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A Maturity Model for Mobile Learning

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A thesis submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree in Electrical and Computer Engineering
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by

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Abstract

Higher education is becoming increasingly interested in adopting innovative and modern technologies as a mode of imparting education. Mobile technologies are considered to be the next frontier of educational platforms as they have the capability to provide high-quality learning experiences and to satisfy the increasing demand for mobility and flexibility. In view of the ubiquitous nature of mobile technology and the immense opportunities it offers, there are favorable indications that the technology could be introduced as the next generation of learning platforms.

The present research aims to develop a comprehensive framework based on the well-known Capability Maturity Model (CMM) and to empirically evaluate the maturity of mobile learning (m-Learning) initiatives in universities. The objective is to first identify key factors that affect m-Learning adoption, then classify these factors into target groups, and eventually use this as a theoretical basis for proposing a maturity model for m-Learning. In doing so, the research focuses on three major stakeholders in post-secondary education, namely students, instructors, and university management.

The proposed Mobile Learning Maturity Model (MLMM) is based on a framework that outlines an adoption rate using five maturity levels. The measuring instrument for the model contains nine critical success factors selected from three of our empirical studies that examined the perspectives of students, instructors, and academic management. The model uses assessment questionnaires, a rating methodology, and two case studies. All data has been collected from five universities in Saudi Arabia.

Keywords

Dedicated To My Family

They have been the biggest influence in my life.

Indeed, behind the success of a man, there is always a woman. I am blessed to have a very supportive wife and beautiful children. Through the thick and thin of my academic life, my wife has been my support system and my friend.

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First of all, all praise goes to Allah Almighty, who is the most merciful and beneficent. I am highly grateful to Allah for His countless blessings and for providing me the opportunity to carry out PhD studies. Without His guidance and blessings, nothing is possible.

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List of Abbreviations and Symbols

BL   Blended Learning

c   Coefficients

CAGR   Compound Annual Growth Rate

CMM   Capability Maturity Model

CMP   Change management practices

CSF   Critical Success Factor

DARE   Database of Abstracts for Reviews and Dissemination

e-Learning   Electronic Learning

EMM   e-Learning Maturity Model

ePCMM   e-Learning Process Capability Maturity Model

f   Independent variables/ factors

H   Hypothesis

IA   Internet access

IAU   Instructor autonomy

ID   Study identification

IP   Increased Productivity

ISO/IEC   International Organization for Standardization/International Electrotechnical
             Commission

IT   Information Technology

LMI	Learning Made Interesting
MF	m-Learning Factor
MFN	M-Learning Factor Number (an integer)
ML	Maturity Level (an integer)
m-Learning	Mobile Learning
MLMM	m-Learning Maturity Model
NAS	Number of Achieved Statement
OCDMM	Online Course Design Maturity model
PCA	Principal Component Analysis
PDA	Personal Digital Assistant
PLC	Partial Least Square
R&D	Research and Development
S	Statement
SMS	Short Message Service
SN	Statement Number (an integer)
SoC	System on Chip
TCI	Technical Competence of Instructors
UC	University's Commitment to m-Learning
ULP	University Learning Practices
UNESCO	United Nations Educational, Scientific, and Cultural Organization

Chapter 1

1   Introduction[1]

In the present day, higher educational institutions throughout the world are increasingly being persuaded to make use of mobile technology (Traxler, and Kukulska-Hulme, 2005) − a trend that is widely accepted and used almost everywhere in the world as a mode of communication. The fast-paced evolution of emerging technologies in this area has a significant effect on the way society communicates, learns, accesses information, and connects with peers and colleagues. The pervasive nature and application of innovative technologies continue to challenge the foundations of learning, teaching, research, and creative inquiry, especially in the higher education arena. This emerging 21st century mobility paradigm presents opportunities, challenges, and, sometimes, barriers in the ways learners interact, collaborate, connect, contextualize, and personalize their learning environments.

Therefore, the field of mobile learning (m-Learning) is becoming increasingly capable of supporting high quality learning experiences. On top of this, students are increasingly demanding greater mobility and flexibility in their learning experiences. As a result, higher education has been gradually considering the implementation of institutional m-Learning strategies (Attewell et al., 2009).

Furthermore, researchers have come to appreciate that mobile technology has facilitated inter-communication in ways that were never thought of before. Thus, it is generally accepted that the concept of m-Learning is much wider in scope than simply gaining or imparting knowledge using mobile technology, and that m-Learning involves related

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[1] Parts of this chapter were published in following articles:

1. Alrasheedi, M., & Capretz, L. F. (2013d). Can m-Learning Maturity Be Measured? A Preliminary Work, Proceedings of the Canadian Engineering Education Association, Montreal, Canada, June 17-20, 2013, 1-6.

2. Alrasheedi, M., & Capretz, L. F. (2013c). An M-Learning Maturity Model for the Educational Sector, the Sixth International Conference of MIT's Learning International Networks Consortium (LINC), MIT, Cambridge, Massachusetts, USA, June 16-19, 2013, 1-11.

investigations into how interpersonal interactions using mobile technology can facilitate the process of learning (Sharples et al., 2007). Moreover, the rapid development in mobile technology has correspondingly increased capabilities in supporting education not only in stand-alone environments but also in blended contexts, i.e., in conjunction with traditional teaching techniques. This has made the field of m-Learning into the new learning paradigm. The field is now the focus of increasing research and development (R&D) activities (Kukulska-Hulme and Traxler, 2007).

M-Learning is a fairly recent concept and research in this area is still in its infancy. In fact, the earliest research projects in this field started appearing only in the latter half of the 1990s and the first international research conference dates back less than a decade. As is obvious, the relative newness of the field also means that the processes, frameworks, tools, etc., have not yet been standardized (Vavoula and Sharples, 2009). The continually evolving concepts in m-Learning, related to both technology and communication networking, makes the research into m-Learning challenging in every aspect including evaluation. In order to overcome the challenges of evaluation, tailored tools and frameworks need to be developed. Presently, researchers in this field borrow frameworks and tools from other areas based on their similarities. However, these practices will not be sufficient if the acceptance of the technology is to be popular and universal (Kukulska-Hulme and Traxler, 2007).

The use of mobile technology in the educational sector is not limited to addition of a delivery method, for instance electronic learning (e-Learning) on a mobile device. In fact, there are several other contexts arising from the use of a mobile device, which include but are not limited to, distance learning, which is especially important for people living in remote communities and the possibility of anytime-anywhere learning for students. Other important contexts are a tailored learning processes to suit each students' pace and collaborative learning between students as well as instructors in geographically distant locations (Motiwalla, 2007). In order to successfully use the full capabilities of mobile technology in the educational sector, the assessment framework would have to include these contexts. Thus it can be seen that existing frameworks for educational evaluation, including for platforms such as e-Learning, are not sufficient for successfully evaluating

m-Learning (Vavoula and Sharples, 2008). This points to a clear need for developing assessment frameworks that are especially tailored to assess m-Learning and its successful implementation in the educational sector.

One of the modes for developing a successful evaluation framework is to use a popular technology implementation framework and adapt it for evaluating m-Learning in higher education. This research aims to use this mode for developing a framework by attempting to adapt the capability maturity model (CMM) framework – detailed descriptions regarding the CMM are discussed in section (2.2.1) below – for evaluating m-Learning in higher education. The primary goal of the present research is to put forward a maturity model for m-Learning.

1.1 Mobile Learning Definition

The emergence of the concept of m-Learning has led to many attempts to define the concept. Choosing one definition among the many proposed can be controversial. The main reason for this is that the mobile platform (hardware and software) is undergoing rapid transformations with new technologies being developed every few months. The newer versions are getting more sophisticated but the older versions, or phones, are still widely used. The platform is not limited to mobile phones, as the name suggests, but includes a host of other devices including notebook computers, tablets, digital cameras, music players, and even gaming consoles. The concept of m-Learning has been part of several debates (Kukulska-Hulme and Taxler, 2007). The main question to be asked here is: Does the concept of m-Learning refer to the mobility of the student or does the term reflect the mobile device itself? Both points of view are equally relevant and powerful and choosing either would have a significant impact on the implementation process. One aspect common to both is that the concept of m-Learning encompasses learning within the traditional classroom setting as well as the possibility of formal or informal education outside the traditional classroom set-up using any of the possible mobile devices. It is also clear that interaction with mobile devices is just one part of m-Learning; the most important part is the characterization of these interactions so that they support the educational process.

Looking at the two different views of m-Learning, it is clear that the last definition is more in line with the point of view supported by Kukulska-Hulme and Traxlor (2007). This is because it can be argued that, in this case, the location of the learners is vital, in the sense that they have to be separated enough so that interaction between them is possible only through mobile devices. People also have to be free to move without affecting the overall learning process (Kukulska-Hulme and Traxler, 2007).

From a technical standpoint, the m-Learning platform should be one that responds to learners based on their requests and provides information effectively. Furthermore, such a device should be capable of interactive communication among different actors in the learning process. These actors include students and instructors, as well as the higher education managers.

Many definitions of m-Learning consider it as an extension of the e-Learning process. For instance, Quinn (2000) defines m-learning as e-Learning through devices that are mobile. Similarly, m-Learning is often defined as a point at which e-Learning and mobile computing intersect to provide a learning experience based on the anytime, anywhere concept. However, it is evident from these definitions that m-Learning is considered as an extension of e-Learning. Thus, these definitions are limited to the learning that takes place through a device that offers mobile connectivity away from the traditional learning environment.

However, when looking at m-Learning from the perspective of users, the concept becomes more clear and broad. From the user perspective, m-Learning should include the mobility of the learner as well as of the device itself. In addition, this does not eliminate the need for a traditional learning environment like classrooms. In fact, any learning activity that is complemented or supported by mobile devices, whether in a traditional learning environment or an m-Learning environment, is considered to be m-Learning. Therefore, m-Learning includes any learning which is supported by a wireless, Internet-connected device, either inside or outside the classroom.

To explain this concept, UNESCO (2013) in its policy guidelines, uses the term m-Learning to describe learning that is possible anytime and anywhere and involves the use

of mobile technology either in standalone mode or in conjunction with any other information and communication technology.

El-Hussein and Cronje (2010) emphasized the use of the mobile technology aspect clearly while defining m-Learning in their paper, where they note that the devices used for m-Learning must be noticeably mobile. However, the architects of m-Learning models must not consider the process as merely the extension of e-Learning using mobile devices. The focus of designing m-Learning applications must be specific to the usage of mobile technology, using all the advantages the technology offers to facilitate the process of learning. In the context of this research, the definition of El-Hussein and Cronje (2010) is considered to be the most relevant definition.

Figure 1.1 below shows the different ways in which m-Learning can be utilized in an education setting as summarized by Schofield et al. (2011). More elaborations about the m-Learning concept will follow in section 2.1.
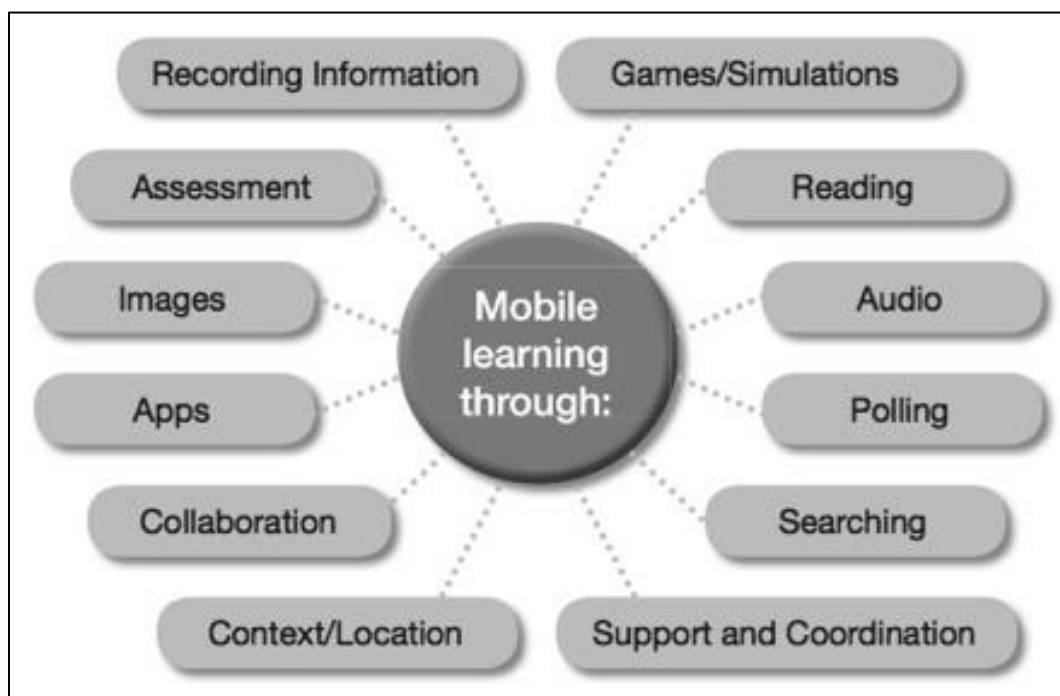
Figure 1.1 Utilities of m-Learning (adapted from Schofield et al. (2011))

1.2 Research Objectives

The primary goal of this research is to put forward a maturity model for m-Learning. In addition, this research also aims to illustrate various stages in the model in order to assist the process of assessing the maturity of m-Learning.

In order to accomplish the basic goal of this research, the study first attempts to prove the validity of applying CMM concepts to the m-Learning platform. Following this, the study proposes to adapt the CMM framework to assess the m-Learning initiatives within higher education. The idea is to use the CMM concept as a guideline to evaluate and enhance the process of adoption of m-Learning initiatives both as a stand-alone platform and as an integrated platform with existing e-Learning initiatives within higher education. The advantages of using the modified version of CMM for m-Learning will also be discussed as part of the research. As mentioned, the framework is aimed at universities that would be able to use it to appraise their present m-Learning initiatives in terms of adoption success by various stakeholders involved in the learning process. In addition, this research attempts to make an in-depth assessment of the validity of applying CMM to the m-Learning domain.

In short, this research addresses the following question:

Is it possible to creatively use CMM in proposing a maturity model for m-Learning?

The intention is to effectively use the CMM model to evaluate the maturity of m-Learning. The scope of the research is limited to the evaluation of CMM as it applies to m-Learning and how it can be mapped precisely to define the m-Learning maturity. It is also aimed to discuss the merits of the modified model as well as propose suggestions to make it comprehensive. This question led to a series of formulated research questions given in section (1.6) below.

1.3 Motivation

Paul and Seth (2012) reported that less than a decade ago, 70% of the world population had never used a cell phone. However, the World Bank reported that in 2012 close to

75% of the world, including the developing world, have access to a mobile phone (RFE/RL, 2012). This not only shows the immense success of the technology itself, but also the fact that people are aware of the multitude of benefits of mobile phones (Li et al., 2008). In addition, most of the mobile devices are also multifunctional offering varied functionality in terms of multiple speeds and capacities of data storage and processing. The use of these versatile devices in the educational sector has the potential to allow students to access their course materials as well as interact with fellow students and their instructors regardless of their location and time. In other words, mobile technologies have the capability to support anytime and anywhere learning (Wains and Mahmood, 2008).

The immense advantages offered by m-Learning have not gone unnoticed, as is evident from the fact that the global market for m-Learning related products reached $3.2 billion in 2010 (Schofield et al., 2011). With researchers estimating the compound annual growth rate (CAGR) at 22.7% for the near future, it is clear that the era of the m-Learning platform has arrived (Schofield et al., 2011). Higher education is now expected to tap into these benefits in order to stay in competition by offering newer channels to attract students and increase their admission capacity (Adesope et al., 2007; Lindbeck, and Fodrey, 2010).

Due to these factors, there is clear impetus to ensure successful implementation of an m-Learning platform within universities. This, in turn, needs knowledge of whether the m-Learning platform has been successfully implemented and a road map has been developed for the successful acceptance of the m-Learning platform by all categories of stakeholders in higher education. The only way this is possible is by using the right evaluation framework, which will not only give a true picture of the current status of m-Learning implementation within the educational institute, but also provide a roadmap for success that includes evaluation of m-Learning at important milestones. This is the objective of the present research.

1.4 Problem Statement

The rapid development in mobile technology has led to a corresponding increase in its functional capabilities. The increased possibilities of mobile technology in the

educational sector has catapulted the field of m-Learning into a new learning paradigm and the field is now the focus of increasing R&D activities (Kukulska-Hulme and Traxler, 2007).

Over the past decade, several theoretical and pilot research studies have been conducted to assess the use of mobile technologies in education. Regardless of the differences in contexts of these studies, all have consistently agreed on the existence of several barriers to the adoption of an m-Learning platform in education. Higher educational institutions are wary of investing extensively in overhauling the existing system by embedding the mobile platform; this hesitation is primarily due to the extremely fast rate at which newer devices with better capabilities keep entering the market, thus rendering the older devices obsolete. This has resulted in very few higher institutions in the higher education sector actually implementing m-Learning initiatives on a wide scale.

Researchers, such as Wishart and Green (2010), consider the lack of a comprehensive framework for evaluating the use of mobile technologies in higher education to be probably the foremost concern in the area of m-Learning. The presence of an overall framework that uses the process of m-Learning adoption could result in efficiencies in the process, and it would definitely enhance learning outcomes for students. In view of the urgency in implementing m-Learning, due to current needs, an evaluation method is required to assess the value that institutions gain by adoption, implementation, and assessment. However, m-Learning evaluation methodology requires a comprehensive framework that has not yet been explored by researchers.

A CMM, as the name suggests, is a maturity model used to determine how far a technology can grow or mature with its capability in a particular area. The use of CMM in the educational context is not a new idea, as reported by Lutteroth et al. (2007). Indeed, Jalote (2003) asserts that the CMM can be used as a tool to overcome any deficit in the quality standards of a process in any area, including the educational sector. A CMM model has been successfully modified and adapted to assess process maturity in varied domains like the usability of open source software (Raza, 2011; Raza et al., 2012a; Raza et al., 2012b) and software product line engineering maturity (Ahmed et al., 2007;

Ahmed and Capretz, 2010; Ahmed and Capretz, 2011a; Ahmed and Capretz, 2011b). This proves that with appropriate modifications, the CMM model can be adapted to also assess the maturity of m-Learning within higher education, which is the primary goal of this research.

One of the more relevant researches in the area is the work by Hain and Back (2011) where a maturity model for e-Collaboration has been developed on the lines of CMM. E-Collaboration shares similarities with m-Learning in the sense that effects from the platform are immense, like m-Learning, but not yet fully identified and exploited. M-Learning too can be used in several different contexts. The exponentially fast development of mobile technologies and the ensuing convergence of communication between people means that there is a fair possibility of the development of newer contexts. The e-Collaboration maturity model focuses only on the most popular and relevant areas to begin with, though the model can be extended to other contexts as well. Ideally, the m-Learning maturity model could also use popular areas such as remote learning and collaborative learning for the initial framework design. Finally, e-Collaboration also focuses on the socio-cultural context and includes it within the maturity model (Hain and Back, 2011).

Thus, using the above framework as a guideline, the present research attempts to overcome the absence of an overall comprehensive framework by developing an m-Learning maturity model to aid in evaluating the m-Learning maturity. In the initial stage, the framework identifies the stages of maturity from the perspectives of students, instructors, and the management as a whole.

In order to develop this framework, it is necessary to address the following inquiries and the related sub-inquiries.

1. To empirically discover and classify the factors contributing directly or indirectly to the maturity evaluation of m-Learning. This primary issue has the following sub-problems that need to be addressed as well:
    I. Identification of the key factors from the student viewpoint
    II. Identification of the key factors from the instructor viewpoint

   III.   Identification of the key factors from the university management
          viewpoint.

2. To create a maturity model for m-Learning in the university set-up. This primary
   problem has the following sub-problems that also need to be addressed:

   I.   Identification of the different maturity levels for the m-Learning maturity
         model (MLMM)

   II.   Development of the evaluation questionnaires for assessing m-Learning

   III. Development of the rating scheme for m-Learning maturity levels.

3. To apply the MLMM developed above and the evaluation of the proposed
   framework. This problem has the following sub-problems that need to be
   addressed as well:

   I.   Development of a comprehensive evaluation methodology

   II.   Development of case studies to carry out explorations in m-Learning
         initiatives

   III. Gathering and interpreting evaluation data.

1.5 Research Methodology

As discussed in the above section, the main purpose of the research is to understand the
issues involved in the implementation of m-Learning in universities from the points of
view of different stakeholders – students, instructors, and university management. This
assessment gives the key factors from the points of view of the three stakeholders and
uses these to build a maturity model for the successful implementation of m-Learning in
universities. The approach used for the development of the maturity model is similar to
the research model and the corresponding method reported in (Raza, 2011; Raza et al.,
2012a, 2012b; Ahmed and Capretz, 2010, 2011a, 2011b). Accordingly, the detailed
methodology used in the present study is as described below:

The primary intent is simply to develop the MLMM with defined objectives and
milestones for each level. The research addresses the three problems identified in the
Problem Statement section (1.4) above. The final research deliverable includes a
comprehensive literature review of m-Learning in different set-ups that helps in
discovering the key factors of m-Learning in the university context. The in-depth study

also helps in developing a viable assessment approach to derive appropriate scales for capability assessment responses for each stakeholder group.

