356	.88982	.03679

Descriptives

		95% Confidence Interval for Mean		Minimum	Maximum
		Lower Bound	Upper Bound		
mUSE	< 5 Years	2.2076	2.4591	1.00	4.50
	5 - 9	2.2939	2.5394	1.00	4.50
	> 9 Years	2.0057	2.6610	1.00	4.50
	Total	2.2899	2.4588	1.00	4.50
mBI	< 5 Years	3.0313	3.2295	1.00	5.00
	5 - 9	3.1346	3.3411	1.00	5.00
	> 9 Years	2.7503	3.3925	1.00	5.00
	Total	3.1088	3.2493	1.00	5.00
mPU	< 5 Years	3.2856	3.4725	1.00	5.00
	5 - 9	3.3712	3.5489	1.50	5.00
	> 9 Years	3.2888	3.8223	1.83	5.00
	Total	3.3691	3.4941	1.00	5.00
mPEOU	< 5 Years	3.2239	3.4048	1.00	5.00
	5 - 9	3.2733	3.4304	1.33	5.00
	> 9 Years	3.2476	3.7285	1.67	5.00
	Total	3.2877	3.4029	1.00	5.00
mFC	< 5 Years	2.8922	3.0588	1.00	5.00
	5 - 9	2.9094	3.0698	1.00	5.00
	> 9 Years	2.7750	3.2964	1.50	4.75
	Total	2.9303	3.0432	1.00	5.00
mSQ	< 5 Years	3.1056	3.2611	1.50	5.00
	5 - 9	3.1109	3.2450	1.00	4.67
	> 9 Years	2.8911	3.3272	1.58	4.50
	Total	3.1258	3.2249	1.00	5.00
mT	< 5 Years	3.1648	3.3392	1.00	5.00
	5 - 9	3.3084	3.4728	1.25	5.00
	> 9 Years	3.3753	3.9878	1.75	5.00
	Total	3.2911	3.4110	1.00	5.00
mCS	< 5 Years	3.3992	3.6125	1.00	5.00
	5 - 9	3.4183	3.6257	1.00	5.00
	> 9 Years	3.5033	4.1157	1.67	5.00
	Total	3.4634	3.6079	1.00	5.00

Test of Homogeneity of Variances

	Levene Statistic	df1	df2	Sig.
mUSE	.204	2	582	.816
mBI	2.329	2	582	.098
mPU	.351	2	582	.704
mPEOU	1.002	2	582	.368
mFC	2.969	2	582	.052
mSQ	2.237	2	582	.108
mT	6.761	2	582	.001
mCS	1.815	2	582	.164

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
mUSE	Between Groups	1.015	2	.508	.468	.626
	Within Groups	631.000	582	1.084		
	Total	632.015	584			
mBI	Between Groups	2.086	2	1.043	1.395	.249
	Within Groups	434.970	582	.747		
	Total	437.056	584			
mPU	Between Groups	1.582	2	.791	1.337	.263
	Within Groups	344.350	582	.592		
	Total	345.932	584			
mPEOU	Between Groups	1.113	2	.556	1.106	.331
	Within Groups	292.637	582	.503		
	Total	293.750	584			
mFC	Between Groups	.135	2	.068	.140	.870
	Within Groups	281.699	582	.484		
	Total	281.835	584			
mSQ	Between Groups	.202	2	.101	.271	.762
	Within Groups	217.094	582	.373		
	Total	217.296	584			
mT	Between Groups	7.542	2	3.771	7.062	.001
	Within Groups	310.810	582	.534		
	Total	318.352	584			
mCS	Between Groups	3.430	2	1.715	2.175	.115
	Within Groups	458.967	582	.789		

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
mUSE	Between Groups	1.015	2	.508	.468	.626
	Within Groups	631.000	582	1.084		
	Total	632.015	584			
mBI	Between Groups	2.086	2	1.043	1.395	.249
	Within Groups	434.970	582	.747		
	Total	437.056	584			
mPU	Between Groups	1.582	2	.791	1.337	.263
	Within Groups	344.350	582	.592		
	Total	345.932	584			
mPEOU	Between Groups	1.113	2	.556	1.106	.331
	Within Groups	292.637	582	.503		
	Total	293.750	584			
mFC	Between Groups	.135	2	.068	.140	.870
	Within Groups	281.699	582	.484		
	Total	281.835	584			
mSQ	Between Groups	.202	2	.101	.271	.762
	Within Groups	217.094	582	.373		
	Total	217.296	584			
mT	Between Groups	7.542	2	3.771	7.062	.001
	Within Groups	310.810	582	.534		
	Total	318.352	584			
mCS	Between Groups	3.430	2	1.715	2.175	.115
	Within Groups	458.967	582	.789		
	Total	462.397	584			