Figure 1.2 below illustrates the first phase of the research. Within this phase we intend to tackle problems 1, 1-i, 1-ii, and 1-iii, with a goal to find workable solutions for each of the problems.
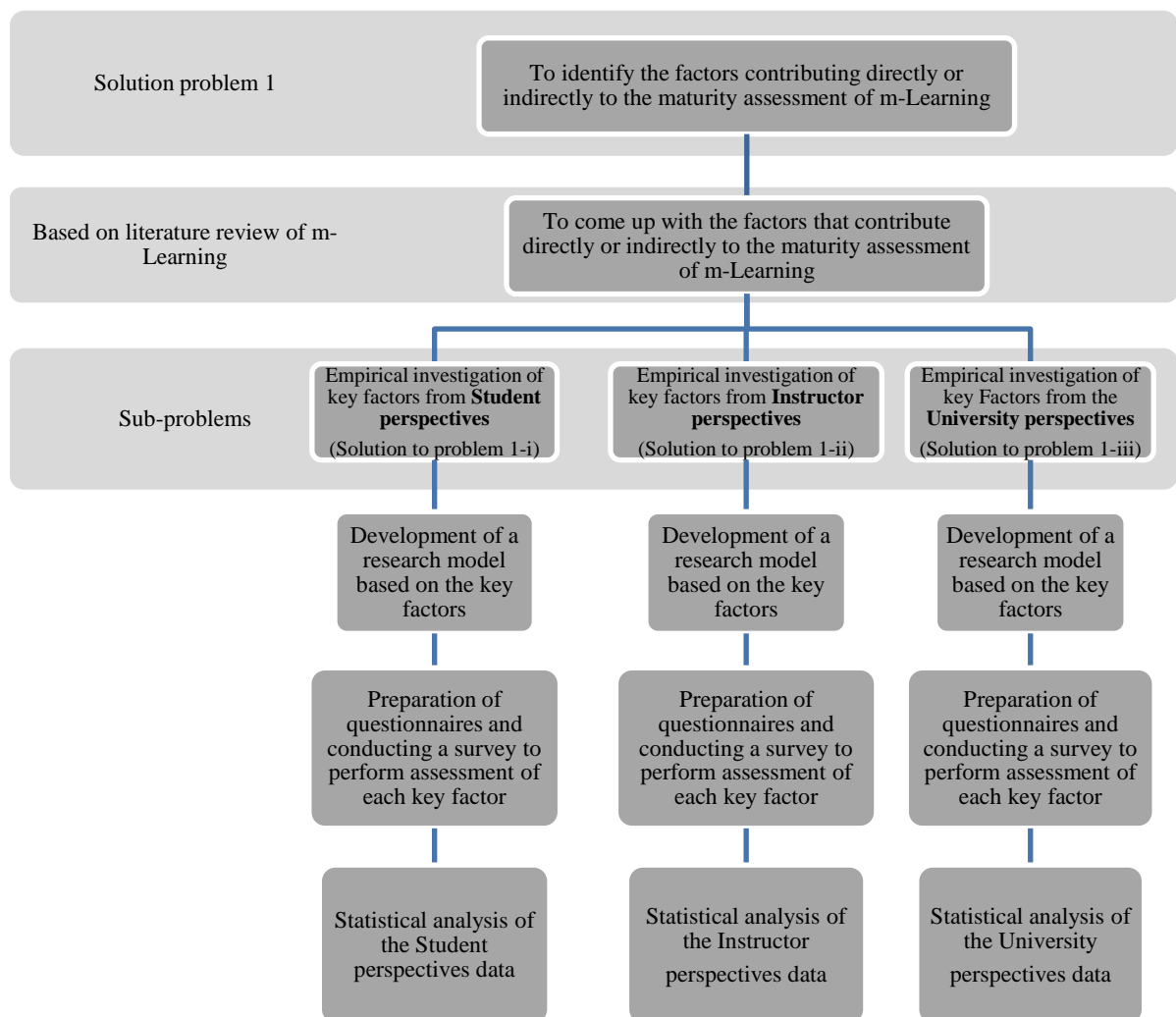
Figure 1.2 m-Learning Assessment Maturity Model [Research Phase I]

Figure 1.3 below illustrates the 2nd phase of the research. Within this phase it is intended to tackle problems 2, 2-i, 2-ii, and 2-iii, with a goal to find feasible solutions for each problem.
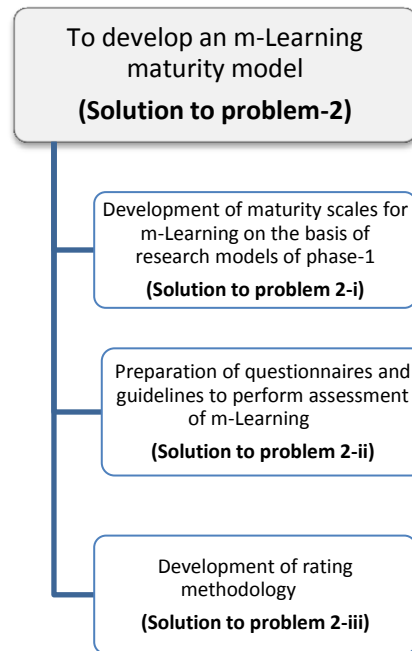
Figure 1.3 m-Learning Assessment Maturity Model [Research Phase II]

Figure 1.4 below illustrates the 3rd phase of the research. Within this phase it is intended to address problems 3, 3-i, 3-ii, and 3-iii, with a goal to find workable solutions for each problem.
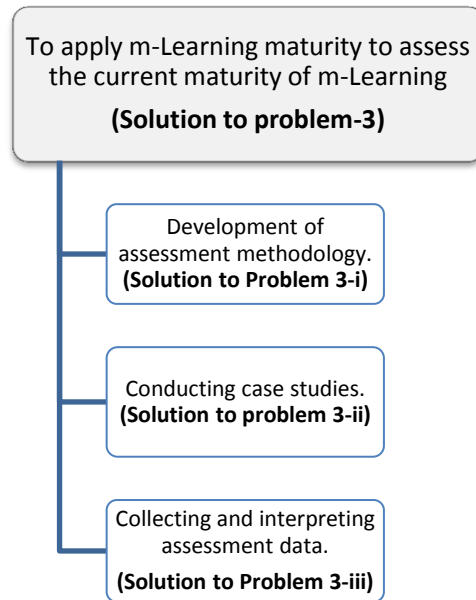
Figure 1.4 m-Learning Assessment Maturity Model [Research Phase III]

1.6 Research Questions

As discussed above, the main purpose of this research is to find answers to a series of formulated research questions in order to fill the research gap in the area of m-Learning assessment. The answers to these questions will provide a comprehensive methodology for assessing the MLMM. Following are the questions that need to be answered within the scope of this research:

1. Is it possible to clearly differentiate between e-Learning and m-Learning platforms based on their characteristics?
2. Are there any frameworks available for evaluating m-Learning maturity in the educational setting?
3. Is the application of CMM to m-Learning viable?
4. What are the critical success factors (CSFs) that affect successful m-Learning adoption based on the literature?
5. What are the key factors that contribute towards m-Learning maturity from the perspective of the students?
6. How can we assess the success of m-Learning from the perspective of the instructors?

7. What are the CSFs that contribute towards m-Learning adoption from the perspective of the university management?

8. How can we perform the assessment of m-Learning capability within a university environment?

9. Can we develop a methodology for evaluating the maturity level of m-Learning initiatives in higher education

10. What are the future implications from the development of MLMM?

1.7 Contributions to Knowledge

There are three major contributions of this research, which are discussed below:

1. Development of a novel evaluation framework targeting groups such as students, instructors, researchers, practitioners, and academic administrators in the field of m-Learning.

2. The resulting model of the framework, derived from CMM, is useful for identifying factors that directly or indirectly contribute to maturity assessment (from a literature review) and an assessment of the importance of the critical success factors from the points of view of the stakeholders (students, instructors, and institutional management). This provides the experimental validation of the model developed.

3. The model is evaluated using two case studies to assess the present maturity level of different institutions. This not only helps in fine tuning the model for evaluation purposes, but also creates a road map for future m-Learning evaluation efforts.

1.8 Thesis Structure

The organization of this thesis is based on 13 articles that have been published or are currently under review in software engineering and educational technology journals and conferences. These papers are cited accordingly in the corresponding chapters. In Chapter 2, we give more details about the m-Learning concept and technical jargon as well as

provide a summary of related work. Then in Chapter 3, we present a literature review that is related to m-Learning CSFs.

Chapter 4 presents an empirical investigation for studying the impact of key factors on m-Learning adoption from the perspective of students, establishing the relationship between the key CSFs and m-Learning adoption from the viewpoint of students. The study conducted and reported in this chapter can enhance the understanding of CSFs that affect the implementations of m-Learning from student viewpoints. Consequently, the m-Learning researchers can use this research to address CSF issues in their projects. Therefore, this empirical investigation provides justification for considering these CSFs as a measuring instrument for a maturity model that assesses the m-Learning.

Accordingly, Chapter 5 presents a research model of an empirical investigation that establishes a relationship between the CSFs from the perspective of instructors and m-Learning adoption. The results of this investigation show that the key factors in our research model assist in improving and developing MLMM.

Chapter 6 presents an empirical investigation for studying the impact of CSFs from the perspective of university management, including deans, department chairs, and IT decision makers. In this study, we investigate the effects of CSFs on m-Learning adoption and discover answers to the research question stated in this investigation. The study will enable m-Learning development teams to improve their understanding of the relationship between the key factors and m-Learning adoption.

In Chapter 7 the MLMM is presented. In particular, the model examines the relationship between m-Learning and the level of adoption. The measuring instrument of the model contains nine factors that have been selected from three of our empirical studies that examined the perspectives of students, instructors, and the university management. In addition to presenting the MLMM, this chapter discusses assessment questionnaires, a rating methodology, and two case studies from Saudi Arabian universities.

Finally, Chapter 8 concludes this thesis and provides a summary of the research contributions of this dissertation in the area of m-Learning. This chapter also discusses future research directions in m-Learning assessment.

Chapter 2

2   Background[2]

This chapter explains different technical jargon and terms used in this research to develop a clear understanding the various concepts related to this thesis. This chapter also aims to differentiate between e-Learning and m-Learning with respect to technology and the implementation process. Moreover, this chapter presents a comprehensive outlook on related work.

2.1 M-Learning Concept

This section aims to discuss and evaluate the concept of m-Learning from different perspectives. In doing so, this section presents the differences between m-Learning, e-Learning, and distance learning. The section also covers some distinct characteristics of m-Learning, the limitations of m-Learning, and various challenges faced in the implementation of m-Learning.

2.1.1 M-Learning vs. E-Learning

E-Learning is a popular concept that emerged long before the concept of m-Learning, which, on the contrary, is a very recent concept. E-Learning involves any learning and teaching which is supported by electronic devices (Woodill, 2012). More specifically, e-Learning includes computer-and-network-based learning and knowledge transfer. Thus, e-Learning not only includes computer-based but also web-based learning. E-Learning revolutionized the educational industry by shifting the focus from an instructor-centric learning model to a learner-centric model (Capuruço and Capretz, 2009). During the last decade of the 20th century, e-Learning reigned in the use of technology in education. However, with the turn of the new millennium and the emergence of smartphones, m-Learning start gaining more attention. This new technology has grasped the attention of

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[2] Parts of this chapter were published in following article:

 Alrasheedi, M., & Capretz, L.F. (2013e). Developing a Mobile Learning Maturity Model, International Journal for Infonomics, 6(4), 771-779.

researchers, practitioners, as well as learners. The m-Learning platform has been winning a great deal of approval (Abu-Al-Aish and Love, 2013), especially among young students who have grown up using portable videogames as well as sophisticated wireless technological devices.

Pinkwart et al. (2003) view m-Learning as a descendant of e-Learning because m-Learning is a subset of e-Learning. However, while m-Learning has evolved from e-Learning, there are a number of distinct differences between the two platforms and processes. The conceptual difference between the two is easy when viewed at the superficial level. Simply stating, the two learning concepts differ in the capabilities of the web browsers involved in each environment. This, however, leads to the erroneous conclusion that as e-Learning is to be an alternative to campus or classroom learning, therefore, m-Learning can be viewed as a means to take the learning environment away from a certain fixed point. This is fallacious because while e-Learning is used primarily as an alternative to learning in classrooms, m-Learning can actually be a complementary activity to both traditional learning and e-Learning. More importantly, m-Learning considers the fact that users involved will interact with many educational resources regardless of their exact location with respect to the normal learning location (Traxler and Kukuskra-Holme, 2005; Attewell et al., 2009).

Significant differences between the two concepts are discussed below:

- Platform and Accessibility

In order to develop a successful m-Learning platform, it is important to understand that the e-Learning and m-Learning platforms are completely different. The standard differences between the platforms are enumerated by Saleem (2011). According to the author, the e-Learning platforms use wired devices whereas m-Learning uses wireless devices. This also leads to a difference in the access provisions. In e-Learning, the device needs to be connected to an available telephone service by a fixed line, whereas mobile devices can access the Internet through their service providers.

- Learning Style

E-Learning is considered as a tethered learning mechanism (associated to something), for example (distant learning), whereas m-Learning offers an untethered learning process. This is why e-Learning is considered formal and structured, while m-Learning is less formal.

- Devices

E-Learning and m-Learning devices also differ in various aspects. E-Learning devices include desktop PCs, CD/DVDs, and laptops, whereas m-Learning devices include tablets, smart phones, mobile phones, and iPods.

- Time and Context

Yet another difference exists in terms of time and context. The e-Learning platform offers flexibility in terms of larger storage space and adequate display, which gives greater tolerance while designing educational material. On the other hand, m-Learning offers many limitations because of small screen size and limited storage space, which also limits the size and duration of learning material and sessions, unless they are cloud-based.

It is worth mentioning that while e-Learning has an advantage over m-Learning because of better storage techniques, file transfer is easier in mobile devices as compared to devices used in e-Learning. Transfer of learning materials, in fact, the entire device itself is much easier in m-Learning as compared to e-Learning devices (Saleem, 2011).

ELEARNING CONTINUUM

FACE TO FACE	CLASSROOM AIDS	MIXED MODE / BLENDED		FULLY ONLINE	
		SYNCRONOUS	ASYNCRONOUS	SYNCRONOUS	ASYNCRONOUS
ADMINISTRATIVE FUNCTIONS	POWERPOINT PRESENTATIONS	LIVE VIDEO STREAMING	ARCHIVED VIDEO STREAMING	WEB BASED	ARCHIVED VIDEO STREAMING
	ELECTRONIC FILES	VIDEO CONFERENCING TECHNOLOGY	CD-ROM DVD-ROM	MOBILE DEVICES	CD-ROM DVD-ROM
	MULTIMEDIA	VOIP			
		SATELLITE VIDEO			

DISTANCE

eLEARNING

Figure 2.1 E-Learning Continuum (copied from: http://www.elearning.uwo.ca/)

The e-Learning continuum, depicted by Figure 2.1 above, shows how e-Learning supports learning and education under different scenarios. From a face-to-face interaction to full online capabilities, e-Learning offers a myriad of combinations. Under face-to-face interactions, e-Learning can assist in administrative tasks. A more appropriate and widely used mode of e-Learning is as classroom aids through multimedia, PowerPoint presentations, and electronic files used by instructors and students. Moving on, the e-Learning continuum offers blended learning capabilities through either synchronous (live video feed, video conferencing, satellite video, or voice over IP (VOIP)) or asynchronous (archived audio or video streaming, and CD or DVD) learning facilities. Finally, the last scenario of e-Learning is through a fully online medium where learning can be done solely by using electronic devices. This fully online medium can be used for distance learning as well.

Cobcroft (2006) used different contexts to explain the differences between the two concepts. The first difference is pedagogical. In e-Learning, the communication between students and instructors is usually asynchronous, passive, and scheduled, which also makes it time-delayed. For instance, students need to visit websites or check their emails

on wired devices. In contrast, m-Learning offers the opportunity for instant communication that is synchronous as well as spontaneous based on needs. The use of mobile devices that students carry with them all the time makes it easier to deliver and receive messages using both e-mail and short messaging services (SMS). Furthermore, while e-Learning also offers interactive opportunities with audio and video conferencing techniques, students and instructors have to access systems at a prescribed location, usually within some time limits. In contrast, mobile technologies are not geographically bound and there is a possibility to reach the collaborators at anytime and from anywhere. Additionally, the opportunities for one-on-one communication are immense in the use of mobile technology. Another context suggested by Cobcroft (2006) is the evaluation scenario that is different for both platforms. In an e-Learning platform, for example, the traditional grading scheme is used to assess students, whereas m-Learning offers opportunities for customized assessment. The mobile platform also offers the prospects of using knowledge in real-time cases and on the site experiments as opposed to e-Learning, which is mostly simulation and lab-based (Cobcroft, 2006).

E-Learning has, indeed, been around for many more years than m-Learning, particularly with many types of the recent employment of e-Learning. Nevertheless, m-Learning is winning great approval from proponents and critics alike, especially by young students who have grown up employing their portable videogames as well as their wireless technological devices. Corresponding to such meaning, m-Learning can appeal not only to the persons who actually require portable learning, but also to others who would like to use their mobile devices for either learning or playing games (Teall et al., 2011).

2.1.2 Evolution of M-Learning

Mobile technologies have been successfully demonstrated across many countries showing that one can get benefits from using such devices in the education process (Ozdamli and Cavus, 2011). M-Learning development offers endless valuable opportunities to both students and instructors, considering the emergence of the highest technology of both networks and mobile devices (Engel et al., 2011). Hence, we can assert that mobile technologies, especially after many years of continued evolution and development, have become so mature to simply support the process of learning. The

advanced mobile devices involved – for example, personal digital assistants (PDAs), iPods, wireless networks, and mobile phone techniques – might assist in making the m-Learning process more feasible, especially in teaching and learning (Ozdamli & Cavus, 2011). Moreover, there is a new attitude among the educational experts and institutions towards adopting m-Learning simply as an instructional strategy. Hence, one can forecast such alternative modes related to m-Learning concerning the education of involved students, whereas such techniques allow more flexibility in the process of learning (Kukulska-Hulme et al., 2011).

 Figuring out the starting ages of students for using mobile techniques could indicate that new generations might already be adapted to this technology, simply to use mobile techniques in supporting the learning in classrooms. As mentioned earlier, the new generations are living in an environment that is full of mobile technologies (Engel et al., 2011). M-Learning, consequently, would be the learning of the future that logically could expand the process of e-Learning and, additionally, has the potential to further evolve and expand so much so that the process of learning becomes available for all (Elias, 2011).

On the other hand, while developing the process of m-Learning, one should consider the new mode of learning with care, particularly when implementing it as a new educational option for students. The matter requires balance, especially with the needs of students as well, because of the rapid technical development (Frohberg et al., 2009).

For understanding the process and technologies involved in m-Learning, one must conceptualize the necessary elements of the whole process, which includes students/learners, instructors, the surrounding environment, the contents, and, finally, assessment methods. Figure 2.2 shows all the basic elements of m-Learning.
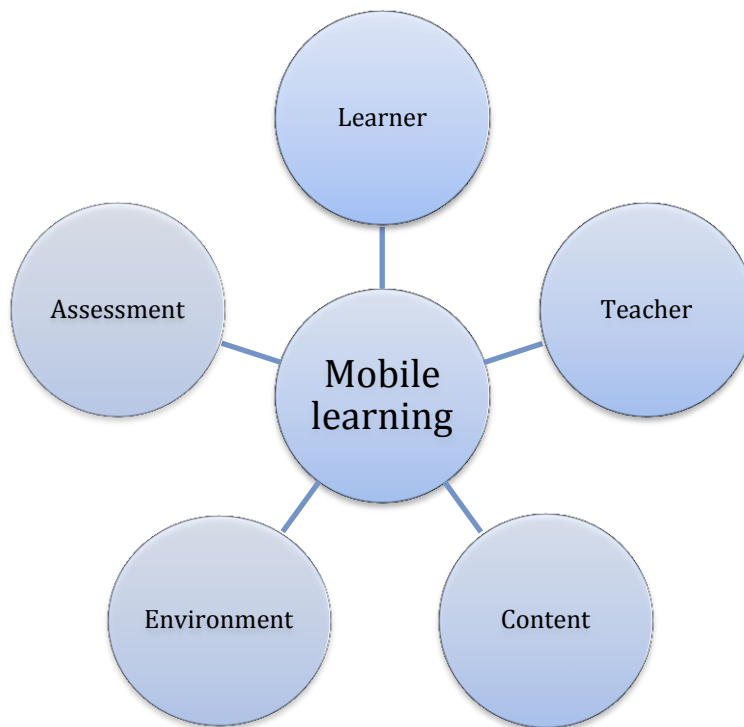
Figure 2.2 The basic elements of the m-Learning process (adapted from: Ozdamli and Cavus (2011))

2.1.3 Advantages of M-Learning

Indeed, m-Learning involves many advantages, such as making the learning process easily accessible at any time and at any place. This can save time and effort for teachers and students alike, in addition to making the process of education more enjoyable (Zengning, 2011). Some of the major characteristics of an m-Learning platform, as discussed by Ozdamli and Cavus (2011), are shown in Figure 2.3 below:
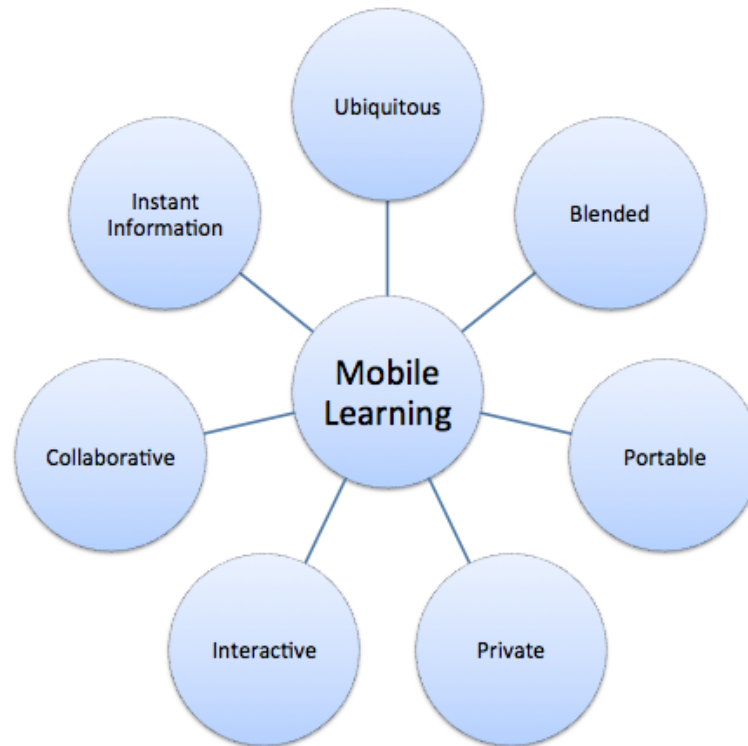
Figure 2.3 The Characteristics of m-Learning (adapted from: Ozdamli and Cavus (2011))

Other prominent advantages of m-Learning include:

- Mobility

The most significant advantage that m-Learning offers over all other instructional media is the mobility. As long as the learner has a telecommunication network, the user is able to acquire learning and education.

- Real Time Accessibility

M-Learning offers synchronous learning through real-time interaction between the learner and the learning material. The interaction and communication among peers and between student and instructor can be made in real time through messaging services and applications.

- Virtualization

Smartphones and advanced mobile devices have a camera feature, which can act as a virtual environment for learning. For example, the instructor can create virtual classrooms using this technology. Similarly, video calls can enable the interactive learning processes.

2.1.4 Disadvantages or Limitations of M-Learning

- Mobile

Besides several advantages of m-Learning, there are several disadvantages associated with the use of m-Learning. These start with the set-up costs for the acquisition of the necessary equipment; the costs can also include additional costs such as training by the educational organization (Fotouhi-Ghazvini et al., 2011). Moreover, the facts of copyright and security issues have recently become the main concern of the institutions involved, as data privacy and security have become major concerns for global mobile phone users in recent years.

Despite the distinct feature of mobility, there are a number of technical limitations that limit the scope of m-Learning. These technical limitations include input limitations, storage limitations, security challenges, low resolution, limited battery life, small screen size, Internet access limitations, and lack of standardization across mobile devices. These disadvantages of m-Learning are discussed below in detail.

- Input Limitations

Although smartphones have improved input mechanisms through touch keypads, the voice recognition features are not reliable. Similarly, the small size of a virtual keyboard makes it challenging to type very fast.

- Storage Limitations

Unlike laptops and desktops, which offer huge data storage capacities, mobile phones do not offer large storage. Even with the addition of SD cards, the issue of storage for

mobile devices is always a limitation. Similarly, the processing speed and power of mobile devices is slower than e-Learning devices, which negatively impacts the transmission of learning material.

- Security Challenges

Security challenges are not limited to the mobile technology, but also concern the e-Learning media as well. However, because mobile phones are smaller in size, there is a higher vulnerability for mobile thefts and lost mobiles, which endanger the security of the mobile user.

- Low Resolution

As compared to computers, the resolution of mobile devices is still very low because of battery and processing limitations. Because of the low resolution screen, it becomes hazardous for humans to spend too much time reading on mobile screens. This is one of the biggest hurdles in the proliferation of the m-Learning platform.

- Small Screen Size

Although newer mobiles are boasting larger screen sizes, with tablets having reasonable screen sizes, they are still smaller as compared to laptops and desktops. Small screens are necessary for allowing the portability feature of mobiles, however, they impede the development of m-Learning as the leading educational tool.

- Internet Access Limitations

Yet another limitation offered by mobile devices is that many web pages are designed for computers and become distorted when opened in mobile applications. Several mobile apps are now replacing the traditional web pages, nevertheless, differences between mobile and desktop devices can make switching between the two platforms difficult.

- Lack of Standardization

A variety of mobile phones and mobile operating systems are available on the market, and there is a lack of standardization among them. This makes it difficult for instructors and universities to design generic learning material. This is another major barrier in the way of m-learning proliferation.

However, despite these limitations, it should be admitted that m-Learning is a creative and valuable means by which one can enhance the experience of learning, either at the workplace or in education (Kukulska-Hulme et al., 2011; Lam et al., 2010).

2.1.5 Challenges in M-Learning

Vavoula and Sharples (2008) specified six challenges in evaluating m-Learning: analyzing and capturing learning in or across context, measuring the process and outcomes of m-Learning, respecting the privacy of the learner/ participant, assessing the utility or even usability of mobile devices, regarding the wider context of an organization, and understating the socio-culture of learning. To these could be added, evaluating informality. However, the authors admitted that these challenges result from the complicated nature of learning based on mobile devices, where the focus is social instead of being technical (Vavoula and Sharples, 2008).

2.2 Related Works

This section presents a brief summary about CMM as well as a critical assessment of the existing evaluation frameworks for m-Learning. A review of the frameworks gives a precise idea of the research direction in terms of developing an assessment framework.

2.2.1 Capability Maturity Model (CMM)

Originally the use of the CMM was to assess the maturity of government contractors to work on a contracted software project (Paulk, 1993). CMM is basically a hierarchical model with five levels illustrated in Figure 2.4 that helps to judge the maturity of various software contractors who are hired by institutions or organizations to develop software applications. In addition, the framework helps to identify critical steps and other validated

practices that are required for the effective implementation of a process. Five levels of such a model can be described as the following (Paulk, 1993):

1) Initial: in this case the developed process can be characterized as ad-hoc, whereas few processes can be defined and the resulting success may focus basically on an individual's heroics and efforts.

2) Repeatable: the process of the main project management is to be established to a certain track schedule, cost, and functionality. The process discipline needed can be seen in place, in order to repeat the earlier success of such projects, especially with the same application.

3) Defined: the development and management activities can be standardized, documented, and integrated into a set of friendly standard processes for the institute or organization involved.

4) Managed: the detailed process is measured as well as the quality of products can be collected to make the process easy and the product involved can be controlled and understood.

5) Optimizing: the regular and continued process enhancement can be facilitated, particularly by feedback from the process involved, as well as from the piloting technologies and other innovative ideas.

Critically, CMM's originality was designed in order to offer these various benefits, such as offering certain road maps for enhancing the software development process of the institute or organization (Paulk, 1993).
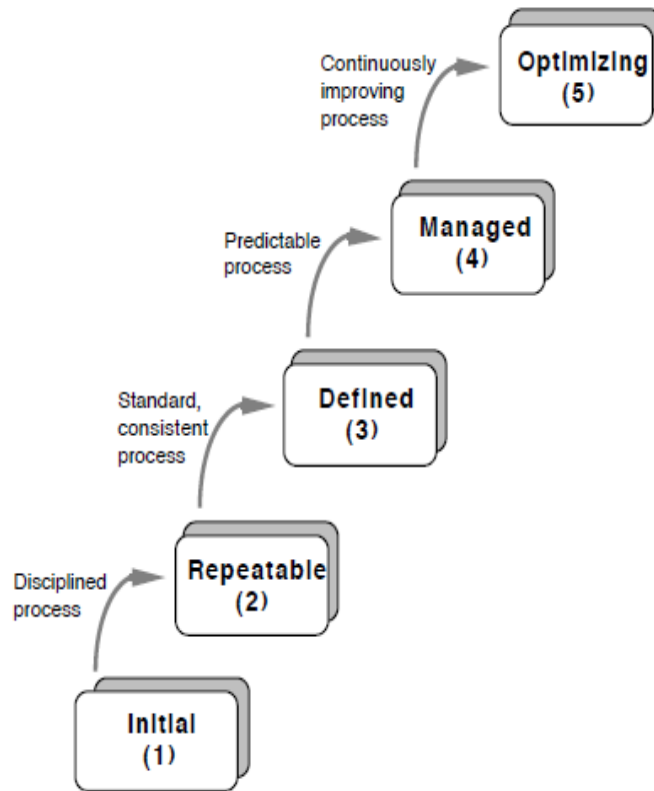
Figure 2.4 Five Levels of CMM (Paulk, 1993)

2.2.2 Current Evaluation Frameworks

As the field of m-Learning is still in its infancy, few frameworks and models have been developed and evaluated by researchers. For instance, Vavoula and Sharples (2008) have suggested six complications in the assessment of m-Learning: evaluating the current learning settings and analyzing the possibility of meaning in different settings (setting includes physical and social environment, learning objectives, tools, and methods); deciding the assessment methods and outcomes for m-Learning (existing learning assessment methods have been validated by long-term research); evaluating and presenting ethical guidelines for m-Learning platform; understanding the impact of highly technical nature of the mobile-platform in an educational setting; evaluating the process of m-Learning platform on a long-term basis to understand the change process between the traditional and the new learning context (as a result of m-Learning); and assessing and presenting the best mix of formal/informal settings for m-Learning in an

educational setting. However, while the six complications mentioned exhaustively cover the various m-Learning contexts, collaborative learning, and apply-as-you-learn concepts, which offer core advantages of m-Learning are not addressed.

Vavoula and Sharples (2009) also present the theoretical framework developed by previous research, Vavoula et al. (2006) for assessing m-Learning in an educational setting. The framework known as M3 assesses the m-Learning platform at three levels: *micro*, in which only user experiences are assessed; *meso,* in which the overall learning environment is assessed; and *macro*, which assesses how the new platform blends into the established set-ups of the higher education. Several suggestions have also been proposed to modify the framework for future researchers. The biggest drawback of the framework is that it does not have any levels of growth. Implementation and successful acceptance of any new technology are not one-step processes. Moreover, while the views of students and instructors are being taken, applying them progressively to improve the implementation is not discussed in the research.

In contrast, Seipold and Pachler (2011) have assessed the process of m-Learning by presenting a detailed analysis of a particular scenario of mobile device usage in higher education. They have also discussed the way in which the use of mobile phone technology in the educational sector could be tailored to suit the existing structures, cultural practices, and institutions involved. The discussion, however, does not include a framework for assessment. Also, it involves a case-specific approach, which draws conclusions but does not present an actual framework that could be used in similar or different scenarios.

A better framework is proposed by Parson and Ryu (2006) in which the ISO/IEC metrics that are used for the measurement of software quality are used to assess the quality of m-Learning in higher education. The framework for assessment covers both technical and non-technical aspects of m-Learning. At the same time, the use of a standardized framework such as ISO/IEC, means that the results from the assessment would be standardized. Again, the drawback of the proposed framework is that while it is a precise

tool for measuring the current quality of m-Learning in higher education, it does not present a roadmap for successful implementation.

In the context of developing an assessment framework, the six challenges specified by Vavoula and Sharples (2009) in evaluating the m-Learning process need to be addressed methodically. The challenges can be enumerated as: analyzing and capturing learning in or across context, measuring the processes and outputs from the m-Learning platform, respecting the privacy of the learner/participant, assessing the utility and/or usability of mobile devices, considering the wider context of an organization or the socio-culture of learning, and, finally, evaluating the resulting informality. The authors have acknowledged that these challenges are a result of the social implications arising from the diverse effects of using mobile devices, rather than being due to technical aspects (Vavoula and Sharples, 2009).

The review of existing frameworks for the assessment of m-Learning in higher education has shown that the frameworks lack a complete roadmap for successful implementation of m-Learning. The present research is thus an attempt to address this gap by proposing a framework that includes this aspect.

2.2.3 E-Learning Maturity Models

Marshall and Mitchell (2002) presented the e-Learning Maturity Model (EMM) where their focus was to boost the adoption of the platform and consequently improve the process. It also involved the ability of the model determination using SPICE ISO/IEC (Dorling, 1993). In case of SPICE there is an additional level, zero, which specifies the condition where the process could not be accomplished or was performed incompletely (Marshall and Mitchell, 2004).

The basic objectives of EMM in the context of the educational sector are similar to that of CMM, but the domain appears to be different. This implies that the model cannot be used for the purpose of m-Learning. Another model that could be applied effectively is the Online Course Design Maturity model (OCDMM) proposed by Neuhauser (2004). The model is essentially an e-Learning Maturity Model based on CMM, and it describes the

various stages of e-Learning technology adoption in an educational institution. The maturity levels in the CMM-based e-Learning model differ to the extent to which the technology of e-Learning can be employed successfully. The focus of the framework is not on the actual e-Learning platform but on how a course can be designed successfully under the new platform.

Some of the best practices from EMM and OCDMM can be taken while attempting to fit the levels into the five-level framework of the CMM model. One must consider that the model is essentially tailored to the context of the industry. However, aspects such as clear communication practices and approaches for employee motivation should be a part of the educational arena as well. One important goal of an educational program is to motivate the students. In addition, it is important to improve the communication among students, between students and instructors, and between instructors and management as well as between students and management.

As discussed later, other maturity models appear to rely on developing a culture of professionalism among students as the onus of the industry. The process of e-Learning is considered as a special domain and the culture promoted by the domain is not viewed to be an inherent part of the educational sector but as a consequence of technology. In any case, it can be argued that the e-Learning approach cannot be applied directly to the m-Learning platform.

Even though higher education rapidly adopted the e-Learning platform, the process of investing in a new, albeit similar, platform is challenging. Success cannot be taken for granted and the implementation process must be tailored to the individual educational institution taking into account their individual geographical and cultural aspects. This would ensure that the platform is adopted universally and efficiently within an institution. However, according to Zhou (2012), the currently existing maturity models for e-Learning platforms proposed by Marshall and Mitchell (2002, 2003, 2004) clearly delineate the performance at different maturity levels. This makes it easier to view the process improvement stages, but quantifying the process is still difficult as is the usage of auto-evaluation tools to measure improvement. For this reason, Zhou has proposed a

quantitative model that measures the progress of an educational institution operating e-Learning programs, in terms of the CMM concepts of capability and maturity. The model is named e-Learning Process Capability Maturity Model (ePCMM) (Zhou, 2012). However, this model has not been validated yet, nor is it specifically designed with considerations for new emerging technology such as m-Learning. A review of the model conclusively negates its usage for the m-Learning platform regardless of the similar domains. This is because the inherent mobility of the technology platform adds several other usage parameters that are simply not required in an e-Learning platform.

In summary, it can be seen that an e-Learning maturity framework is extremely unsuitable for direct application in an m-Learning environment to assess the maturity of an m-Learning platform, even though both share the same application area, i.e., the educational sector. Therefore, this research aims to bridge that gap in the knowledge and put forward a comprehensive maturity model for m-Learning.

Chapter 3

3   Literature Review[3]

This chapter presents an analytical and critical review of existing literature in the field of
m-Learning. The phenomenon of the use of an m-Learning platform in higher education
is slowly gaining momentum. However, the enthusiasm with which mobile phones have
been welcomed into every aspect of our lives is not yet apparent in the educational sector.
To comprehend the reason, it is important to understand the user expectations of the
system. This chapter documents a systematic review of existing studies to find the
success factors for effective m-Learning. The systematic review collates results from 30
studies conducted in 17 countries, where 12 CSFs were found to strongly affect m-
Learning implementation. Using these results within the framework of the diffusion of
innovation model for adoption and the CSFs together helped us see what aspects of the
innovation decision process are the likely causes of the reduced take-up of m-Learning by
university users.

3.1 A Systematic Review of the Critical Factors

The concept of mobility actually makes the concept of m-Leaning even more
revolutionary than e-Learning (Ally, 2009). In other words, a learner can control what
they want to learn, when they want to learn, and where they want to learn. They are not

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[3] Parts of this chapter were published in IEEE International Conference on Teaching, Assessment and
Learning for Engineering, (an extended version of this paper appears at the Turkish Online Journal of
Educational Technology.) and, based on a paper published by the Journal of Educational Computing
Research.

1. Alrasheedi, M., & Capretz, L.F. (2013b). A Meta-analysis of Critical Success Factors Affecting
   Mobile Learning, IEEE International Conference on Teaching, Assessment and Learning for
   Engineering, Bali, Indonesia, August 26-29, 2013, pp. 262-267.

2. Alrasheedi, M., & Capretz, L.F. (2015a). Determination of Critical Factors Affecting Mobile
   Learning: A Meta-Analysis Approach, Turkish Online Journal of Educational Technology, 14(2),
   41 - 51.

3. Alrasheedi, M., Capretz, L.F. & Raza, A. (2015e). Systematic Literature Review of Critical
   Factors for Effective Mobile Learning from the Student's Perspective, The Journal of Educational
   Computing Research, doi: 10.1177/0735633115571928.

restricted to prescribed materials, a physical classroom, or even a particular time around which they have to schedule other activities (Kukulska-Hulme, 2005).

Research into m-Learning has always been fragmented and scattered. In the first place, there has been inherent disagreement as to what constitutes m-Learning. As the specific definition used by a particular researcher automatically decides the scope of the research, the ensuing studies have been diversified in context and methodologies. M-Learning was originally defined from a device- centric perspective. The most refined definition from this point of view was given by Traxler (2009a), who described the technology of m-Learning to include both software and hardware that enabled the learning devices to be portable. Device-based definitions, however, limit the scope of m-Learning, as m-Learning is not merely a conjugation of the words mobile and learning.

Similarly, m-Learning is distinctly different from e-Learning and cannot be defined in the words of Traxler (2009b) as "e-Learning made mobile." The rapid changes in technology have also proved to be a hindrance to researchers attempting to define m-Learning in terms of devices.

One of the popular definitions encompasses the mobility and technological aspects, where m-Learning is characterized by its anytime and anywhere learning capacity and use of multiple media functions like pictures, videos, text, and voice (Shih and Mills, 2007). In addition to the unfettered nature of learning in terms of space and time, m-Learning additionally includes ideas like spontaneity, interactivity, informality, and ownership of learning (Traxler, 2008).

Basically, mobile technology has seen high penetration in all aspects of people's lives; however, its usage as an educational platform has been very low. There are definite barriers to adoption of an m-Learning platform, especially by institutions of higher learning. Multiple studies have been conducted in various countries across the world to evaluate the success factors of m-Learning in higher education. The studies are fragmented and meta-analyses of the studies have focused on the geographical clusters, learner profiles, and types of mobile devices. There is a need for research that collates the

studies in the area of m-Learning in terms of factors that users perceive to be important for success.