Post Hoc Tests

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) NewMobile Experience	(J) NewMobile Experience	Mean Difference (I-J)	Std. Error	Sig.
mUSE	< 5 Years	5 - 9	-.08333	.08953	.621
		> 9 Years	.00000	.17340	1.000
	5 - 9	< 5 Years	.08333	.08953	.621
		> 9 Years	.08333	.17198	.879
	> 9 Years	< 5 Years	.00000	.17340	1.000
		5 - 9	-.08333	.17198	.879
mBI	< 5 Years	5 - 9	-.10746	.07434	.318
		> 9 Years	.05896	.14396	.912
	5 - 9	< 5 Years	.10746	.07434	.318
		> 9 Years	.16642	.14279	.474
	> 9 Years	< 5 Years	-.05896	.14396	.912
		5 - 9	-.16642	.14279	.474
mPU	< 5 Years	5 - 9	-.08098	.06614	.439
		> 9 Years	-.17647	.12809	.353
	5 - 9	< 5 Years	.08098	.06614	.439
		> 9 Years	-.09549	.12705	.733
	> 9 Years	< 5 Years	.17647	.12809	.353
		5 - 9	.09549	.12705	.733
mPEOU	< 5 Years	5 - 9	-.03747	.06097	.812
		> 9 Years	-.17372	.11808	.306
	5 - 9	< 5 Years	.03747	.06097	.812
		> 9 Years	-.13624	.11712	.476
	> 9 Years	< 5 Years	.17372	.11808	.306
		5 - 9	.13624	.11712	.476
mFC	< 5 Years	5 - 9	-.01409	.05982	.970
		> 9 Years	-.06022	.11586	.862
	5 - 9	< 5 Years	.01409	.05982	.970
		> 9 Years	-.04613	.11491	.915
	> 9 Years	< 5 Years	.06022	.11586	.862
		5 - 9	.04613	.11491	.915
mSQ	< 5 Years	5 - 9	.00538	.05252	.994

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) NewMobile Experience	(J) NewMobile Experience	Mean Difference (I-J)	Std. Error	Sig.
		> 9 Years	.07421	.10171	.746
	5 - 9	< 5 Years	-.00538	.05252	.994
		> 9 Years	.06882	.10088	.774
	> 9 Years	< 5 Years	-.07421	.10171	.746
		5 - 9	-.06882	.10088	.774
mT	< 5 Years	5 - 9	-.13866	.06284	.071
		> 9 Years	-.42959*	.12169	.001
	5 - 9	< 5 Years	.13866	.06284	.071
		> 9 Years	-.29092*	.12070	.043
	> 9 Years	< 5 Years	.42959*	.12169	.001
		5 - 9	.29092*	.12070	.043
mCS	< 5 Years	5 - 9	-.01611	.07636	.976
		> 9 Years	-.30364	.14788	.101
	5 - 9	< 5 Years	.01611	.07636	.976
		> 9 Years	-.28753	.14668	.123
	> 9 Years	< 5 Years	.30364	.14788	.101
		5 - 9	.28753	.14668	.123

*. The mean difference is significant at the 0.05 level.

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) NewMobile Experience	(J) NewMobile Experience	95% Confidence Interval	
			Lower Bound	Upper Bound
mUSE	< 5 Years	5 - 9	-.2937	.1270
		> 9 Years	-.4074	.4074
	5 - 9	< 5 Years	-.1270	.2937
		> 9 Years	-.3208	.4874
	> 9 Years	< 5 Years	-.4074	.4074
		5 - 9	-.4874	.3208
mBI	< 5 Years	5 - 9	-.2821	.0672
		> 9 Years	-.2793	.3972
	5 - 9	< 5 Years	-.0672	.2821
		> 9 Years	-.1691	.5019
	> 9 Years	< 5 Years	-.3972	.2793
		5 - 9	-.5019	.1691
mPU	< 5 Years	5 - 9	-.2364	.0744
		> 9 Years	-.4775	.1245
	5 - 9	< 5 Years	-.0744	.2364
		> 9 Years	-.3940	.2030
	> 9 Years	< 5 Years	-.1245	.4775
		5 - 9	-.2030	.3940
mPEOU	< 5 Years	5 - 9	-.1807	.1058
		> 9 Years	-.4512	.1037
	5 - 9	< 5 Years	-.1058	.1807
		> 9 Years	-.4114	.1390
	> 9 Years	< 5 Years	-.1037	.4512
		5 - 9	-.1390	.4114
mFC	< 5 Years	5 - 9	-.1547	.1265
		> 9 Years	-.3325	.2120
	5 - 9	< 5 Years	-.1265	.1547
		> 9 Years	-.3161	.2239
	> 9 Years	< 5 Years	-.2120	.3325
		5 - 9	-.2239	.3161
mSQ	< 5 Years	5 - 9	-.1180	.1288
		> 9 Years	-.1648	.3132