This aspect must be understood to determine the best methodology for increasing the adoption rate of mobile devices as a learning tool. Any attempt to use an m-Learning platform can be successful if early adoption by the students is ensured. This not only benefits other studies and program launches, but also ensures long term success.

A significant body of work has been carried out with reference to factors involved in the success of m-Learning. It is, therefore, prudent to look at this body of work to ascertain what this study contributes to research in the field of m-Learning.

Some research focuses on the age and gender take up of m-Learning to understand the effect of demographics on the success of projects. The work of Wang et al. (2009), in particular, has focused on both age and gender with respect to the unified theory of acceptance and use of technology. Other work, such as that by Liu et al. (2010), looks closely at the long-term usefulness of m-Learning as the driving factor for adoption, while the work of Cochrane (2010), among others, examines the interaction between the technology and the course itself as a contributor to the success of a given m-Learning project. While these works all focus on a specific aspect of an m-Learning program, in this chapter we are looking at a more holistic view of the subject to better understand the whole situation in relation to students themselves.

First, this research develops a systematic review of existing studies to determine the CSFs for m-Learning in higher education. Second, an evaluation of studies which were conducted in 17 countries is carried out to offer a broad case selection on which to base findings. Third, a mathematical evaluation of factors is also carried out using a common method and scale (Likert 5-point). Finally, this chapter gives a comprehensive understanding of factors that mobile users (worldwide) expect in a good m-Learning system since an evaluation of factors that users consider important would make it easier to design systems that could be adopted more quickly in a higher education setting.

3.2 Theoretical Framework

Although m-Learning itself is a relatively new concept, the adoption of new technologies and innovation within education is not. With decades of study into this process the theoretical framework required is well researched. Perhaps the most widely adopted framework is that of diffusion of innovation (Rogers, 2003) that has been suggested by many as the best framework for studies conducted in higher education (Li Sui, 2011; Sherry and Gibson, 2002).

The theory postulates that there are five characteristics of innovation: complexity, trialability, observability, compatibility, and relative advantage. Complexity is a measure of the ease of use of the innovation and adopter ability to understand it. Trialability represents the "degree to which an innovation may be experimented with on a limited basis" (Rogers, 2003). Observability refers to the benefits of the new innovation that can be observed by adopters, while compatibility is the degree to which the new process aligns with the needs and expectations of users. Finally, relative advantage refers to the perceived improvement of an idea over the one which it is intending to replace. Rogers (2003) suggests that this can be measured in terms of satisfaction, convenience, social prestige, and economics.

Along with these five attributes, Rogers (2003) also describes three types of decisions in the process: the decisions made by the individual themselves, known as optional; those made through the influence of others, that is collective decisions; and those made under the influence of authority, referred to as authority decisions. In the case of the optional decisions made by the individual, the choice is made independently of the social system. Collective decisions are made within a social system, and the choice is made by a consensus of members of the group. For authority-based choices, on the other hand, the decision is made by a group that possesses power, influence, or technical expertise. The framework builds a picture of adoption of innovation and choice that we can bring into our results.

According to the theory itself, the process of adoption of innovation contains five stages: knowledge, persuasion, decision, implementation, and confirmation. This describes the

process of an individual adopter finding details of the innovation (knowledge), developing views regarding the innovation (persuasion), deciding whether to use the innovation or not (decision), using the innovation (implementation), and then finally successfully applying (confirmation) that innovation. The theory works well for m-Learning because it utilizes mobile technology that is already widely considered as a positive and useful innovation in its own right.

This chapter attempts to answer the following main research question: What factors are critical to the success of m-Learning in the perspective of university users? The purpose of the study is to understand the factors leading to effective m-Learning in higher education. The answer to the research question is gained by conducting a systematic review of the available quantitative studies in this area.

3.3 Research Design

The search process for this study started with a comprehensive search to find suitable studies from across the world to provide the holistic view of the medium. Research expressions that were used for this research purpose include "CSFs m-Learning," "higher education," and "Likert scale."

3.3.1 Inclusion and Exclusion Criteria

As m-Learning is a very recent concept, there was no need to exclude data that were out of date. Indeed, few older works were discovered. Hence, the all-important, date-based exclusion criterion was not employed. On the contrary, there was a need to capture as much data as possible to give a more detailed and true picture of the status of m-Learning. Our inclusion criteria were related to the type of data included in the research papers:

- Research papers that used the Likert scale for assessing participant responses (regardless of the scale length).
- The complete details of the Likert scale data for the responses used in the study for each variable under assessment.

Following are the exclusion criteria:

- Research papers that did not use the Likert scale for assessing participant responses (i.e., included only percentage agreement/disagreement).
- Research papers that did not present the actual Likert scale data (for instance, in several studies only the correlation/regression statistics that had been derived from the Likert scale data were given, but original data were not given).
- Research papers that used only qualitative data.
- Duplicate reports of the same study (at least five studies were rejected on this basis). In such cases, the reports selected were those that had more primary data information and not only publication prestige.
- Research studies that had only procedural information (at least two research studies belonged to this category, where the assessment procedure was cited and used in other studies but the original paper had no primary data, only the methodology).

3.3.2 Quality Assessment

The quality of each study was examined in the same way as Kitchenham's study, by employing a modified version of Database of Abstracts for Reviews and Dissemination (DARE) criteria developed by the Centre for Reviews and Dissemination (Kitchenham et al., 2009). The original DARE criteria were used for conducting the quality assessment of systematic literature reviews, as employed here.

Q1. Does the research study use the 5-point Likert scale?

Q2. Does the research study mention the percentage of the population actually owning a mobile device and already using it for m-Learning purposes?

Q3. Does the research study divide the population based on gender?

Q4. Does the research study include responses from both students and instructors?

The four questions were scored as follows:

Q1. Y (yes), there is no need for conversion; N (no), a different scale was used for assessing the responses and the scale must be converted into the 5-point scale. A simple formula has been used here:

$$\text{Converted score} = \frac{Original\ Score}{Original\ Scale} \times 5$$

Q2. Y (yes), complete details of participant mobile phone usage are available for this research study; N (no), absolutely no details of participant mobile phone usage are available for this research study; and P (partly), only partial details of participant mobile phone usage are available for this research study.

Q3. Y (yes), the research study divides the population specifically into male and female participants; N (no), the research study does not divide the population into male and female participants.

Q4. Y (yes), the research study contains responses from both students and instructors; N (no), the research study does not contain responses from both students and instructors.

The scoring procedure was also similar to Kitchenham: Y=1; P=0.5, N=0. As the evaluation is based on the presence or absence of information and is not qualitative in nature, the value assignment is not subject to any individual researcher's opinion. This gives additional objectivity to the systematic nature of the study result represented in Table 3.1.

3.3.3 Data Collection and Analysis

The data extracted from each study was divided into two segments – the collection of responses of participants and the availability of the platform to participants. The first segment is used for derivation of the success factors and their importance to successful m-Learning implementation. The second segment is used to assess the actual penetration of general mobile usage and the awareness of m-Learning among the users.

Accordingly, for the first segment, CSF data, the following data was extracted:

- The source of the research study and full reference.

- Author information and country where the research was actually conducted.

- Population, gender distribution, and user classification (students/instructors or both).

- Likert scale and actual score on the Likert scale (converted into score on a five-point scale):

  - The individual scores for 20 individual CSFs were derived.

  - Factors – discussion with students, discussion with instructors, discussion tool quality, and accessing discussion – were grouped into the CSF: learner community development.

  - Factors – hardware know-how, software know-how, browser know-how, and overall know-how – were grouped into the CSF: technical competence of users.

  - After grouping, there were a total of 13 CSFs. In the absence of individual CSFs, the average of existing CSFs was taken as the scores for instructor community development and technical competence of students.

For the second segment, i.e., platform availability, the following data was extracted:

- The source of the research study and full reference;

- Author information and country where the research was actually conducted;

- Population and how the data was presented (e.g., in percentage form or absolute numbers;

- The percentage (available or converted from absolute numbers) of users with:

  - Wireless device availability

  - Internet access

  - Access to data services, like SMS services

  - Present use of their mobile phones to access any m-Learning platform

  - Interest in using their mobile phones to access m-Learning.

Using the initial raw data collected from individual studies, data was tabulated systematically into multiple tables for analysis as below:

- A table measuring the quality evaluation of individual studies.
- A table measuring the Likert scale scores for the 13 CSFs with author name, country of study, year of study, and population and gender distribution, if any.
- A table measuring the m-Learning availability, know-how, and interest among users with the number of studies and population.

From the information available, average scores were taken for the percentages for platform availability and Likert scores (converted into a five-point scale, where required). This combined with the total number of studies that had the information (CSF weight), gives the relative importance of the CSF.

The results from the systematic review are summarized and presented in this section. A total of 30 studies were eventually used in the analysis.

3.3.4 Quality Evaluation of Individual Studies

The quality of each individual study was based on a score on the modified DARE criteria. The results of the quality assurance scores based on answers to the four quality assurance questions are shown in Table 3.1. None of the studies score a 4 on the quality assurance scale. This clearly demonstrates the diversity in the m-Learning assessment studies, and shows that there has been no standardized assessment scheme for the studies. This gap indicates a dire need for a standardized assessment framework in the area.

Table 3.1. Quality Evaluation of Individual Studies

ID	Author names	Q1	Q2	Q3	Q4	Total
S1	(Liaw, Hatala, & Huang, 2010)	N	N	Y	N	1
S2	(Motiwalla, 2007)	Y	P	N	N	0.5
S2A	(Motiwalla, 2007)	Y	P	N	N	1.5
S3	(Mac Callum, 2009)	Y	P	Y	N	2.5
S4	(Conradie, Lombard, & Moller, 2013)	Y	P	Y	N	2.5
S5	(Alzaza & Yaakub, 2011)	Y	P	Y	N	2.5
S6	(Ismail, Bokhare, Azizan, & Azman, 2013)	Y	P	Y	Y	3.5
S7	(Maniar, Bennett, & Gal, 2007)	Y	N	N	N	1
S8	(Zengning, 2011)	Y	N	Y	N	2
S9	(Shih, Chuang and Hwang, 2010)	N	N	N	N	0
S10	(Imran, 2007)	Y	N	N	N	1
S11	(Alzaza, 2013)	Y	Y	Y	N	3
S12	(Huang, Yang, Huang, & Hsiao, 2010)	N	N	Y	Y	2
S13	(Jamaldeen, Hewagamage, & Ekanayake, 2012)	Y	Y	N	N	2
S14	(Suresh & Al-Khafaji, 2009)	Y	N	N	N	1
S15	(Adedoja, Adelore, Egbokhare, & Oluleye, 2013)	N	N	N	N	0
S16	(Corlett, Sharples, Bull, & Chan, 2005)	Y	N	N	N	1
S17	(Chang, Yan, & Tseng, 2012)	N	N	Y	N	1
S18	(Uzunboylu, Cavus, & Ercag, 2009)	Y	N	Y	N	2
S19	(Donaldson, 2012)	N	Y	Y	N	2
S20	(Moura & Carvalho, 2009)	N	Y	Y	N	2
S21	(Khwaileh & AlJarrah, 2010)	Y	Y	Y	N	3

S22	(Al-Fahad, 2009)	Y	P	Y	N	2.5
S23	(Thornton & Houser, 2005)	N	Y	Y	N	2
S24	(Knezek & Khaddage, 2012)	Y	Y	N	N	2
S25	(Cheong, Lee, Crooks, & Song, 2012)	N	N	Y	N	1
S26	(Özdoğan, Başoğlu, & Erçetin, 2012)	Y	P	Y	N	3
S27	(Liu, Li, & Carlsson, 2010)	N	P	Y	N	2
S28	(Scornavacca, Huff, & Marshall, 2009)	Y	Y	Y	N	3
S29	(Liaw & Huang., 2011)	N	N	Y	N	1
S30	(Motiwalla, 2008)	Y	P	N	N	2

3.3.5 Information on Platform Availability

From Tables 3.2 and 3.3, it can be seen that out of the total of 30 studies, 12 do not have any information about platform availability. This means that we do not have any information about the mobile platform availability or interest in m-Learning usage for about 34.2% of the population. Researchers have inquired about the availability of mobile phones in 17 cases (population sample of 3,202). It was found that an overwhelming majority, 91.63%, of the sample population in the study owned a mobile phone, which corroborates the immense penetration of mobile technology in recent times. It can be reasonably concluded that access to a mobile phone would not pose a barrier to the success of m-Learning. In 11 cases, the researchers made an inquiry into access to the Internet and access to data services like SMS. This is important information, since either of these are the primary ways in which users would have access to the m-Learning content, whenever they want and wherever they are.

Table 3.2. Platform Availability Information for the Study Population

ID	Country	Population	Availability of Mobile Phone	Internet Access	Access to data services	Already using mobile phone for m-Learning	Interested in using mobile phone for m-Learning
S1	China	152	NA	NA	NA	NA	NA
S2	USA	19	84.21	43.75	NA	NA	57.89
S2A	USA	44	86.36	NA	63.64	79.55	64.63
S3	New Zealand	30	89	NA	NA	NA	NA
S4	South Africa	54	100	NA	100	100	NA
S5	Malaysia	261	95.1	NA	81.3	80.1	NA
S6	Malaysia	38	NA	NA	NA	71.05	89.47
S7	UK	45	NA	NA	NA	NA	NA
S8	China	24	NA	NA	NA	NA	NA
S9	Taiwan	32	NA	NA	NA	NA	NA
S10	Pakistan	438	NA	NA	NA	NA	NA
S11	Palestine	378	97.4	69.8	60.3	79.1	85.2
S12	Taiwan	147	NA	NA	NA	NA	NA
S13	Sri Lanka	154	99	63	64	85	95
S14	UK	26	NA	NA	NA	NA	NA
S15	Nigeria	201	NA	NA	NA	NA	NA
S16	UK	17	NA	NA	NA	NA	NA
S17	Taiwan	158	NA	NA	NA	NA	NA
S18	North Cyprus	41	NA	NA	NA	NA	NA
S19	USA	330	95.15	79.1	84.24	87.27	86.7
S20	Portugal	15	100	87	73	80	93

S21	Jordan	314	86	NA	NA	80.32	80.73
S22	Saudi Arabia	186	47	43	45	25.3	74.4
S23	Japan	333	100	83	100	61	100
S24	USA	81	NA	NA	NA	NA	NA
S25	USA	177	86	NA	NA	NA	87.2
S26	Turkey	81	84	30	NA	NA	80
S27	China	209	93.3	64.59	NA	56	100
S28	New Zealand	569	96.8	64.9	82.8	30	90
S29	Taiwan	168	NA	NA	NA	NA	NA
S30	USA	33	91	45.45	93.9	NA	75.76

Of the 1,565 sample population, about 61.35% had access to the Internet, clearly showing the lack of Internet access of a significant sample population; the cause of this could be either due to prohibitive cost or coverage issues. Similarly, of the 1,831 sample population, about 77.19% had access to data services. The reason behind this lack could be prohibitive costs or lack of reasonable usage plans on the part of the local mobile phone operators. This, too, could be a hindrance to the success of m-Learning. In 13 studies, researchers inquired whether users had experience with or were currently using mobile phones to access m-Learning. The results were encouraging, as of the 1,855 population, about 63.97% reported having already used or currently using their mobile phones for accessing m-Learning. This shows that there is a high level of awareness and experience regarding m-Learning.

Table 3.3. Summary Statistics of the Platform Availability Primary Data

Mobile platform availability	No. of studies out of 30	Population	Percentage of total population (%)
No information	12	1,626 out of total of 4,755	34.20
Availability of mobile phone	17	2,934 out of total of 3,202	91.63
Internet access	11	1,565 out of total of 2,551	61.35
Access to data services	11	1,831 out of total of 2,372	77.19
Already using a mobile phone for m-Learning	13	1,855 out of total of 2,900	63.97
Interested in using mobile phone for m-Learning	14	2,565 out of total of 2,915	88

Finally, in 14 studies, researchers inquired about the interest in using m-Learning; a majority, 88%, of the participants were interested in using m-Learning, indicating the popularity of the platform among potential users.

3.3.6 CSFs from a Systematic Review of the Studies

A total of 14 CSFs have been divided into two tables – Tables 3.4 and 3.5 – each containing scores on the Likert scale for the individual studies for seven CSFs. "NA" indicates that a score for that CSF is not available. In Table 3.4, instructor perceptions have been highlighted separately. This factor is essentially what users think of m-Learning and is the actual factor that determines whether users are interested in using the platform in the future. Care has been taken to clearly show the studies that have user responses on a scale different from the standard and original 1 to 5 Likert scale. 30 studies have been assessed in this research from 17 countries—China (3), United States (6), New Zealand (2), South Africa (1), Malaysia (2), United Kingdom (3), Taiwan (3), Pakistan (1), Palestine (1), Sri Lanka (1), Nigeria (1), North Cyprus (1), Portugal (1), Jordan (1), Saudi Arabia (1), Japan (1), and Turkey (1). The values collected in Tables 3.4 and 3.5 were averaged for all 30 studies. The results are summarized in Table 3.6. All the factors are assessed on a Likert scale of 1 to 5 (Strongly Disagree to Strongly Agree). A score higher than the average 2.5 shows that users are satisfied with the particular

feature of the m-Learning that they are currently using. The most interesting aspect of this study is that all of the 14 factors mentioned are considered to be important by the users, and they are satisfied with the particular feature as all the CSFs show a Likert-scale response much higher than the average value of 2.5.

The first factor of interest is user perception (shown in bold). This shows that users are, in general, happy with the existing m-Learning they are using and would like to continue using the platform in the future. They perceive that the platform offers them sufficient benefits to warrant continuing usage. As this is the core assessment response, it is present in all the studies implying its significance to the users. The presence of other factors and their effect on user perception is actually of greater interest after a cursory look at whether users found the overall system useful or not.

Table 3.4. Likert Scale Responses for CSFs-Part A

ID	Technical Competence, students	Technical Competence, Instructors	Personalization	Instructor Autonomy	User Perception	User Friendly Design	Application Working
S1	1.9[a]	NA	NA	2.87[a]	**3.14[a]**	3.94[a]	3.42 [a]
S2	NA	NA	NA	NA	**3.71**	2.68	3
S2 A	NA	NA	3.7	NA	**3.33**	NA	NA
S3	3.81	NA	NA	NA	**3.22**	NA	NA
S4	4.3	4.16	4.18	NA	**3.72**	3.83	3.28
S5	NA	NA	NA	NA	**3.87**	NA	NA
S6	NA	3.96	NA	NA	**4.21**	NA	NA
S7	NA	NA	3.66	NA	**3.54**	3.44	3.42
S8	4.74	NA	NA	4	**4.43**	NA	3.78
S9	NA	NA	NA	2.9[b]	**2.9[b]**	3.12[b]	3.14[b]
S10	NA	NA	NA	NA	**3.6**	NA	NA
S11	3.5	NA	NA	NA	**4.09**	NA	NA
S12	NA	NA	NA	NA	**3.56[a]**	3.64[a]	3.58[a]
S13	NA	NA	NA	NA	**3.84**	4.33	4.03
S14	NA	NA	NA	NA	**3.16**	3.11	3.08
S15	4.91[a]	NA	NA	2.59[a]	**3.97[a]**	4.36[a]	4.51[a]
S16	2.81	NA	NA	2.69	**3.19**	2	3.56
S17	3.78[a]	NA	3.77[a]	3.86[a]	**3.64[a]**	3.81[a]	3.99[a]
S18	NA	NA	3.8	NA	**3.87**	3.75	3.9
S19	NA	NA	NA	4.01[a]	**3.54[a]**	3.94[a]	3.74[a]
S20	NA	NA	NA	3.12[c]	**4.35[c]**	4.45[c]	4.27[c]
S21	4.1	NA	3.99	3.89	**4.46**	4.07	4.04
S22	NA	NA	NA	NA	**3.68**	NA	NA
S23	3.96[b]	NA	3.83[b]	NA	**4.44[b]**	3.39[b]	3.94[b]
S24	NA	NA	NA	NA	**4.33**	4.17	4.23
S25	3.44[a]	3.21[a]	3.71[a]	3.86[a]	**3.57[a]**	3.79[a]	3.69[a]
S26	NA	NA	4.05	3.63	**3.95**	4.27	3.74
S27	4.1[a]	NA	NA	3.31[a]	**3.43 [a]**	NA	NA
S28	NA	NA	NA	NA	**3.67**	NA	3.67
S29	2.93[a]	NA	NA	3.11[a]	**2.86[a]**	4.09[a]	3.53[a]
S30	NA	NA	NA	NA	**3.58**	3.59	3.06

Note. CSF: critical success factor; NA: not applicable

[a] Converted value from (1-7) scale.

[b] Converted value from (1-9) scale

[c] Converted value from (1-3) scale.

Table 3.5. Likert Scale Responses for CSFs-Part B

ID	Learning made interesting	Assimilation with curriculum	Increased productivity	Learner community development	Platform accessibility	Internet access	Blended learning
S1	3.08[a]	NA	NA	NA	NA	NA	NA
S2	NA	3.79	NA	3.52	NA	NA	NA
S2A	NA	3.64	3.89	4.05	4.27	3.8	3.75
S3	NA	NA	NA	NA	NA	NA	NA
S4	3.8	2.82	3.94	NA	NA	NA	NA
S5	NA	NA	3.91	3.91	4.05	4.05	NA
S6	4.39	4.17	4.08	3.27	4.8	NA	2.16
S7	3.66	NA	3.28	NA	3.89	NA	NA
S8	NA	NA	4.48	NA	4.65	NA	4.48
S9	3.06[b]	3.09[b]	3.28[b]	NA	NA	NA	3.09[b]
S 10	NA	4.2	3.90	3.8	4.1	NA	3.9
S11	NA	3.8	4	3.96	4.03	3.8	NA
S 12	NA	3.55[a]	NA	3.96[a]	NA	NA	NA
S13	4.18	3.25	3.89	2.03	3.6	3.1	NA
S14	NA	NA	NA	NA	NA	NA	NA
SIS	3.78[a]	NA	2.46[a]	NA	NA	NA	NA
S16	3.18	NA	3.37	NA	NA	NA	NA
S17	3.64[a]	3.9[a]	3.65[a]	NA	3.95[a]	NA	NA
S18	4.12	3.87	4.04	3.87	3.85	3.8	4.02
S19	3.11[a]	NA	3.44[a]	3.21[a]	3.81[a]	NA	NA
S20	4.22[c]	4.67[c]	4.1[c]	4.32[c]	4.55[c]	4.55[c]	4.67[c]
S21	4.08	4.08	4.28	NA	4.12	NA	3.89
S22	NA	NA	2.44	2.47	2.55	1.96	NA
S23	4.22[b]	4.62[b]	4.06[b]	NA	NA	NA	4.61[b]
S24	3.98	4.09	4.26	NA	NA	NA	3.95
S25	3.42[a]	3.62[a]	3.51[a]	4.06[a]	4[a]	4.34[a]	3.66[a]
S26	3.65	NA	3.85	3.39	3.92	4.41	NA
S27	NA	NA	3.31[a]	NA	NA	NA	3.34[a]
S28	4.04	2.95	3.76	4.05	3.83	NA	3.58
S29	NA	2.94[a]	2.95[a]	3.89[a]	3.89[a]	4.17[a]	2.86[a]
S30	NA	NA	NA	3.67	3.36	NA	3.9

Note. CSF: critical success factor; NA: not applicable

[a] Converted value from (1-7) scale.

[b] Converted value from (1-9) scale

[c] Converted value from (1-3) scale.

Table 3.6. Summary Statistics of the Likert Scale Responses for the CSFs

Critical Success Factor	Average Value	Number of Studies out of 30	Population out of 4,755	Percentage Population (%)
Technical competence students	3.69	13	2,215	46.58
Technical competence instructors	3.37	3	579	12.18
Personalization	3.86	9	1,247	26.22
Learner autonomy	3.47	13	1,878	39.50
User perception	**3.68**	**30**	**4,755**	**100.00**
User-friendly application design	3.69	21	2,426	51.02
Application working	3.74	23	3,171	66.69
Learning made interesting	3.76	18	2,792	58.72
Assimilation with curriculum	3.73	17	3,006	63.22
Increased productivity	3.52	25	4,348	91.44
Learner community development	3.6	16	2,893	60.84
Platform accessibility	4.01	19	3,454	72.64
Internet access	3.96	10	1,505	31.65
Blended learning	3.8	15	2,516	52.91

From the point of view of the research, an understanding of whether users thought that an m-Learning system increased their productivity was considered to be of the utmost significance. This is evident by the presence of the factor in more than 90% of the studies. Users, on average, considered that using m-Learning led to an increase in their efficiency and productivity. However, this does not mean that a lower percentage indicates that the factor is of less importance. It merely indicates that the researchers did not include the factor as part of their research study. For instance, technical competence was assessed in only three studies. This does not, however, imply that technical competence is not necessary to give maximum benefit to the students. Similarly, access to the Internet, which students consider extremely important, was evaluated in merely 31% of the studies.

The results from the analysis can be used by prospective researchers to enhance their research studies and gain pertinent information regarding the performance and perception of m-Learning within an institution.

3.4 Discussion

3.4.1 Summary of Results

Overall, this research identified 30 studies that contained primary data comprising the actual responses of the m-Learning users on how they evaluated various aspects of the m-Learning process that was tested in their institution. The study contains research conducted in 17 countries worldwide with a combined sample population of 4,755 (the majority being students using m-Learning in various courses). Overall, the research showed that the users were fairly satisfied with the usage of m-Learning within their particular courses and were interested in using the system more in the future. On a 1 to 5 Likert scale, the satisfaction ratio was a respectable 3.6, which clearly shows a positive response.

While universal response about the availability of mobile phones and related services was not available, the studies that included this information found that more than 90% of the sample population claimed to own mobile phones.

Similarly, although information regarding access to the Internet and data services was not universally available, more than 61% and 77% of the population, respectively, had access to these services. Interestingly, about 66% of the population (for the studies where information was available) had already used m-Learning platforms, and an overwhelming 88% of the population was interested in using mobile phones for m-Learning purposes. It is important that future studies conducted in this area have information on these aspects, as this would give a clear picture of the actual status of m-Learning in a particular institution and of possible technological barriers that need to be overcome in individual cases.

3.4.2 Discussion on CSFs

The information available about the CSFs is hard to analyze because it is highly subjective to each individual researcher. However, even without considering the number of studies that assessed the success factors, the results of the present research can be used to indicate the relative importance of critical factors from the point of view of users.

Platform accessibility was considered to be the most important factor, followed by Internet access, personalization of the platform, the possibility of blended learning, and the prospect of learning made interesting. This showed that the factor judged to be the most important was the involvement of the university administration in providing clear access, goals, and guidelines to using the platform. The second most important factor was access to the Internet, and the third most important factor was personalization of the platform. This is interesting because this shows that while students may or may not be interested in instructor autonomy, they are extremely interested in the possibility of tailored learning that would satisfy individual learning goals and objectives. The next most important factor was blended learning. Users also considered the prospect of using mobile phones as an interesting way to learn to be a key success factor. This factor becomes even more important in light of the fact that m-Learning is mostly controlled at learner pace and time, and it would not work efficiently if users are not interested in the learning itself. These top five CSFs need to be kept in mind if m-Learning is to find sustainable long-term success.

The other eight success factors, in decreasing order of importance, are: application working, assimilation with curriculum, technical competence of students, user friendly application design, instructor community development, increased productivity, instructor autonomy, and technical competence of instructors. A remarkable aspect of these results is that, while the factors are rated in decreasing order of importance, the least important factor has a Likert score of 3.37, which is significantly higher than average. Also, all the factors are close to each other with the maximum distance between adjoining factors of $\leq$ 1.

A total of 13 CSFs were evaluated as part of the study along with a measurement of user perceptions of the m-Learning. All 13 factors were found to have a significant impact on the success of m-Learning from user perspectives. It was also found that users were satisfied with m-Learning and were interested in using it in the future. M-Learning was also considered to improve efficiency and productivity among the users. If we look back to the theoretical framework, we can see that our 13 CSFs can be assigned to the attributes of innovation as described.

- Relative Advantage – Learning made interesting, increased productivity
- Compatibility – Assimilation with curriculum, blended learning
- Complexity – User friendly design, Internet access, application working
- Trialability – Platform accessibility, instructor autonomy, personalization
- Observability - Technically competent students, technically competent instructors, instructor community development.

On the other hand, for the sake of simplicity we combined user friendly design and application working into one factor (user friendly design), giving us 12 CSFs. Moving on, we can see that these CSFs can also be attributed to the types of decisions being made as well, as shown here:

- Personal decision – Platform accessibility, instructor autonomy, personalization, learning made interesting, increased productivity, user friendly design
- Collective decision – Instructor community development, Internet access
- Authority decision – Assimilation with curriculum, blended learning, technically competent students, technically competent instructors.

Using the framework and our 12 CSFs together helps us see what aspects of the innovation decision process are the likely causes of the reduced take-up of m-Learning in comparison to the popularity of the adoption of mobile options in other aspects of life.

To conclude the literature review, there are a number of aspects of the research that must be borne in mind when assessing the resulting data. Because different research assessed different demographics and numbers absolute comparison is difficult. However, by utilizing these results together, a broader view of the reaction to m-Learning throughout a wide range of students across the world can be gained. The opportunity for further work in the field by more detailed research into specific demographics and regions should not be ignored, however, and building on the findings of this study would be a good starting place.

In summary, this chapter presents an exhaustive systematic survey of the existing research studies evaluating m-Learning worldwide. The results of this systematic review

showed that the research conducted in the area of m-Learning is fragmented and idiosyncratic as it is largely based on the understanding of the individual researcher. Putting all our confirmed key CSFs into the theoretical framework, the results of the works studied here do show that although the aspects required for successful adoption are largely in place, they are heavily skewed towards the personal decision type of adoption. This may seem an obvious occurrence given the nature of m-Learning, but it is also perhaps an indication that the benefits for the other innovation decisions, particularly the authority type choices, are not as well satisfied currently. This gives an indication as to where the resistance to take-up is actually occurring.

The next step is to divide these 12 CSFs into two perspectives (students and instructors) in order to evaluate the impact of individual success factors on the overall perception of the m-Learning (more details to follow in chapters 4 and 5). This would quantify the effect of each success factor in precise statistical terms, and it would be a relevant basis on which to design and implement an m-Learning maturity model.

Table 3.7. CSFs split for future study

Student perspectives	Instructor perspectives
Technically competent students	Technically competent instructors
Personalization	Instructor autonomy
Learning made interesting	User friendly design
Increased productivity	Assimilation with curriculum
Platform accessibility	Instructor community development
Internet access	Blended learning

Chapter 4

4 Student Perspectives of Mobile Learning: An Empirical Study[4]

Higher education is becoming more interested in adopting technological innovations like an m-Learning platform for education. Mobile technologies are the next frontier for education because they can provide high-quality learning capabilities to satisfy the rising student demand for mobility and flexibility. Because of the ubiquitous nature of mobile technology (smartphones) and the vast opportunities it offers, there are indications that smartphones could lead the next generation of learning platforms. Researchers have examined the idea from several angles and produced a copious amount of literature devoted to explaining the interrelationships of technology and learning. In this chapter, we aim to offer a view of student perspectives, giving a systematic examination of m-Learning adoption that can be used as a framework for further research into the success of m-Learning. We found that making learning more interesting, increasing productivity, and providing Internet access had the greatest effect on student perceptions.

4.1 Literature Review of CSFs of Students

This research offers a systematic way of analyzing student perceptions of a successful m-Learning platform that can be emulated in other studies to understand the CSFs of m-Learning in different contexts. We empirically studied and analyzed the impact of six CSFs that have had the most effect on student perceptions: 1- the technical competence of students, 2- the personalization of the learning program, 3- the ability to make learning

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[4] Parts of this chapter were published in the World Congress on Engineering and Computer Science and an extended version was submitted to Journal of Computing in Higher Education, (Springer).

1. Alrasheedi, M., & Capretz, L.F. (2014). Learner Perceptions of a Successful Mobile Learning Platform: A Systematic Empirical Study, the World Congress on Engineering and Computer Science, San Francisco, USA, pp. 306-310.

2. Alrasheedi, M., Capretz, L.F. & Raza, A. (2015d). Student Perspectives of the Mobile Learning Platform: An Empirical Study, *in preparation*.

interesting, 4- an increase in productivity, 5- the access to the Internet, and 6- the accessibility of the platform.

The first factor, the technical competence of students, refers to the technical knowledge and skills of students; these are key determinants in the success of m-Learning. The ability to use new technology determines student acceptance of new technology, such as e-Learning and m-Learning (Park et al., 2012). Lack of skills may hinder an individual's ability to embrace m-Learning. Training in the use of the new system may help an individual to cope and fully use the new platform (Volery and Lord, 2000).

Personalization is another significant factor that determines the success of m-Learning; it refers to student self-perception and self-management in being capable of succeeding in learning tasks. The individualization of m-Learning to suit the individual needs of a student also determines the efficiency of learning. In this case, it refers to student perception and management of using m-Learning in the learning process. The use of m-Learning successfully enhances the teaching and learning process when students are ready and feel personally valued (Liaw et al., 2010). Personalization also refers to the practice of dynamically customizing your site to suit your purposes and intent. The practice of personalization differs from one student to the next. With regards to m-Learning, personalization will be of help to the m-Learning students since they will be in a position to design and fashion their learning materials in a way that suits them and their learning needs.

It is generally accepted that there are two adaptive approaches to personalization (Kinshuk et al., 2009). The first is that the learning service itself can adapt to individual learner characteristics. This includes their requirements, learning styles, profiles, performance, and status. The second approach is that the learning service adapts to the context surrounding the learners. Of the two, the first is the easier to understand. The way to best illustrate this concept would be for learners who have shown better performance from a visual learning style to receive the service using multimedia materials. The second approach relies on the context-awareness of the learning service, which is a slightly more difficult concept to grasp. An illustration of this approach in action would be for someone

to be learning in a library supplied with learning material in book form, which best suits the context of the learner (Kinshuk et al., 2009).

There are currently a variety of learning technologies available that use different mobile platforms, including mobile phones or PDA devices. The idea behind these platforms is to support an anytime and anywhere learning experience and, indeed, in pilot studies the level of engagement and interest in the students is comparable to the response to computer labs (Nedungadi and Raman, 2012). Additionally, m-Learning delivers a level of personal interaction that cannot be matched by other learning methodologies and can be utilized to provide excellent feedback on the progress of the learner (Sampson and Zervas, 2013).

Making learning interesting and enjoyable is another CSF identified by the literature review. Every student expects that the use of new technology will enhance their performance by making learning interesting. The m-Learning system, therefore, needs to demonstrate the usefulness of context awareness support, providing appropriate information to support a student's study experience. The students learn from each other, which increases the intrinsic and extrinsic motivation towards learning (Lee et al., 2005).

Increased productivity is yet another critical success factor in m-Learning. The extent to which students believe that they can receive information or digital mobile content through mobile devices with serviceable and appropriable quality determines the quality of their m-Learning, which in turn determines their level of productivity (Woodill, 2012). A higher quality of mobile content could completely determine student interest in adopting m-Learning for their learning experience. The higher quality of content and the ability to customize the system are of great importance in the student level of satisfaction with the mobile technology; this in turn leads to utilization of m-Learning and an increase in student productivity levels. In other words, the quality of the content in m-Learning increases the productivity of the students and enhances their level of success in the job market (Abachi and Muhammad, 2014).

The fifth factor is Internet access. The extent to which students are able to easily access the network to gain information through mobile devices is a CSF in m-Learning (Shunye,

2014). This concept is built upon the concepts of mobility, convenience, and the anywhere-anytime paradigm upon which m-Learning is based. Internet access has a great influence on the students who use m-Learning because it helps to fully mediate the intentions to use m-Learning (Gupta and Manjrekar, 2012).

The sixth and final factor is platform accessibility. Here the platform means the various operating systems, such as the iOS, Android, Blackberry, and Windows (Pocatilu, 2013). This also includes diverse hardware manufacturers for platforms such as HTC, Google, Samsung, and Apple (Sarrab et al., 2012). This factor contributes positively to the use of m-Learning among students, as they are able to access the learning materials anywhere and in different designs as long as they have the appropriate handheld computing device.

4.2 Research Model and Hypotheses

This section presents a research model for analyzing the relationship between key CSFs and student perspectives towards m-Learning, as shown in Figure 4.1. The model derives its theoretical foundations by combining the previous work by (Alrasheedi and Capretz, 2013b, 2014; Alrasheedi et al., 2015d). The model uses six CSFs: 1- the technical competence of students, 2- the personalization of m-Learning, 3- the ability to make learning interesting, 4- an increase in productivity, 5- the access to the Internet, and 6- the accessibility of the platform. The dependent variable of this study is m-Learning adoption according to student perceptions. Hereafter, the six independent variables are referred to as CSFs. Overall, the objective of this study is to investigate the answer to the following question:

"To what extent do the CSFs have an impact on m-Learning adoption based on the perception of university students?"
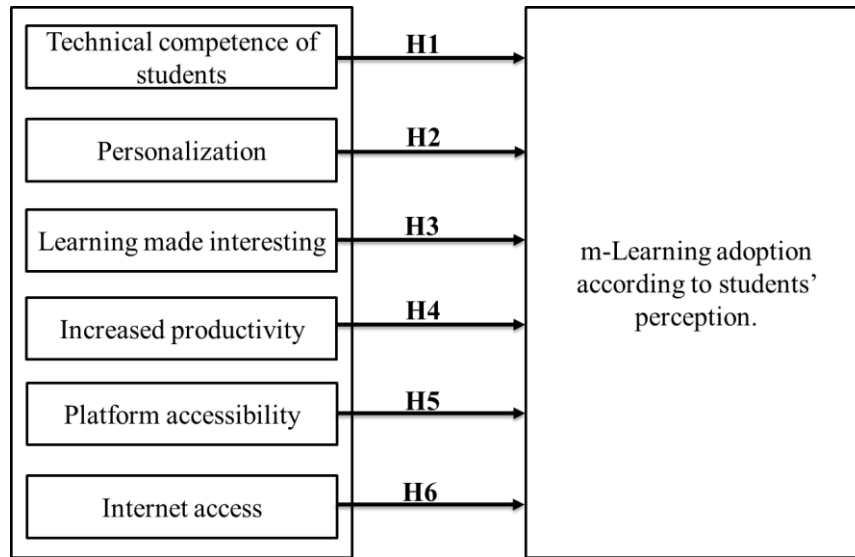
Figure 4.1 Research Model: CSFs Affecting the Success of m-Learning Adoption According to Students' Perception

In this context the following six hypotheses are to be tested:

Hypothesis 1. The technical competence of students positively affects the m-Learning adoption according to student perceptions.

Hypothesis 2. The extent of personalization positively affects m-Learning adoption according to student perceptions.

Hypothesis 3. The possibility of interesting ways of learning the course matter is positively related to the m-Learning adoption according to student perceptions.

Hypothesis 4. Increased productivity plays a positive role towards m-Learning adoption.

Hypothesis 5. Improved Internet access has a positive impact on m-Learning adoption by students.

Hypothesis 6. Improved platform accessibility is positively related to m-Learning adoption according to the student perceptions.

Without doubt, students are the target user group around which the entire platform has been built and, hence, their attitudes are extremely important. Our previous research found six factors that affect the overall attitude towards the m-Learning platform (Alrasheedi and Capretz, 2014). To determine user satisfaction levels, we have conducted a detailed survey targeting students who are using the m-Learning platform. The multiple linear regression equation of the model is as follows:

m-Learning adoption as per students' perceptions $= c_0 + c_1f_1 + c_2f_2 + c_3f_3 + c_4f_4 + c_5f_5 + c_6f_6$. (4.1)

In the equation c_0, c_1, c_2, c_3, c_4, c_5, and c_6 are coefficients and f_1, f_2, f_3, f_4, f_5, and f_6 are the six independent variables. To empirically investigate the research question, the six hypotheses are presented with a belief that they all positively affect m-Learning adoption according to student perceptions.

4.3 Research Methodology

As students form the largest user group, this chapter focuses on gathering their opinions in a systematic manner. The methodology is depicted in Figure 4.2, below. First, the study systematically identified the factors contributing directly or indirectly to m-Learning adoption from student perspectives. In order to do an empirical investigation of the key factors from student perspectives, a research model was developed based on the key factors shown in Figure 4.1. After this, a survey questionnaire was prepared to assess each key factor. Finally, we performed a statistical analysis of data on student perspectives. The analysis was performed using quantitative tools, specifically Minitab v.17.