Multiple Comparisons

Tukey HSD

Dependent Variable	(I) NewMobile Experience	(J) NewMobile Experience	95% Confidence Interval	
			Lower Bound	Upper Bound
	5 - 9	< 5 Years	-.1288	.1180
		> 9 Years	-.1682	.3059
	> 9 Years	< 5 Years	-.3132	.1648
		5 - 9	-.3059	.1682
mT	< 5 Years	5 - 9	-.2863	.0090
		> 9 Years	-.7155	-.1436
	5 - 9	< 5 Years	-.0090	.2863
		> 9 Years	-.5745	-.0073
	> 9 Years	< 5 Years	.1436	.7155
		5 - 9	.0073	.5745
mCS	< 5 Years	5 - 9	-.1955	.1633
		> 9 Years	-.6511	.0438
	5 - 9	< 5 Years	-.1633	.1955
		> 9 Years	-.6322	.0571
	> 9 Years	< 5 Years	-.0438	.6511
		5 - 9	-.0571	.6322

APPENDIX F

REGRESSION ANALYSIS

Regression Analysis on the influence of Behavior Intention to Use on Use Behavior

Descriptive Statistics

	Mean	Std. Deviation	N
totalBI	12.7162	3.46037	585
totalPU	20.5897	4.61785	585
totalPEOU	20.0718	4.25533	585
totalSQ	38.1043	7.31983	585
totalT	26.8085	5.90660	585
totalCS	10.6068	2.66945	585

Correlations

		totalBI	totalPU	totalPEOU	totalSQ	totalT	totalCS
Pearson Correlation	totalBI	1.000	.617	.468	.408	.131	-.007
	totalPU	.617	1.000	.653	.535	.192	.075
	totalPEOU	.468	.653	1.000	.609	.264	.034
	totalSQ	.408	.535	.609	1.000	.186	.057
	totalT	.131	.192	.264	.186	1.000	.301
	totalCS	-.007	.075	.034	.057	.301	1.000
Sig. (1-tailed)	totalBI	.	.000	.000	.000	.001	.436
	totalPU	.000	.	.000	.000	.000	.034
	totalPEOU	.000	.000	.	.000	.000	.205
	totalSQ	.000	.000	.000	.	.000	.086
	totalT	.001	.000	.000	.000	.	.000
	totalCS	.436	.034	.205	.086	.000	.
N	totalBI	585	585	585	585	585	585
	totalPU	585	585	585	585	585	585
	totalPEOU	585	585	585	585	585	585
	totalSQ	585	585	585	585	585	585
	totalT	585	585	585	585	585	585
	totalCS	585	585	585	585	585	585

Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	totalCS, totalPEOU, totalT, totalSQ, totalPU[a]	.	Enter

a. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.628[a]	.395	.390	2.70338

a. Predictors: (Constant), totalCS, totalPEOU, totalT, totalSQ, totalPU

b. Dependent Variable: totalBI

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2761.398	5	552.280	75.569	.000[a]
	Residual	4231.498	579	7.308		
	Total	6992.896	584			

a. Predictors: (Constant), totalCS, totalPEOU, totalT, totalSQ, totalPU

b. Dependent Variable: totalBI

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.500	.805		3.107	.002
	totalPU	.396	.033	.528	12.027	.000
	totalPEOU	.058	.039	.071	1.496	.135
	totalSQ	.039	.020	.083	1.978	.048
	totalT	.008	.021	.013	.379	.705
	totalCS	-.075	.044	-.058	-1.694	.091

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.500	.805		3.107	.002
	totalPU	.396	.033	.528	12.027	.000
	totalPEOU	.058	.039	.071	1.496	.135
	totalSQ	.039	.020	.083	1.978	.048
	totalT	.008	.021	.013	.379	.705
	totalCS	-.075	.044	-.058	-1.694	.091

a. Dependent Variable: totalBI

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	totalPU	.542	1.844
	totalPEOU	.463	2.158
	totalSQ	.595	1.680
	totalT	.844	1.185
	totalCS	.903	1.108

a. Dependent Variable: totalBI

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions			
				(Constant)	totalPU	totalPEOU	totalSQ
1	1	5.849	1.000	.00	.00	.00	.00
	2	.068	9.308	.00	.06	.04	.03
	3	.034	13.130	.00	.04	.00	.01
	4	.021	16.776	.19	.49	.01	.34
	5	.016	19.366	.53	.27	.38	.08
	6	.013	21.014	.27	.14	.56	.54

a. Dependent Variable: totalBI

Collinearity Diagnostics[a]

Model	Dimension	Variance Proportions totalT	totalCS
1	1	.00	.00
	2	.04	.42
	3	.79	.39
	4	.07	.04
	5	.01	.14
	6	.08	.00

a. Dependent Variable: totalBI

Casewise Diagnostics[a]