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┌─────────────────────────────────────────────────────────────────┐
│  Systematic literature review to come up with the factors that    │
│  contribute directly or indirectly from student perspectives      │
└─────────────────────────────────────────────────────────────────┘
              ┌───────────────────────────────────────────┐
              │  Empirical investigation of key factors    │
              │  from student perspectives                 │
              └───────────────────────────────────────────┘
              ┌───────────────────────────────────────────┐
              │  Development of a research model based on   │
              │  the key factors                           │
              └───────────────────────────────────────────┘
              ┌───────────────────────────────────────────┐
              │  Preparation of questionnaires and          │
              │  conducting a survey to assess each key     │
              │  factor                                     │
              └───────────────────────────────────────────┘
                    ┌─────────────────────────────────┐
                    │  Statistical analysis of data    │
                    └─────────────────────────────────┘
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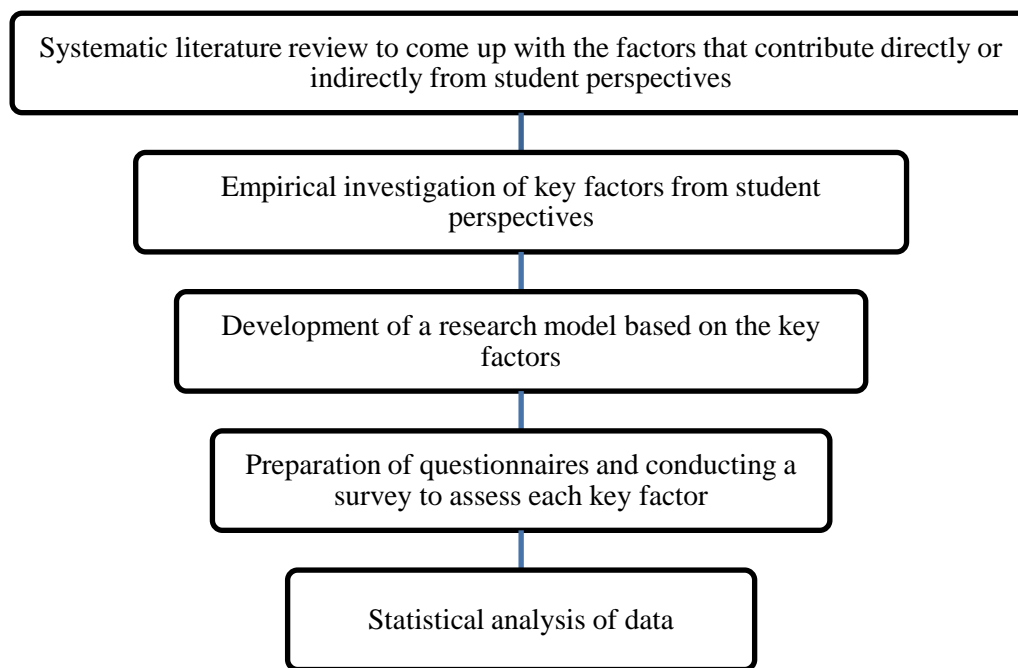
Figure 4.2 Steps Representing the Research Methodology

4.4 Data Collection and the Measuring Instrument

To collect the data, we used an online survey tool (SoGoSurvey). The questionnaire was sent to various undergraduate students of different faculties in five universities in Saudi Arabia based on the research ethics approval (Appendix IV). All the participant responses and information was kept confidential in line with the ethical research guidelines of the institutions. A total of 202 completed questionnaires were received from the survey.

The measuring instruments presented in (Appendix I) were used to study the perceived level of student satisfaction as well as the extent to which these CSFs were important for the students in adopting m-Learning. The questionnaire required participants to indicate the extent of their agreement or disagreement with statements using a five-point Likert scale. For all of the items associated with each variable, the scale was (1= Strongly Disagree, 2= Disagree, 3= Neither Agree or Disagree, 4= Agree, 5= Strongly Agree).

The questionnaire had three parts:

1. The first part was used to determine the general profile of the respondents and consisted of questions regarding their gender, age group, and educational status.

2. The second part was used to determine the extent to which students have access to mobile devices and the Internet, and their experience in using these devices.

3. The third part was used to determine the different factors that affected user perception of the m-Learning platform as below: Question 1 (Technical competence of students), Question 2 (Personalization), Question 3 (Learning made interesting), 4-7 (Increased productivity), Questions 8-11 (Platform accessibility), Questions 12-14 (Internet access), and Questions 15-17 (Cumulative overall perception of m-Learning adoption, in this case from student perspectives).

4.5 Data Analysis Method

We started our data analysis by making a descriptive analysis of the demographic distribution of the population. Then, in order to analyze the research model and test the hypotheses, the data analysis procedure involved three steps. First, a parametric correlation was found between the dependent and independent variables to see if any of the variables, i.e., hypotheses, could be rejected. The second step was conducted by making a non-parametric correlation using the same set of data in order to reduce the threat to external validity (Raza et al., 2012). Finally, the third step involved testing the hypotheses by using the Partial Least Square (PLS) technique.

4.5.1 Demographic Distribution of the Population

This section provides a description of the demographic distribution of the survey population. The total population of the research consisted of 202 undergraduate students studying in different departments in five universities in Saudi Arabia.

The gender distribution of the population consisted of 123 male students and 78 female students. Only one person did not answer the question of respondent distribution as illustrated in Figure 4.3. The age distribution of the population is as follows. A majority of the population was younger than 25 years (132 persons). No respondents were older

than 55 years and 4 persons chose not to answer this question. 47 of the respondents were aged 26-35 years, and 19 of the respondents were aged 36-55 years.
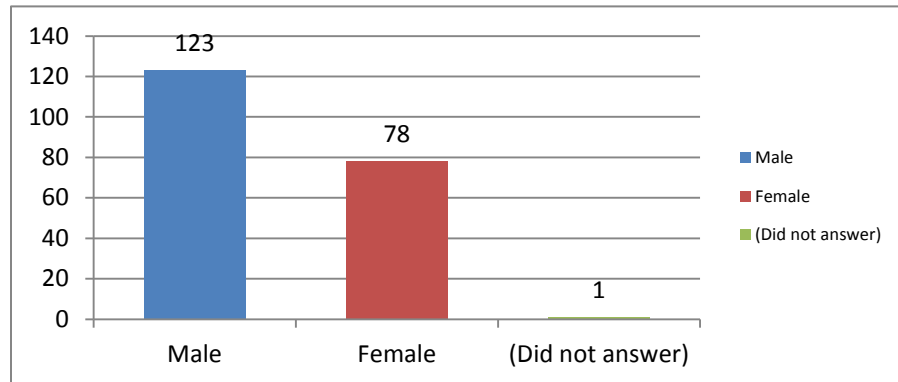
Figure 4.3 Respondent Gender Distribution

The research population consisted of 146 full-time students and 55 part-time students. One person did not answer this question. 125 students were studying computer science and IT; 38 students were in other engineering branches; 7 were social sciences students; 4 were health sciences students; and 2 were agriculture students. 15 were studying other courses, as shown in Figure 4.4. The research also investigated the mobile usage demographics of the research population. All 202 students owned mobile phones or smartphones.
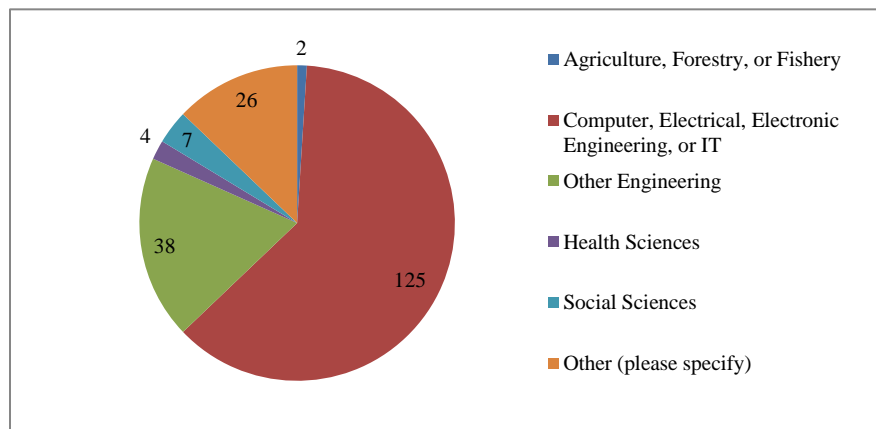
Figure 4.4 Respondent Faculty Distribution

4.5.2 Reliability and Validity Analysis of the Measuring Instrument

Among the responses of the questionnaire regarding perception of various aspects of the m-Learning platforms, three are straightforward and involve single-item measurement scales. However, the remaining three factors are measured using multi-item rating scales – student productivity, platform accessibility, and Internet access. The dependent variable also involves the use of a multi-item rating scale. In these particular cases, it is important to assess the reliability of the measurement scales. Reliability analyses indicate the reproducibility of a measurement. We have done an internal consistency analysis to calculate the Cronbach's alpha. Various researchers have cited different satisfactory levels for the reliability coefficient. As an example, van de Ven and Ferry (1980) believe that a coefficient of 0.55 and higher is satisfactory. However, recent researchers such as Osterhof (2001), believe that the coefficient must be at least 0.6. In our case, the reliability coefficient is >0.63 in all the cases, which means that the measuring instruments used are reliable. Table 4.1 below shows the values of Cronbach's alpha for the factors discussed.

Table 4.1. Cronbach's Alpha for Multi-Measuring Rating Scales

Success Factors	Item Numbers	Cronbach's Alpha	PCA Eigen Values
Technical competence of student	1	0.7621	1.6258
Personalization	2	0.6305	1.4632
Learning made interesting	3	0.7553	1.6134
Increased productivity	4-7	0.8922	1.7502
Platform accessibility	8-11	0.835	1.6304
Internet access	12-14	0.7465	1.6097

Validity is the strength of the inference of the true value starting from the value of a measurement. Comrey and Lee's (2013) Principal Component Analysis (PCA) was performed for all six CSFs, and reported in Table 4.1. We used an Eigen value (Kaiser, 1970) as a reference point to observe the construct validity, using PCA. We used the Eigen Value One criterion, which is known as the Kaiser Criterion (Kaiser, 1960; Stevens, 1986) that indicated any component having an Eigen value more than 1 would be retained. In our study, the Eigen-value analysis discovered that all six variables form a single factor, as presented in Table 4.1. Therefore, according to our statistical analysis,

the convergent validity of our instrument for m-Learning adoption according to student perspectives can be considered as sufficient.

4.6 Hypothesis Tests and Results

We analyzed the research model and the significance of Hypotheses H1-H6, using different statistical techniques in three phases. In phase I, we used normal distribution tests and parametric statistics, whereas in phase II, we used non-parametric statistics. Both parametric as well as non-parametric statistical approaches were used to reduce the threats to external validity. As our measuring instrument had multiple items for all six independent variables as well as the dependent variable (as shown in Appendix I), the ratings by the respondents were added up to get a composite value for each rating. Tests were conducted for hypotheses H1- H6 using parametric statistics by determining the Pearson Correlation Coefficient. For non-parametric statistics, tests were conducted for hypotheses H1-H6 by determining the Spearman correlation coefficient. To increase the reliability of the results, hypotheses H1-H6 of the research model were tested using the PLS technique in Phase III. The results of the statistical calculation for the Pearson correlation coefficient are shown in Table 4.2 below. It is well known that the lower the p-value the better the chance of rejecting the null hypothesis and, hence, the more significant the result in terms of its statistical significance (Stigler, 2008). The significance of each coefficient was indicated in terms of p-values; in the present case all p-values are <0.05. This indicates that the results are significant.

Table 4.2. Hypothesis Testing Using a Parametric Test

Hypothesis	Critical Success Factor	Pearson Correlation Coefficient	Spearman Correlation Coefficient
H1	Technical competence of students	0.626*	0.613*
H2	Personalization	0.463*	0.442*
H3	Learning made interesting	0.613*	0.606*
H4	Student productivity	0.750*	0.727*
H5	Platform accessibility	0.630*	0.616*
H6	Internet access	0.610*	0.574*

* Significant at P < 0.05

4.6.1 Phase I

The Pearson correlation coefficient between the technical competence of students towards m-Learning and m-Learning adoption was positive: 0.626 at $P < 0.05$, and, hence, hypothesis H1 is justified. For H2, the relationship between personalization and m-Learning adoption, the Pearson correlation coefficient was 0.463 at $P < 0.05$, and, hence, it was found to be significant as well. Furthermore, hypothesis H3 was accepted based on the Pearson correlation coefficient of 0.613 at $P < 0.05$, which represents the relationship between learning made interesting and m-Learning adoption. Similarly, hypothesis H4, which denotes the relationship between student productivity and m-Learning adoption, yields a Pearson correlation coefficient of 0.750 at $P < 0.05$. This hypothesis is statistically significant, and, consequently, it was accepted. For H5, the relationship between platform accessibility and m-Learning adoption, the Pearson correlation coefficient was 0.630 at $P < 0.05$; hence, it was found to be significant and was accepted as well. Likewise, hypothesis H6 was accepted based on the Pearson correlation coefficient of 0.610 at $P < 0.05$, which represents the relationship between Internet access and student perceptions towards m-Learning. Hence, as observed and reported, all hypotheses – H1, H2, H3, H4, H5, and H6 – were found to be statistically significant and were accepted.

In the second step, non-parametric statistical testing was performed by examining the Spearman correlation coefficient including the individual independent variables, all CSFs, the dependent variable, and m-Learning adoption according to student perceptions, as shown in Table 4.2.

4.6.2 Phase II

Non-parametric statistical testing was conducted in this phase by examining Spearman correlation coefficients between individual independent variables (CSFs) and the dependent variable (m-Learning adoption). The results of the statistical calculations for the Spearman correlation coefficients are also displayed in Table 4.2. The Spearman correlation coefficient between the technical competence of students and m-Learning adoption according to student perceptions was positive, i.e., 0.613 at $P < 0.05$, and,

hence, hypothesis H1 was justified. For hypothesis H2, which examined the relationship between personalization and m-Learning adoption, the Spearman correlation coefficient of 0.442 was observed at $P < 0.05$, which indicates that this hypothesis was significant. Moreover, hypothesis H3 was accepted based on the Spearman correlation coefficient of 0.606 at $P < 0.05$, representative of a statistically significant relationship between learning made interesting and m-Learning adoption. For hypothesis H4, which involves student productivity and m-Learning adoption, the Spearman correlation coefficient of 0.727 was observed at $P < 0.05$. Since a significant relationship was found between productivity and m-Learning, H4 was accepted. For H5, the relationship between platform accessibility and m-Learning adoption, the Spearman correlation coefficient was 0.616 at $P < 0.05$, which means it was found to be significant; consequently, it, too, was accepted. Similarly, hypothesis H6 was accepted based on the Spearman correlation coefficient of 0.574 at $P < 0.05$, which represents the relationship between Internet access and m-Learning adoption according to student perceptions. Therefore, as observed and reported, all hypotheses – H1, H2, H3, H4, H5, and H6 – were found to be statistically significant and were accepted.

4.6.3 Phase III

In order to do the cross-validation of the results obtained in Phase I and Phase II, the PLS technique was used in this phase of hypothesis testing. Fornell and Bookstein (1982) reported that the PLS technique is particularly valuable in different circumstances, including complexity, non-normal distribution, low theoretical information, and small sample size. Accordingly, the PLS technique was used to increase the reliability of the results.

Table 4.3. Hypotheses Testing Using Partial Least Square Regression

Hypothesis	Factor	Path Coefficient	R^2	F- Ratio
H1	Technical competence of students	0.52	0.39	128.7*
H2	Personalization	0.41	0.21	54.6*
H3	Learning made interesting	0.52	0.37	120.6*
H4	Increased productivity	0.80	0.56	257.4*
H5	Platform accessibility	0.63	0.39	131.8*
H6	Internet access	0.65	0.37	118.3*

*Significant at P < 0.05

In the PLS approach, the dependent variable of our research model (m-Learning adoption according to student perceptions) is considered as the response variable, and the independent variables (CSFs) are considered as predicators. The test outcomes, which contain the observed values of the path coefficient R^2 and the F-ratio, are illustrated in Table 4.3. The technical competence of students is observed to be significant at $P < 0.05$ with a path coefficient of 0.52, an R^2 value of 0.39, and an F-ratio of 128.7. Personalization has a path coefficient of 0.41, an R^2 value of 0.21, and an F-ratio of 54.6. Learning made interesting has the same direction as proposed in hypothesis H3, with a path coefficient of 0.52, an R^2 value of 0.37, and an F-ratio of 120.6. The variable of student productivity had a path coefficient of 0.80, an R^2 value of 0.56, and an F-ratio of 257.4. The variable of platform accessibility had a path coefficient of 0.63, an R^2 value of 0.39, and an F-ratio of 131.8. Finally, the variable of Internet access had a path coefficient of 0.65, an R^2 value of 0.37, and an F-ratio of 118.3.

4.7 Testing the Research Model

The multiple linear regression equation of our research model is depicted by Equation-4.1. The purpose of research model testing was to provide empirical evidence that our CSFs play a significant role towards m-Learning adoption. The testing process consisted of conducting regression analysis, as well as reporting the values of the model coefficients and their direction of association. We placed m-Learning adoption as

response variable and CSFs as predicators. Table 4.4 below shows the regression analysis results of the research model.

Table 4.4. Multiple Regression Analysis of the Research Model

Critical Success Factor	Coefficient term	Coefficient value	t-value
Technical competence of student	f_1	0.0812	1.57**
Personalization	f_2	-0.0919	-1.81**
Learning made interesting	f_3	0.2105	4.10*
Increased productivity	f_4	0.4079	5.09*
Platform accessibility	f_5	0.1116	1.72**
Internet access	f_6	0.2526	3.93*

*Significant at P < 0.05, **Insignificant at P > 0.05*

The results of the statistical calculations for the multiple regressions are displayed in Table 4.4. The t-value for the technical competence of students and m-Learning adoption according to student perceptions was 1.57 at P > 0.05, and, hence, it is insignificant. The t-value between Personalization and m-Learning adoption according to student perceptions was observed negative at (-1.81) and the P > 0.05, which indicates that it, too, was insignificant. However, the t-value was 4.10 and the P < 0.05, illustrative of a statistically significant relationship between Learning made interesting and m-Learning adoption according to student perceptions. Similarly, the t-value for increased productivity and m-Learning adoption according to student perceptions, was observed as being equal to 5.09 at P < 0.05. Since a significant relationship was found between increased productivity and student perceptions towards m-Learning, H4 was accepted. For H5, the relationship between Platform accessibility and m-Learning adoption according to student perceptions, the t-value was observed to be 1.72 at P > 0.05, which means it was found to be insignificant; consequently, it was not accepted. The last hypothesis, H6, was accepted, based on the t-value of 3.93 at P < 0.05, which represents the relationship between Internet access and m-Learning adoption according to student perceptions. Therefore, the first interesting part of the analysis is that not all the

coefficients are positive. Personalization has a negative coefficient. Similarly, both technical competence of students and platform accessibility were found to be insignificant since their corresponding p-values were >0.05. Hence, the corresponding hypotheses H1, H2, and H5 were rejected.

The final regression equation is as follows (4.1):

$$\textbf{\textit{Students' perceptions}} = 0.239 + 0.0812 \,(Technical\ competence\ students) -$$
$$0.0919 \,(Personalization) + 0.2105 \,(Learning\ made\ interesting) +$$
$$0.4079 \,(Increased\ productivity) + 0.1116 \,(Platform\ accessibility) +$$
$$0.2529 \,(Internet\ access)$$

As can be seen, personalization is negative in this case. The model accounts for 66.05% variability in the dependent variable, i.e., m-Learning adoption from student perceptions.

4.8 Discussion

The data analysis of the survey covers only a limited portion of the results. The gender distribution was skewed towards male students, but female students were still a significant part of the population. A majority of the students were under the age of 25 and in full-time undergraduate study. Finally, the student population consisted mainly of computer and other engineering students. Some of the questionnaire consisted of multiple-response rating scales, and so the first step constituted determining whether the overall responses were valid. The values of Cronbach's alpha in the relevant parameters (student productivity, platform accessibility, Internet access, and the dependent variable, m-Learning adoption) were all found to be higher than 0.63, which was above the most recently decided threshold of 0.6. Hence, the averages of the response could be used for determining the individual variable coefficients in the research mode.