Case Number	Std. Residual	totalBI	Predicted Value	Residual
125	-5.167	4.00	17.9692	-13.96919
143	-3.542	8.00	17.5765	-9.57651
226	-3.615	7.00	16.7714	-9.77144
374	-3.321	4.00	12.9768	-8.97685
488	3.176	20.00	11.4143	8.58571

a. Dependent Variable: totalBI

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	6.3030	18.3702	12.7162	2.17449	585
Std. Predicted Value	-2.949	2.600	.000	1.000	585
Standard Error of Predicted Value	.118	.555	.259	.088	585
Adjusted Predicted Value	6.3208	18.3044	12.7178	2.17423	585
Residual	-13.96919	8.58571	.00000	2.69179	585
Std. Residual	-5.167	3.176	.000	.996	585
Stud. Residual	-5.221	3.184	.000	1.002	585
Deleted Residual	-14.26371	8.63168	-.00160	2.72530	585
Stud. Deleted Residual	-5.344	3.210	-.001	1.005	585
Mahal. Distance	.123	23.605	4.991	4.259	585
Cook's Distance	.000	.096	.002	.007	585
Centered Leverage Value	.000	.040	.009	.007	585

a. Dependent Variable: totalBI

Regression Analysis on Factors influencing Behavior Intention to Use

Descriptive Statistics

	Mean	Std. Deviation	N
totalUSE	4.7487	2.08059	585
totalBI	12.7162	3.46037	585
totalFC	11.9470	2.77876	585

Correlations

		totalUSE	totalBI	totalFC
Pearson Correlation	totalUSE	1.000	.451	.435
	totalBI	.451	1.000	.451
	totalFC	.435	.451	1.000
Sig. (1-tailed)	totalUSE	.	.000	.000
	totalBI	.000	.	.000
	totalFC	.000	.000	.
N	totalUSE	585	585	585
	totalBI	585	585	585
	totalFC	585	585	585

Variables Entered/Removed

Model	Variables Entered	Variables Removed	Method
1	totalFC, totalBI[a]	.	Enter

a. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.521[a]	.271	.268	1.77949

a. Predictors: (Constant), totalFC, totalBI

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.521[a]	.271	.268	1.77949

a. Predictors: (Constant), totalFC, totalBI

b. Dependent Variable: totalUSE

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	685.105	2	342.552	108.177	.000[a]
	Residual	1842.957	582	3.167		
	Total	2528.062	584			

a. Predictors: (Constant), totalFC, totalBI

b. Dependent Variable: totalUSE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.300	.355		-.844	.399
	totalBI	.193	.024	.321	8.086	.000
	totalFC	.217	.030	.290	7.323	.000

a. Dependent Variable: totalUSE

Coefficients[a]

Model		Collinearity Statistics	
		Tolerance	VIF
1	(Constant)		
	totalBI	.797	1.255
	totalFC	.797	1.255

a. Dependent Variable: totalUSE

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	totalBI	totalFC
1	1	2.937	1.000	.00	.01	.00
	2	.037	8.911	.26	.98	.13
	3	.026	10.656	.74	.01	.87

a. Dependent Variable: totalUSE

Casewise Diagnostics[a]

Case Number	Std. Residual	totalUSE	Predicted Value	Residual
32	3.029	9.00	3.6091	5.39092

a.Dependent Variable: totalUSE

Residuals Statistics[a]

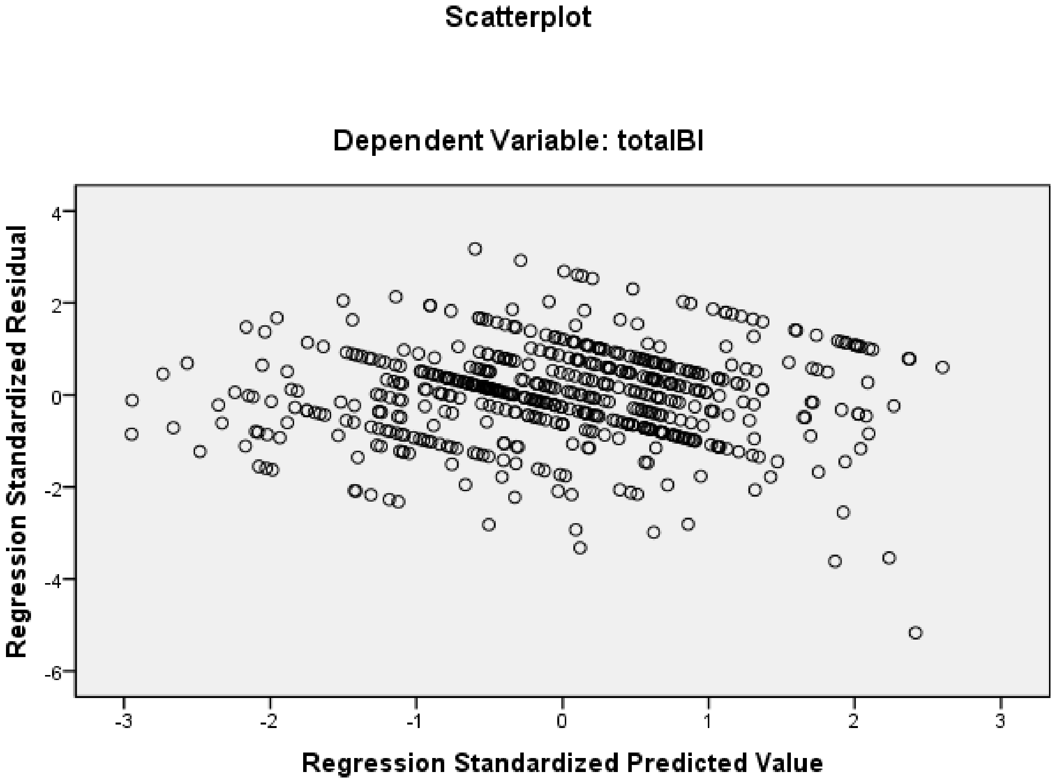
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.7265	7.9034	4.7487	1.08311	585
Std. Predicted Value	-2.790	2.913	.000	1.000	585
Standard Error of Predicted Value	.074	.388	.120	.043	585
Adjusted Predicted Value	1.6880	7.9017	4.7485	1.08378	585
Residual	-4.38174	5.39092	.00000	1.77644	585
Std. Residual	-2.462	3.029	.000	.998	585
Stud. Residual	-2.475	3.035	.000	1.001	585
Deleted Residual	-4.42597	5.41141	.00023	1.78577	585
Stud. Deleted Residual	-2.486	3.057	.000	1.002	585
Mahal. Distance	.007	26.762	1.997	2.421	585
Cook's Distance	.000	.044	.002	.004	585
Centered Leverage Value	.000	.046	.003	.004	585

a.Dependent Variable: totalUSE

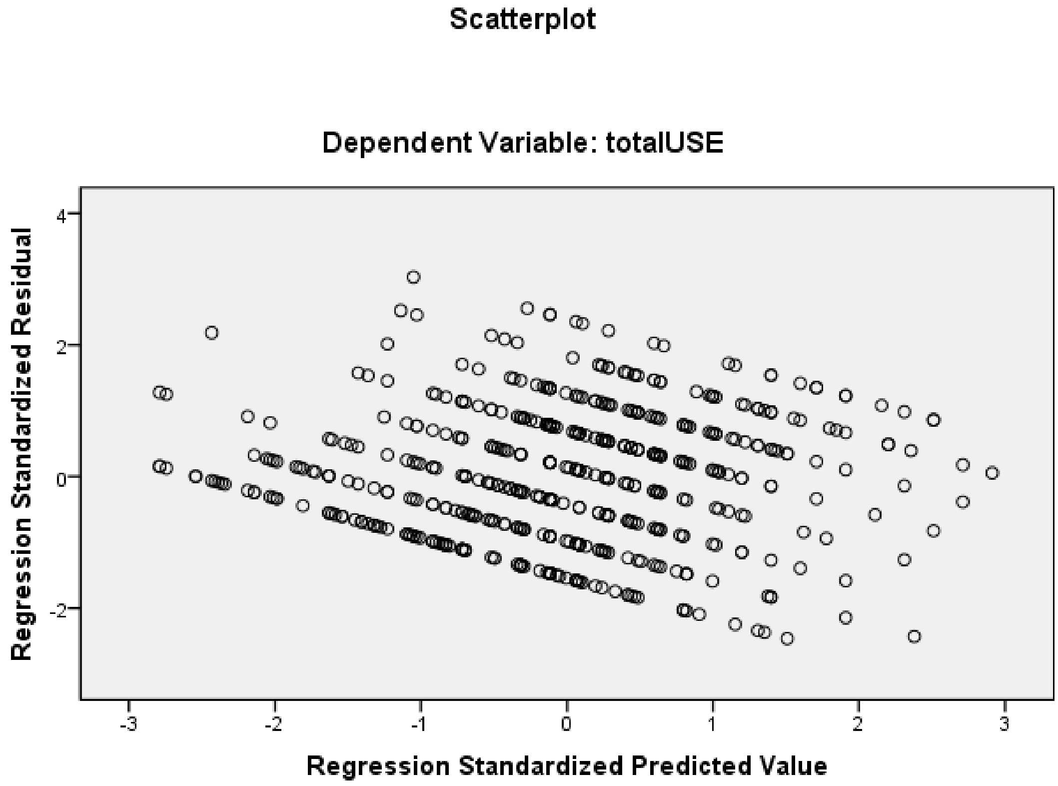
APPENDIX G

SCATTER PILOTS

Relationship between Behavior Intention to Use (DV) and Acceptance Factors (IV)