In order to remove the threats to external validity, both parametric and non-parametric studies were carried out. The coefficients were similar in both tests, though the Spearman's Rho tended to be somewhat lower than Pearson's coefficient. More importantly, none of the hypotheses could be rejected at this stage because, statistically speaking, all were found to be significant with a p-value of <0.05. The next crucial result

was that none of the correlation coefficients were lower than 0.4, suggesting that the data was at least fairly correlated and none of the hypotheses could be rejected based on the issue of poor correlation.

Armed with this information, the next step constituted determining the regression equation for the research model. The regression analysis showed that three out of six variables were statistically significant and, hence, H3, H4, and H6 were accepted. All of the variables except personalization had the expected direction based on the original hypotheses.

4.9 Limitation of the Study

The present research is detailed in terms of the analysis of student responses. However, there are certain limitations and they are mostly related to the analysis of data.

As in the case of any empirical investigation, this study has certain limitations. Easterbrooks et al. (2007) refer to construct validity, internal validity, external validity, and reliability as four criteria of validity in an empirical study. In most cases, the researcher's ability to generalize the experimental outcome to industrial practice is generally limited by threats to external validity (Wohlin et al., 2000), which is the case with this study. We took specific measures to support external validity, including our use of a random sampling technique that selects respondents from all departments to at least represent the general population of students within the university.

Furthermore, another aspect of validity concerns whether or not the study results correspond to previous findings. Our work involved the selection of six independent variables that related to the dependent variable of student perspectives. While there are other key factors that influence m-Learning adoption, the scope of this study is restricted to the area of m-Learning adoption from the perspective of students.

Another limitation of this study involves its relatively small sample size. Although, we sent our survey to a large number of students who were enrolled in five universities, we only received 202 responses. Consequently, the relatively small number of responses was a potential threat to the external validity. However, we followed the appropriate research

procedures by conducting and reporting tests in order to improve the reliability and validity of the study, and certain measures were also taken to increase the external validity.

4.10   Conclusion

The present study conducted a systematic and detailed investigation into the factors affecting student perceptions that is based on a survey taken from students of five universities in Saudi Arabia. The purpose was to understand the specific factors that affected student perceptions at the higher education levels. Additionally, determining the extent of the effect of individual factors was a related objective. The results of the analysis showed that, according to student perceptions, the following parameters were found to be significant to m-Learning adoption: learning made interesting, increased productivity, and Internet access. The study conducted and reported here will enable m-Learning software designers and developers to better understand the effectiveness of the relationships of the stated key factors and m-Learning adoption of their projects. This empirical investigation provides us some justification to consider these key factors as metrics and measuring instruments for a MLMM; more details will be come in Chapter 7.

Chapter 5

5 Instructor Perspectives of Mobile Learning: An Empirical Study[5]

M-Learning is the cutting-edge learning platform to really gain traction, driven mostly by the huge uptake in smartphones and their ever-increasing uses within the educational community. Education has long benefitted from the proliferation of technology; however, m-Learning adoption has not proceeded at the pace one might expect. There is a discrepancy between the rate of adoption of the underlying platform (smartphones) and the use of that technology within learning. The reasons behind this have been the subject of several research studies.

Our previous study (Chapter 4) has mostly focused on investigating the CSFs from student perspectives. In this chapter, we have carried out an extensive study of the six factors that impact the success of m-Learning from instructor perspectives. The results of the research showed that three factors – technical competence of instructors, Instructor autonomy, and blended learning – are the most important elements that contribute to m-Learning adoption from instructor perspectives.

5.1 Literature Review of CSFs

Higher education focuses a significant proportion of time and effort on ensuring that students are learning; this is the driving force behind the face-to-face interactions during teaching and assessment. The need to ensure that students are learning is improved by

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[5] Part of this chapter was published in the International Educational Technology Conference. An extended version of this paper has been submitted to International Journal of Computer Science and Information Technology.

1. Alrasheedi, M., & Capretz, L.F. (2015b). An Empirical Study of Critical Success Factors of Mobile Learning Platform from the Perspective of Instructors. Procedia-Social and Behavioral Sciences, 176, 211-219. Elsevier, doi:10.1016/j.sbspro.2015.01.463.

2. Alrasheedi, M., Capretz, L.F. & Raza, A. (2015a). Instructors' Perspectives of Mobile Learning Platform: An Empirical Study, International Journal of Computer Science and Information Technology, 7(3), 27-40. doi:10.5121/ijcsit.2015.7303.

wireless technology, where instructors are expected to impart educational learning to the same standards with the same caliber of student if m-Learning is going to be considered a mainstream educational platform (Ally, 2009). Furthermore, it's vital for instructors to improve the teaching strategies (Seddigi, Capretz, & House, 2009).

Looking at student interaction with the platform, the work of Brett (2011) noted that the user experience of the platform remained very positive where such use aligned with student need, and because students own ever more sophisticated technology themselves. With higher education facing ever tighter fiscal limitations, the shift to student-supplied devices would seem beneficial.

However, for the m-Learning system to succeed, various CSFs should be considered. This study offers a systematic approach to analyzing instructor perceptions of a successful m-Learning platform that can be emulated in other studies to understand the CSFs of m-Learning. We studied and empirically analyzed the impact of six CSFs that have had the most effect on instructor perceptions based on our previous research (Alrasheedi and Capretz, 2015b); those factors are the technical competence of instructors, instructor autonomy, user-friendly application design, assimilation with curriculum, instructor community development, and blended learning.

Considering the first factor, the technical competence of the instructors, Volery and Lord (2000) report that the instructors must have adequate skills with the technology that will enable them to carry out teaching through the Internet. A lack of technological skills by instructors will be a significant hindrance to the adoption of the new learning technology (Papanikolaou and Mavromoustakos, 2006).

Another important factor for successful adoption of the system of m-Learning is instructor autonomy. One of the critical factors for success in adoption of an m-Learning system is the way an instructor uses m-Learning. When instructors who decide to use the new system of m-Learning encourage students to start appreciating the value of adopting the system the influence of the instructor will motivate students to use the technology in their studies. This happens because social influence is a determinant for adopting the new

technology, and it is important for students to receive encouragement to adopt new technology within their learning setting (Bhuasiri et al. 2012).

The assimilation of the m-Learning system with the curriculum is also a key factor in the success of adoption of the m-Learning system. If the Ministry of Education permits the m-Learning system to be included in the education system, the adoption of m-Learning will be quite successful. However, if the educational ministry does not acknowledge the system, it will be very challenging to adopt the mobile system in education (Adeyeye et al., 2013).

In addition, the availability of a user-friendly application design is another major factor that influences the adoption of the m-Learning system. Unlike standard computers, the user interfaces of mobile devices are extremely varied and designing a common user interface presents a challenge (Ali et al., 2014). This design should be able to be used with ease by both students and instructors when dealing with the system of m-Learning. Additionally, user-friendly design is perceived to positively correlate to the perceptions of instructors. That is, for users to choose the platform of m-Leaning, a user-friendly design is essential (Liaw et al., 2010)

Instructor community development, which refers to using the platform of m-Learning to connect with instructors and other learners (Alrasheedi and Capretz, 2013b), also plays an important role in adopting the m-Learning system. With this connection, adoption of m-Learning becomes effective because the instructor wants to keep contact with the students and that is only possible through the use of m-Learning (Sharples et al., 2009). Blended learning is another CSF in the adoption of the new technology. Al-Busaidi and Al-Shihi (2012) argue that students are involved in blended learning in which they learn at home through the home-grown learning management system (LMS). Blended learning is a key factor in adopting the system of m-Learning since students using blended learning cannot afford to do it without the use of the new learning technology of m-Learning.

5.2 Research Model and Hypothesis

This research is intended to present a research model for the assessment and analysis of the six factors (CSFs) that affect instructor perspectives regarding m-Learning adoption within higher education.

Figure 5.1 below shows the research model diagram. The model derives its theoretical foundations by combining the previous work by (Alrasheedi and Capretz, 2013b, 2014; Alrasheedi et al., 2015d). The model uses six CSFs: 1. The technical competence of instructors, 2. Instructor autonomy, 3. User-friendly application design, 4. Assimilation with curriculum, 5. Instructor community development, and 6. Blended learning. The dependent variable of this study is m-Learning adoption according to instructor perceptions of m-Learning. The six independent variables are referred to as CSFs hereafter.
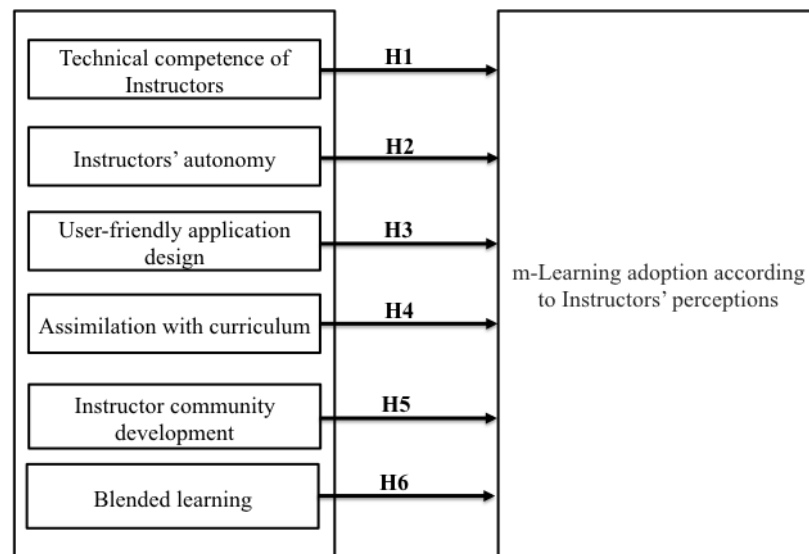
Figure 5.1 Research Model – Critical Success Factors Affecting the Success of m-Learning from Instructor Perspectives

Since instructors are at the very core of the learning process, it is essential that their views and ideas regarding a new learning platform are fully understood. In previous work (Alrasheedi and Capretz, 2015b), we found six factors that affect the overall attitude towards m-Learning. A detailed survey has been constructed to enable us to determine

the CSFs for m-Learning from the instructor perspectives, with the final objective of this research aiming to offer a response to the following question:

To what extent do various CSFs impact m-Learning adoption from instructor perceptions?

The multiple linear regression equation of the model of the answer is represented as follows:

m-Learning adoption from instructors' perceptions $= C_0 + C_1f_1 + C_2f_2 + C_3f_3 + C_4f_4 + C_5f_5 + C_6f_6$. (5.1)

In the equation C_0, C_1, C_2, C_3, C_4, C_5, and C_6 are coefficients and f_1, f_2, f_3, f_4, f_5, and f_6 are the six independent variables.

To empirically investigate the research question, the six hypotheses are presented below with a belief that they all positively affect m-Learning adoption according to the instructor perceptions as presented:

Hypothesis 1. Technical competence of instructors positively affects the m-Learning adoption according to instructor perceptions.

Hypothesis 2. The extent of instructor autonomy has a positive relationship with the m-Learning adoption according to instructor perceptions.

Hypothesis 3. User friendly design of the m-Learning platform is positively related to the m-Learning adoption according to instructor perceptions.

Hypothesis 4. Assimilation with the curriculum will directly affect the m-Learning adoption according to instructor perceptions.

Hypothesis 5. Perception of increased opportunities for learner community development and the m-Learning adoption according to instructor perceptions are positively related.

Hypothesis 6. The blended learning possibility will positively affect the m-Learning adoption according to instructor perceptions.

5.3 Research Methodology

The instructors are a vital component of the learning platform, not only as one of the two primary user groups of the platform, but also as the mentors for the other primary user group, the actual learners. In addition, as the designers of the course and the disseminators of the material instructors are the most important stakeholder in the m-Learning adoption process. This chapter looks to collate and analyze the views of instructors in a systematic method.

The methodology is presented in Figure 5.2 below. First, we systematically identified the factors contributing directly or indirectly to m-Learning adoption from the instructor perspectives. In order to do an empirical investigation of the key factors from the instructor perspectives, a research model was developed based on the key factors shown in Figure 5.1. Then a questionnaire was prepared and we conducted a survey to assess each key factor. Finally, we performed a statistical analysis of data on instructor perspectives. The data analysis was performed using Minitab v.17 as our quantitative analysis tool.

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┌─────────────────────────────────────────────────────────────┐
│  Systematic literature review to come up with the factors    │
│  that contribute directly or indirectly to factors from      │
│  instructor perspectives                                     │
└─────────────────────────────────────────────────────────────┘
                              │
┌─────────────────────────────────────────────────────────────┐
│  Empirical investigation of key factors from instructor      │
│  perspectives                                                │
└─────────────────────────────────────────────────────────────┘
                              │
┌─────────────────────────────────────────────────────────────┐
│  Development of a research model based on the key factors     │
└─────────────────────────────────────────────────────────────┘
                              │
┌─────────────────────────────────────────────────────────────┐
│  Preparation of questionnaires and conducting a survey to     │
│  perform assessment of each key factor                        │
└─────────────────────────────────────────────────────────────┘
                              │
┌─────────────────────────────────────────────────────────────┐
│  Statistical analysis of the instructor perspectives data     │
└─────────────────────────────────────────────────────────────┘
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Figure 5.2 Steps Representing the Research Methodology

5.4 Data Collection and the Measuring Instrument

To collect the data, we used an online survey tool (SoGoSurvey). The questionnaire was sent to various instructors teaching different undergraduate and post-graduate courses in five universities in Saudi Arabia based on the research ethics approval (Appendix IV). We received a total of 64 completed questionnaires.

The measuring instruments presented in (Appendix II) were used to study the perceived level of instructor satisfaction as well as the extent to which these CSFs were important for the instructors in adopting m-Learning. The questionnaire required participants to indicate the extent of their agreement or disagreement with statements using a five-point Likert Scale. For all of the items associated with each variable, the scale ranged from (1= Strongly Disagree, 2= Disagree, 3= Neither Agree or Disagree, 4=Agree, 5= Strongly Agree).

Our questionnaire had three parts:

1. The first part was used to determine the general profile of the respondents and consisted of questions regarding their gender, age group, and the level of students that they teach.

2. The second part was used to determine the extent to which instructors have accesses to mobile devices and the Internet, and their experience in using these devices in teaching.

3. The third part was used to determine the different factors that affect user perception of the m-Learning platform as below: Question 1- (technical competence of instructors), Question 2- (Instructor Autonomy), Question 3- (User Friendly design), Question 4- (Assimilation with curriculum), Questions 5-8- (Learner community development), Question 9 (Blended learning), and Questions 10-12 (Cumulative overall instructor perspectives).

5.4.1 Data Analysis Procedure

Firstly we started our data analysis by a descriptive analysis of demographic distribution of the population. Next, in order to analyze the research model and test the hypotheses, the data analysis procedure involved three phases. In phase one, a parametric correlation was found between the dependent and independent variables to see if any of the variables, i.e., hypotheses, can be accepted or rejected. The second phase was conducted to compute a non-parametric correlation using the same set of data in order to reduce the threat to external validity (Raza et al., 2012 a/b). Finally, the third phase involved testing the hypotheses by using the PLS technique.

5.4.2 Demographic Distribution of the Population

As mentioned earlier, the total population comprised 64 instructors. Of this, 47 were male and 17 were female. Furthermore, the population comprised instructors from different universities. The distribution was reasonably uniform. Only one of the instructors was under 25 years of age. A majority, i.e., 36 of the instructors, were between 36-55 years of age. The next largest age group was 26-35 years, which was 21 of the instructors. Only 6 instructors were over 55 years of age. An overwhelming majority of the instructors, i.e., 61 out of 64, were employed full-time; the remaining were employed part-time. In terms of the teaching levels, 48 instructors, or 75% of the research population, taught undergraduate classes, while the remaining 16 instructors, or 25% of the research population, taught post-graduate classes.

An essential component of the analysis of the demographics was to establish the level of mobile phone use within the user group, and the survey provided interesting data in this regard. All instructors owned a mobile phone, and a majority owned several devices, i.e., 59 of the instructors owned a smartphone or a PDA. Additionally, 55 instructors owned a desktop PC, while a significant majority, 62 instructors, owned a laptop, tablet, or notebook. All instructors had Internet installed on at least one of these devices, and a significant majority, i.e., 59, of the instructors had the Internet accessed on their mobile phones.

The extent of adoption of both mobile phones and Internet access among the instructors was incredibly high, displaying both awareness of the tools available and wide adoption of the mobile phone as a tool for accessing the Internet.
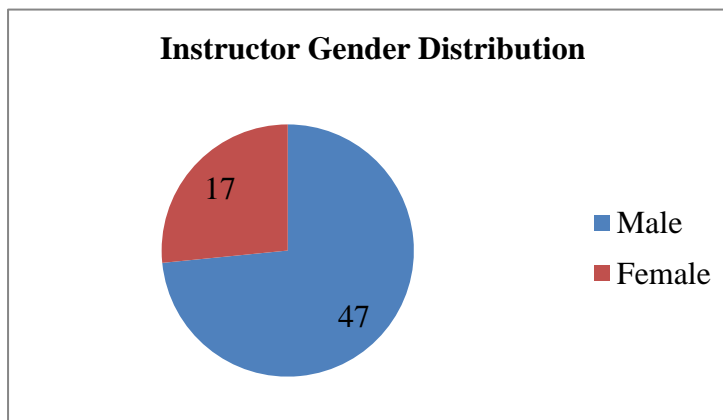
Figure 5.3 Respondent Gender Distribution (Instructors)

5.4.3 Reliability and Validity Analysis of Measuring Instrument

This m-Learning survey was created using a series of questions that looked to evaluate the attitude of the instructors towards the adoption of m-Learning. Five of these questions were straightforward involving single-item measurements. However, two of the questions involved multi-item rating scales: Instructors community development and the overall instructor perceptions; these two questions were also measured using three-item measurement. In all of these cases, it is important to assess the reliability of the measurement scales. This is done to quantify the reproducibility of a measurement and is performed using an internal consistency analysis – calculating the Cronbach's alpha. The limit of the satisfactory levels for this reliability coefficient has been determined by various types of research. Most of the existing work cites the Ven and Ferry study, which considers the coefficient of 0.55 and higher as satisfactory (Van de Ven and Ferry, 2008). Other work, such as the study by Osterhof (2001), however, suggest that a reliability coefficient of 0.6 minimum satisfaction is more appropriate. For this study, the reliability coefficient in all cases is > 0.7 to offer a reliable measuring instrument. Table 5.1 illustrates the values of Cronbach's alpha and PCA Eigen values applicable to the factors in question.

Table 5.1. **Cronbach's Alpha for Multi-Measuring Rating Scales**

Success Factors	Item Numbers	Cronbach's alpha	PCA Eigen Values
Technical competence of instructors	1	0.8145	1.688
Instructor autonomy	2	0.7936	1.658
User friendly design	3	0.7569	1.609
Assimilation with curriculum	4	0.7471	1.601
Instructor community development	5-8	0.7574	1.614
Blended learning	9	0.8218	1.700

Validity is defined as the strength of interference between the value of a measurement and its true value. Comrey and Lee's (2013) PCA was performed for all six CSFs, and reported in Table 5.1. Eigen value (Kaiser, 1970) has been used as a reference point, to observe the construct validity, using PCA. We used the Eigen Value One criterion, which is known as the Kaiser Criterion (Kaiser, 1960; Stevens, 1986) that indicated any component having an Eigen value more than one would be retained. The results of the study show that the Eigen value analysis of all 6 variables form a single factor, as seen in Table 5.1. Statistical analysis, therefore, shows that the convergent validity of the instrument for instructor perspectives on m-Learning adoption can be considered sufficient.

5.5 Hypothesis Tests and Results

The significant hypotheses, H1-H6, were analyzed within the research model using three statistical methods within three distinct phases. Phase I consisted of normal distribution tests and parametric statistics, while phase II used non-parametric statistics. Both parametric and non-parametric statistical approaches were used to reduce the threats to external validity. As our measuring instrument had multiple items for all the six independent variables as well as the dependent variable (shown in Appendix II), the ratings by the respondents were added up to get a composite value for each rating. Tests were conducted for hypotheses H1-H6 using parametric statistics by determining the Pearson correlation coefficient. For non-parametric statistics, tests were conducted for

hypotheses H1-H6 by determining the Spearman correlation coefficient. To increase the reliability of the results, hypotheses H1-H6 of the research model were tested using the PLS technique in Phase III. The results of the statistical calculation for the Pearson correlation coefficient are shown in Table 5.2 below. It is established that lower p-values signify a higher chance of rejecting the null hypothesis and, therefore, provide results of more meaningful statistical significance (Stigler, 2008). Here all p-values were below 0.05, demonstrating that the results hold significance.