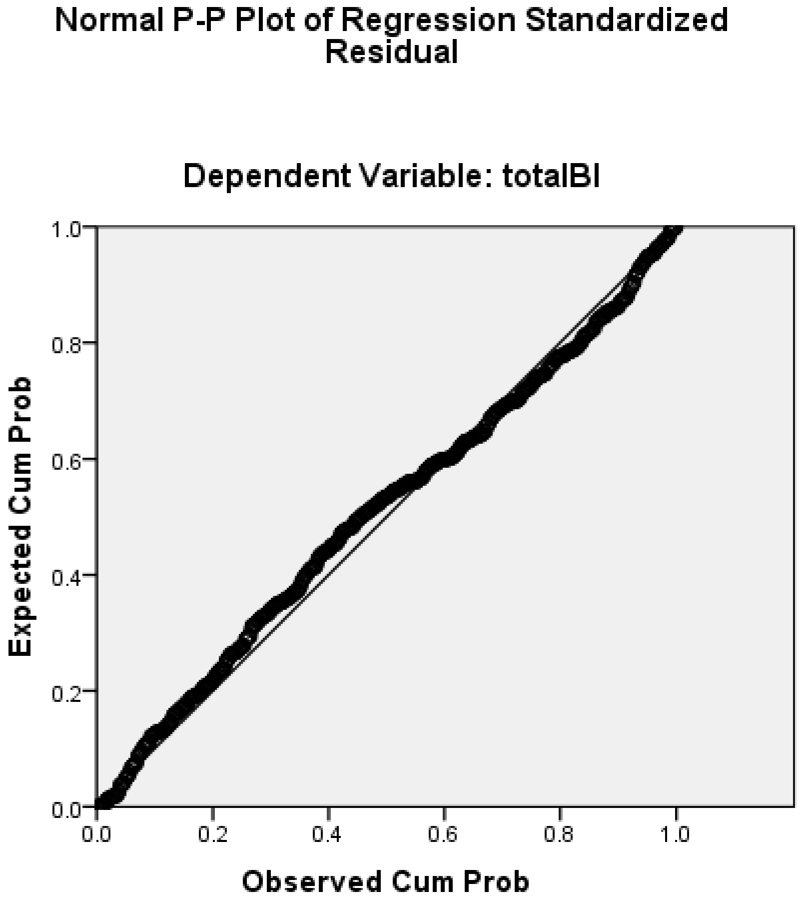
Relationship between Use Behavior (DV) and Behavior Intention (IV)



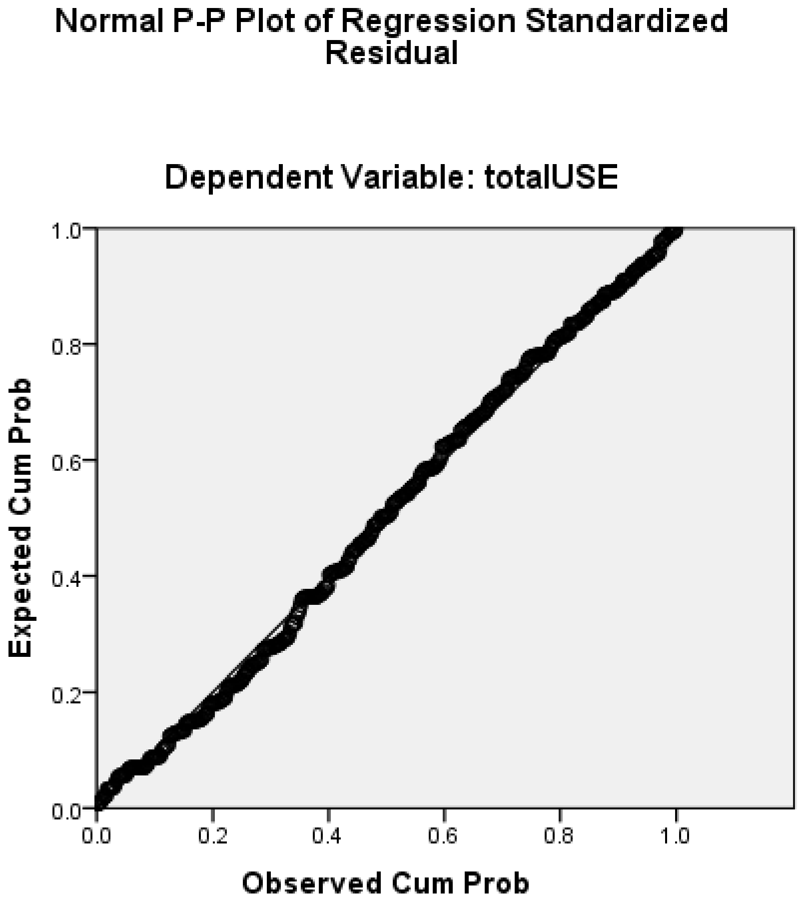
APPENDIX H

NORMAL PROBABILITY PLOTS

Relationship between Behavior Intention to Use (DV) and Acceptance Factors (IV)



Relationship between Use Behavior (DV) and Behavior Intention (IV)



APPENDIX I

QUESTIONNAIRE OF STUDENT’S MOBILE INFORMATION PROTOTYPE

Universiti Utara Malaysia (UUM)
College of Arts and Sciences (CAS)

Student's Mobile Information Prototype (SMIP)

Evaluation for the Higher Education Environment

Dear student,

This questionnaire aims to understand what aspects of the Student's Mobile Information Prototype (SMIP) you are particularly concerned about and the aspects that satisfy you.

Your participation in answering this questionnaire is very much significant and appreciated to ensure the success of this study. The information provided by you will be handled with utmost confidentiality.

Thank you very much for your cooperation.

For further enquiries, please contact:

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A. GENERAL INFORMATION

This section is about your background information. *Please fill up the blanks and mark [√] the most appropriate (please tick one only).*

1. What is your gender: [ ] Male [ ] Female
2. What is your age:
   [ ] Below 20 [ ] 20-25 [ ] 26-30 [ ] 31-35
   [ ] 36-40 [ ] More than 40
3. Your Education background (*Please Tick one only*):
   [ ] Science (*e.g., IT, ICT, Math, Engineering*)
   [ ] Business (*e.g., Accounting, Finance, Management*)
   [ ] Art Studies (*e.g., Languages, Law, History*)
   [ ] Other (*Please identify*) ____________________
4. Your current study program:
   [ ] Bachelor [ ] Master [ ] PhD
5. What is your Mobile device type [ ] PDA [ ] Smart Phone
   [ ] Hand Phone [ ] Other (*Please Identify*) ____________________
6. Your mobile applications experience
   [ ] Less than 5 years [ ] 5 - 9 [ ] More than 9 years

2

The following set of sections and statements are related to your perception towards the Student's Mobile Information Prototype (SMIP).

Please indicate your degree of agreement on the following statement, by circling or tick the most appropriate choice using the scale below:

1= ***Strongly Disagree*****, 2=** ***Disagree*****, 3=** ***Neutral*****, 4=** ***Agree*****, 5=** ***Strongly Agree***

B. USEFULNESS OF SMIP PROTOTYPE

1. This section aims to understand the *Perceived Usefulness (PU)* of SMIP.

1.	Using the SMIP would enable me to accomplish tasks more quickly.	1	2	3	4	5
2.	Using the SMIP would improve my performance in education environment.	1	2	3	4	5
3.	Using the SMIP would increase my productivity in education environment.	1	2	3	4	5
4.	Using the SMIP would enhance my effectiveness in education environment.	1	2	3	4	5
5.	Using the SMIP would make it easier to engage me in education environment.	1	2	3	4	5
6.	I find the SMIP useful in my education environment.	1	2	3	4	5

2. This section aims to understand the *Perceived Ease of Use (PEOU)* of SMIP

1.	Learning to use the SMIP is easy for me.	1	2	3	4	5
2.	I find it easy to use the SMIP to find what I want.	1	2	3	4	5
3.	My interaction with the SMIP is clear and understandable.	1	2	3	4	5
4.	I find the SMIP are flexible to interact with.	1	2	3	4	5
5.	It is easy for me to become skillful in using the SMIP.	1	2	3	4	5
6.	Overall, I find the SMIP easy to use.	1	2	3	4	5

3

3. This section aims to understand the *Learnability (L)* of SMIP

1.	It was easy to learn to use the SMIP.	1	2	3	4	5
2.	There was too much information to read before I can use the SMIP.	1	2	3	4	5
3.	The information provided by the SMIP was easy to understand.	1	2	3	4	5

C. INFORMATION QUALITY OF SMIP

4. This section aims to understand the *Information Quality (INF)* of SMIP

1.	SMIP gives error messages that clearly tell me how to fix problems.	1	2	3	4	5
2.	Whenever I make a mistake using the SMIP, I recover easily and quickly.	1	2	3	4	5
3.	The information (on-screen messages) provided with the SMIP is clear.	1	2	3	4	5
4.	It is easy to find the information I need.	1	2	3	4	5
5.	The information provided with the SMIP is easy to understand.	1	2	3	4	5
6.	The information is effective in helping me complete my work.	1	2	3	4	5
7.	The organization of information on the SMIP screens is clear.	1	2	3	4	5

5. This section aims to understand the *Functionality (F)* of SMIP

1.	SMIP has all the functions and capabilities that I expected it to have.	1	2	3	4	5
2.	The information retrieved by SMIP was effective in helping me to complete the tasks.	1	2	3	4	5
3.	The services listed by SMIP as a reply to my request were suitable for my education environment.	1	2	3	4	5
4.	It is easy to access all the functionality of the SMIP.	1	2	3	4	5

4

6. This section aims to understand the *Errors / System Reliability (ER)* of SMIP

1.	Whenever I made a mistake using the SMIP, I could recover easily and quickly.	1	2	3	4	5
2.	SMIP gave error messages that clearly told me how to fix problem.	1	2	3	4	5

7. This section aims to understand the *Outcome / Future Use (FU)* of SMIP

1.	I was able to complete my tasks quickly using SMIP.	1	2	3	4	5
2.	I could effectively complete my tasks using SMIP.	1	2	3	4	5
3.	I was able to efficiently complete my tasks using SMIP.	1	2	3	4	5
4.	I believe I could become productive quickly using SMIP.	1	2	3	4	5
5.	From my current experience with using SMIP, I think I would use it regularly.	1	2	3	4	5
6.	I would recommend SMIP	1	2	3	4	5

D. INTERFACE QUALITY OF SMIP

8. This section aims to understand the Interface Quality (IQ) of SMIP

1.	The interface of the SMIP is pleasant.	1	2	3	4	5
2.	I like using the interface of the SMIP.	1	2	3	4	5
3.	SMIP has all the functions and capabilities I expect it to have.	1	2	3	4	5
4.	Overall, I am satisfied with the SMIP.	1	2	3	4	5

5

9. This section aims to understand the *Design / Layout (DL)* of SMIP

1.	I like using the interface of the SMIP.	1	2	3	4	5
2.	The organization of information presented by the SMIP was clear.	1	2	3	4	5
3.	The interface of the SMIP was pleasant to use.	1	2	3	4	5

E. EFFICIENCY OF SMIP

10. This section aims to understand the *Didactic Efficiency (DE)* of SMIP

1.	SMIP increases the quality of my m-learning (mobile learning).	1	2	3	4	5
2.	Learning objectives can be met by SMIP.	1	2	3	4	5
3.	Communication with SMIP was easy.	1	2	3	4	5
4.	SMIP is convenient for communication with other University services.	1	2	3	4	5

11. This section aims to understand the *Cost Effectiveness (CE)* of SMIP

1.	SMIP increases access to education administrative services.	1	2	3	4	5
2.	The cost of accessing the SMIP services was acceptable.	1	2	3	4	5
3.	The cost of communicating with the SMIP was acceptable.	1	2	3	4	5

Briefly, do you have any other comments about SMIP?

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Thanks for Your Cooperation and Efforts

6

APPENDIX J

LIST OF AWARDS AND PUBLICATIONS

(i) Awards

Alzaza, N. S., Yaakub, A. R., & Zulkifli, A. N. (2010, February 4-6). Golden Medal and Best Award about software product Student's Mobile Information Prototype (SMIP). Kuala Lumpur, Malaysia: Malaysia Technology Expo (MTE2010).

Alzaza, N. S., & Zulkifli, A. N. (2008, February 21-23). Silver Medal about software product Mobile Based Library Loan Services (MBLLS). Kuala Lumpur, Malaysia: Malaysia Technology Expo (MTE2008).

Alzaza, N. S., Yaakub, A. R., & Zulkifli, A. N. (2010, December 2-4). Bronze Medal about Mobile Learning (m-learning) software product for the Higher Education Environment. Seoul, Korea: Seoul International Invention Fair 2010 (SIIF 2010).

(ii) Publications

Alzaza, N. S., & Yaakub, A. R. (2011a). Student's Mobile Information Prototype (SMIP) for the Higher Education Environment. *American Journal of Economics and Business Administration*, *3*(1), 81-86.

Alzaza, N. S., & Yaakub, A. R. (2011b). Students' Awareness and Requirements of Mobile Learning Services in the Higher Education Environment. *American Journal of Economics and Business Administration*, *3*(1), 95-100.

Alzaza, N. S., & Yaakub, A. R. (2010a, May 25-27). *Student's Mobile Information Prototype (SMIP) for the Higher Education Environment.* Paper presented at the Knowledge Management 5th International Conference 2010: Knowledge Management: Theory, Research, and Practice, Kuala Terengganu, Malaysia.

Alzaza, N. S., & Yaakub, A. R. (2010b, May 25-27). *Students' Awareness and Requirements of Mobile Learning Services among Malaysian Students in the Higher Education Environment.* Paper presented at the Knowledge Management 5th International Conference 2010: Knowledge Management: Theory, Research, and Practice, Kuala Terengganu, Malaysia.

Alzaza, N. S., & Zulkifli, A. N. (2007, November 20–21). *Mobile Based Library Loan Service (MBLLS).* Paper presented at the Rural ICT Development Conference '07 (RICTD'07), Executive Development Centre (EDC), Sintok, Malaysia.