Table 5.2. Hypothesis Testing Using Parametric Test

Hypothesis	Critical Success Factor	Pearson Correlation Coefficient	Spearman Correlation Coefficient
H1	Technical competence of instructors	0.689*	0.592*
H2	Instructor autonomy	0.658*	0.627*
H3	User friendly design	0.610*	0.582*
H4	Assimilation with curriculum	0.601*	0.564*
H5	Instructor community development	0.615*	0.552*
H6	Blended learning	0.701*	0.650*

*Significant at P < 0.05.

The results of the statistical calculation for the Pearson correlation coefficient are shown in Table 5.2. The lower the p-value, the better chance there is of rejecting the null hypothesis and, hence, the more significant is the result in terms of its statistical significance (Stigler, 2008). In the present case, all the p-values in both (Pearson Correlation Coefficient and Spearman Correlation Coefficient) are < 0.05, which indicate the significance of the results.

5.5.1 Phase I

The Pearson correlation coefficient between the technical competence of instructors towards m-Learning adoption was positive: 0.689 at P < 0.05, and, hence, hypothesis H1 is justified. For H2, the relationship between instructor autonomy and m-Learning adoption, the Pearson correlation coefficient was 0.658 at P < 0.05, and, hence, it was found to be significant as well. Furthermore, hypothesis H3 was accepted based on the Pearson correlation coefficient of 0.610 at P < 0.05, which represents the relationship between user-friendly design and m-Learning adoption. Similarly, in hypothesis H4, the

relationship between assimilation with curriculum and m-Learning adoption, the Pearson correlation coefficient was 0.601 at $P < 0.05$; hence, it was found to be significant and was accepted as well. Likewise, hypothesis H5 was accepted based on the Pearson correlation coefficient of 0.615 at $P < 0.05$, which represents the relationship between instructor community development and instructor perceptions towards m-Learning. Finally, the Pearson correlation coefficient between blended learning and m-Learning adoption was positive 0.701 at $P < 0.05$, and, thus, hypothesis H6 was accepted. Hence, as observed and reported, all hypotheses – H1, H2, H3, H4, H5, and H6 – were found to be statistically significant and were accepted.

5.5.2 Phase II

In the second step, non-parametric statistical testing was performed by examining the Spearman correlation coefficient including the individual independent variables, all CSFs, and the dependent variable, m-Learning adoption according to instructor perceptions, as shown in Table 5.2.

In phase II, a non-parametric statistical testing was conducted by examining the Spearman correlation coefficients between individual independent variables (CSFs) and the dependent variable (m-Learning adoption). The results of the statistical calculations for the Spearman correlation coefficients are also displayed in Table 5.2. The Spearman correlation coefficient between the technical competence of instructors and m-Learning adoption according to instructor perceptions was positive 0.592 at $P < 0.05$, and, hence, hypothesis H1 was justified. For hypothesis H2, which examined the relationship between instructor autonomy and m-Learning adoption, the Spearman correlation coefficient of 0.627 was observed at $P < 0.05$, which indicates that this hypothesis was also significant. Moreover, hypothesis H3 was accepted based on the Spearman correlation coefficient of 0.582 at $P < 0.05$, which is representative of a statistically significant relationship between user-friendly design and m-Learning adoption. For hypothesis H4, which involves the relationship between assimilation with curriculum and m-Learning adoption, the Spearman correlation coefficient was 0.564 at $P < 0.05$, which means it was found to be significant; consequently, it was accepted, also. Similarly, hypothesis H5 was accepted based on the Spearman correlation coefficient of 0.552 at P

< 0.05, which represents the relationship between instructor community development and m-Learning adoption according to instructor perceptions. The last hypothesis, H6, was accepted also, based on the Spearman correlation coefficient of 0.650 at P < 0.05, which represents the relationship between blended learning and m-Learning adoption according to instructor perceptions. Consequently, as observed and reported, all hypotheses H1, H2, H3, H4, H5, and H6 were found to be statistically significant and were accepted.

5.5.3 Phase III

For cross validation of the results that were obtained during Phases I and II, the PLS technique was utilized during Phase III. As put forward by Fornell and Bookstein (1982), the PLS technique is incredibly useful in a variety of situations including complexity, non-normal distribution, low theoretical information, and small sample sizes, and the adoption here ensures the increased reliability of the results.

Table 5.3. Hypotheses Testing Using Partial Least Square Regression (Instructor Perspectives)

Hypothesis	Factor	Path Coefficient	R^2	F-Ratio
H1	Technical competence of instructors	0.64	0.474	55.89*
H2	Instructor Autonomy	0.64	0.433	47.35*
H3	User friendly design	0.58	0.371	36.66*
H4	Assimilation with curriculum	0.53	0.361	35.06*
H5	Instructor community development	0.70	0.377	37.66*
H6	Blended learning	0.63	0.491	59.89*

Significant at P < 0.05

Within this PLS methodology, the dependent variable of the research model (m-Learning adoption according to the instructor perceptions) is considered as the response variable, and the independent variables (CSFs) are considered as predicators. The statistical results, which contain the observed values of the path coefficient R^2 and the F-ratio, are illustrated in Table 5.3. The technical competence of instructors is observed to be significant at P < 0.05, with a path coefficient of 0.64, an R^2 value of 0.47, and an F-ratio of 55.89. Instructor autonomy has a path coefficient of 0.64, an R^2 value of 0.43, and an F-ratio of 47.35. User-friendly design has the same direction as proposed in hypothesis

H3, with a path coefficient of 0.58, an R^2 value of 0.37, and an F-ratio of 36.66. Assimilation with curriculum has the same direction as proposed in H4 with a path coefficient of 0.53, an R^2 value of 0.36, and an F-ratio of 35.06. Instructor community development has a path coefficient of 0.70, an R^2 value of 0.37, and an F-ratio of 37.66. Finally, the variable of blended learning has a path coefficient of 0.63, an R^2 value of 0.49, and an F-ratio of 59.89. All the corresponding p-values related to F- ratios have been found significant at < 0.05.

5.5.4 Assessing the Research Model

A multiple linear regression equation for our research model was depicted earlier in Eq-5.1.

In order to determine the coefficients of the equation above we ran a multiple regression analysis. In addition to giving the model coefficient, the regression also gives the direction of association. As can be seen from the model Eq- 5.1, all the CSFs are assumed to have a positive association with user perception. The regression analysis will inform whether this is true in all cases. The results are given in Table 5.4 below.

Table 5.4. Multiple Regression Analysis of the Research Model

Critical Success Factor	Coefficient term	Coefficient value	t-value
Technical competence of instructors	f_1	0.217	1.62*
Instructor autonomy	f_2	0.237	1.55*
User friendly design	f_3	0.089	0.57**
Assimilation with curriculum	f_4	0.120	0.93**
Instructors community development	f_5	-0.222	-1.04**
Blended learning	f_6	0.336	2.71*

*Significant at P < 0.05. ** Insignificant at P >= 0.05*

Table 5.4 shows the multiple regression calculation results. The t-value for the technical competence of instructors and m-Learning adoption according to instructor perceptions was positive, 1.62 at $P < 0.05$, and, hence, it is significant. For the t-value between instructor autonomy and m-Learning adoption according to instructor perceptions was positive at 1.55 at $P < 0.05$, which indicates that it is significant. Besides, the t-value was 0.57 and the $P > 0.05$, illustrative of a statistically insignificant relationship between user-

friendly design and m-Learning adoption according to instructor perceptions. For H4, the relationship between assimilation with curriculum and m-Learning adoption according to instructor perceptions, the t-value was 0.93 at P > 0.05, which means it was found to be insignificant, too; consequently, it was also rejected. Similarly, hypothesis H5 was rejected since the t-value was found to be negative (-1.04) at P > 0.05, which represents the relationship between instructor community development and m-Learning adoption according to instructor perceptions. The last hypothesis, H6, was accepted, based on the t-value of 2.71 at P < 0.05, which represents the relationship between blended learning and m-Learning adoption according to instructor perceptions. Consequently, the results of the regression analysis offer interesting insights into the model. First, not all of the coefficients are positive. This means that CSFs – user friendly design, assimilation with curriculum, and instructor community development – all have negative association with instructor perceptions. This deviates from the expected relationship.

The final regression equation is as follows after fitting the model in equation (5.1):

$$m - Learning\ adoption\ according\ to\ Instructor\ perceptions =$$
$$1.174\ +\ 0.200\ (Technical\ competence\ of\ instructor) +$$
$$0.229(Instructor\ Autonomy\ ) +\ 0.077\ (User friendly\ design) +$$
$$0.119\ (Assimilation\ with\ curriculum) -$$
$$0.234\ (Instructor\ community\ development)\ + 0.330\ (Blended\ learning)$$

From the regression analysis, it is seen that the model accounts for 59.85% variability in the dependent variable, i.e., instructor perceptions.

5.6 Discussion of the Results

The use of the Internet was also universal and a majority of the population accessed the Internet from their mobile devices. The instructors were also found to be technically savvy and owned other devices such as a desktop PC, laptops, and tablet PCs. This clearly shows that lack of technical awareness is not an issue in the adoption of an m-Learning platform within the five Saudi universities.

In examining our results, data analysis started off with assessing the reliability of the instrument. This was done by conducting an internal analysis and by determining the Cronbach's Alpha for these multiple-items. It was found that the Cronbach's Alpha in all the cases was > 0.7. This is clearly much higher than even the recently determined higher threshold of 0.6. Hence, the averages of the response could be used for determining the individual variable coefficients in the research model.

The next step involved determining whether there was a correlation between the different independent variables and the dependent variables. In the present study, both parametric and non-parametric studies were carried out. This was to remove the threats to external validity. In all of the cases, the Spearman correlation coefficient was found to be somewhat lower than the Pearson correlation coefficient, though the correlations were always >0.4. More importantly, all the hypotheses were found to be statistically significant as the p-values in each case for both parametric and non-parametric correlation analysis were found to be < 0.05. This meant that in all cases there was a reasonable correlation between the various CSFs and the instructor perceptions based on the current data.

Once it was determined that the CSFs had statistically significant relationships with m-Learning adoption, according to instructor perceptions, the next step was to determine the regression model. It is at this point that the present study reached a hitch. First, in the case of the variable, instructor community development, the expected direction is negative. This means that in all these cases, the instructors believe that the CSF is inversely related to the success of m-Learning. One of the research studies in the literature review section points towards the attitude that instructors believe that mobile phones are disruptive to m-Learning, which might explain this attitude (Pollara, 2011). The prime objective of this work, to find out which factors have the greatest influence, was attributed to m-Learning adoption in the perspectives of the instructors; therefore, the statistical outcome confirms that the three factors are technical competence of instructors, instructor autonomy, and blended learning, which were found to be significant in the research model testing.

5.7 Limitations of the Study

Our study relies on an empirical investigation, this means that this study has certain limitations. In general, Wohlin et al. (2000) indicated that the external validity is the most common threat that limits researcher ability to generalize their experimental result to industrial practice, which is applicable in this study, too. We have ensured that specific measures have been taken to support external validity, and that includes our use of a random sampling technique that selects respondents from all departments to at least represent the general population of instructors within the university. Another limitation of this study involves its relatively small sample size. Although we sent our survey to a large number of instructors who were teaching in five universities (geographical limitation of Saudi universities), we only received 64 responses. Consequently, the relatively small number of responses was another potential threat to the external validity.

Furthermore, another aspect of validity concerns whether or not the study results correspond to previous findings. Our work involved the selection of six independent variables that related to the dependent variable of instructor perspectives. While there are other key factors that influence m-Learning adoption, the scope of this study was restricted to the area of m-Learning adoption from the perspective of instructors.

However, we followed the appropriate research procedures by conducting and reporting tests in order to improve the reliability and validity of the study, and certain measures were also taken to increase the external validity.

5.8 Conclusion

In this chapter, the key contribution of this work is a systematic investigation into the CSFs affecting m-Learning adoption from the perspective of instructors. As instructors are one of the vital user groups, it is important to understand the factors they consider crucial for the success of m-Learning. The results of our study showed that, according to instructors, only three out of the six factors analyzed – the technical competence of instructors, instructor autonomy, and blended learning – were found to be statistically significant. On other hand, user-friendly design, assimilation with the curriculum, and

instructor community development, all had insignificant association with the success of m-Learning. This empirical investigation provides us some justification to consider these key factors as metrics and measuring instruments for the MLMM. More details will be following in Chapter 7.

Chapter 6

6 Management Perspectives on CSFs Affecting M-Learning: An Empirical Investigation[6]

M-Learning is considered to be one of the fastest growing learning modes. The immense interest in m-Learning is attributed to the incredible rate of growth of mobile technology and its proliferation into every aspect of modern life. Despite this, m-Learning has not experienced a similar adoption rate in the educational sector, chiefly in higher education. Researchers have attempted to explain this anomaly by conducting several studies in the area. However, most of the research in m-Learning is examined from the perspective of the students and instructors. In this chapter, we contend that there is a third important stakeholder group whose opinion is equally important in determining the success of m-Learning: the university management (higher level management, academic management, department heads, deans, and IT system administrators). The results of the research show that the university commitment to m-Learning, university learning practices, and change management practices are the factors critical to the success of m-Learning from the perspective of university management.

6.1 Literature Review of CSFs from the Management Perspective

Several surveys conducted by researchers have shown that students are almost entirely in favor of adopting m-Learning at the university level (Alrasheedi et al., 2015d). Students tend to believe that this would definitely enhance their learning experience. However, it is interesting that statistics show this is not the case in practice. A 2010 survey conducted by Campus Computing showed that just about 13.1% of the universities surveyed had actually gone ahead and developed or enabled fully functioning m-Learning platforms

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[6] Part of this chapter has been submitted to the Journal of Educational Computing Research.

Alrasheedi, M., Capretz, L.F. & Raza, A. (2015b). Management's Perspectives on Critical Success Factors Affecting Mobile Learning in Higher Education Institutions - An Empirical Study, The Journal of Educational Computing Research, submitted March 2015, under review.

(Quinn, 2011). The obvious reason for this discrepancy between the interest of students and the actual adoption rate of an m-Learning platform, in light of the rapid growth of technology, is that some CSFs impacting the adoption rate have been left unexplored (Zeng and Luyegu, 2011).

It is true that students are the most important of the user groups and are the target focus as well, but they are by no means the only stakeholder group involved in decision making. There is a second stakeholder user group that is equally important – the instructors. A few researchers have also extended their research in this direction. In this group, the skepticism towards m-Learning platforms becomes more apparent (Alrasheedi and Capretz, 2014).

In this chapter, we propose a third stakeholder group that has been almost totally ignored in m-Learning research – the university management (higher level management, academic management department chairs, deans, and IT system administrators). Although they are the smallest group in terms of numbers, they serve as the primary decision makers for any major technology adoption and, hence, their opinions and concerns are very important. The purpose of this chapter is to present the assessment of the CSFs of m-Learning from the perspective of university management / administration.

6.1.1 Organizational Behavior and Organizational Management

Literature review has been performed by researchers on organizational theories (Ahmed and Capretz, 2010), organizational management (Ahmed and Capretz, 2007), and process evaluation (Ahmed et al., 2008). They conclude that there are six factors – organizational structure, organizational culture, organizational commitment, organizational learning, change management, and conflict management – that are the most critical factors to address when studying the organizational perspective. In this research, we adopted and applied the same factors in order to present a foundation for university management perspectives as independent factors presented in this work.

Organizational structure is described by Wilson and Rosenfeld (1990) as the well-known pattern of interactions among the parts of an organization, outlining communication in

addition to control and authority. As reported by Chatman and O'Reilly (1996) and Wilson (2001) the organizational culture is categorized as involving a set of shared values, beliefs, assumptions, and practices that form and guide the attitudes and behaviors of entities within the organization. Moreover, Rosen (1995) mentioned that the internal orientation of workers is constructed mainly on the culture, beliefs, ethics, and expectations of that organization's workers and, consequently, has the prospect of being one of the most influential factors in strategic management. Additionally, organizational commitment is a performance attitude that is associated with the level of staff member contribution and the intention to stay with the organization and is, accordingly, obviously associated with job performance (Mathieu and Zajac, 1990). Furthermore, organizational commitment has been summarized by Crewson (1997) as being a mixture of three recognizable factors relating to staff cooperation: first, a firm belief in and respect of the organization's goals and values; second, excitement to produce excellent work for the organization; and third, ambition to continue with the same organization.

Similarly, organizational learning is defined by Marquardt and Reynolds (1994) as a practice by which individuals acquire new skills and knowledge that govern their behavior and activities. Organizational change, as defined by Beckhard and Harris (1987), is considered to be an organization's drive from its current phase to a future or target phase. Additionally, Todd (1999) describes change management as a systematic method that presents a conceptual framework that includes process, politics, people, and strategy. Organizational change, according to Cao et al. (2000), illustrates the variety of an organization and demonstrates the combination of technical and human actions that have inter-related purposes within the organization. Finally, conflict management involves analytic processes, inter-personal types, negotiating strategies, and other involvements that are considered to avoid unnecessary conflict and lower or resolve excessive conflict (Ahmed et al., 2007).

6.2 Research Model and Hypothesis

For this study, a research model has been developed for assessing how and to what extent different factors affect the perception of university management regarding the success of m-Learning in tertiary higher education. We applied the six organizational factors derived

from Ahmed et al. (2007), to a literature review of organizational theories in addition to organizational management and behavior, in order to evaluate the university management perspectives. The factors and the relationship model are shown in Figure 6.1.
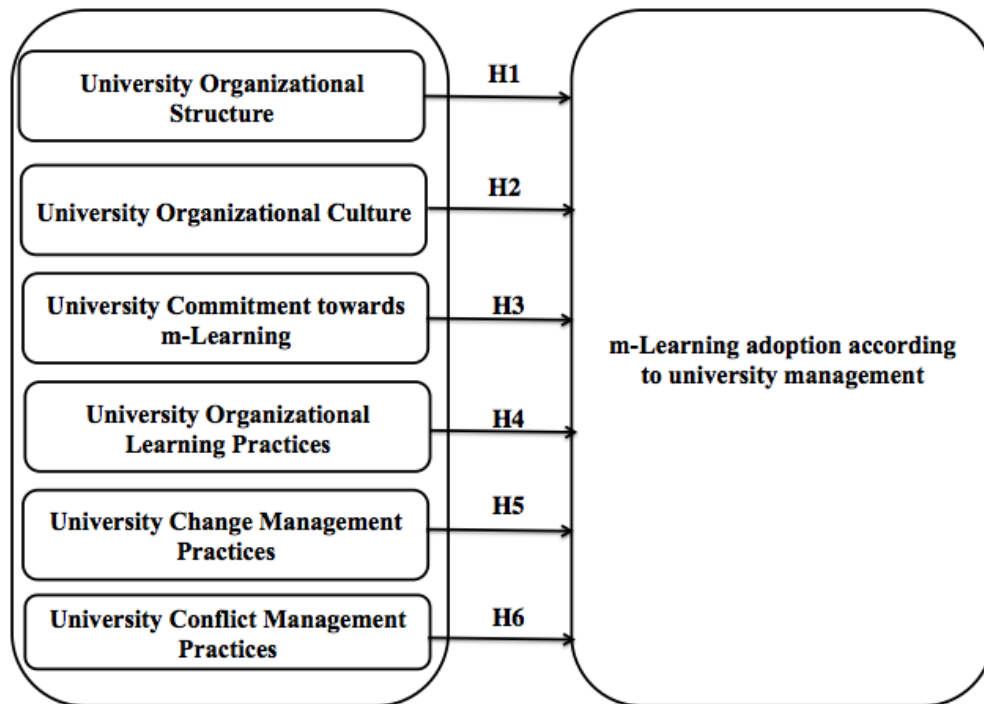
Figure 6.1 Research Model – Critical Success Factors Affecting the Success of m-Learning Adoption from the Perspective of University Management

To empirically investigate the research question, we derived the six hypotheses which are given below:

Hypothesis 1. The university organizational structure has a positive impact on m-Learning adoption, according to university management perspectives.

Hypothesis 2.   The university organizational culture has a positive impact on m-Learning adoption, according to university management.

Hypothesis 3. The university commitment towards m-Learning is positively related to m-Learning adoption, according to the perception of university management.

Hypothesis 4. The university organizational learning practices have a positive impact on m-Learning adoption, according to the perspective of university management.

Hypothesis 5. The university change management practices have a positive impact on m-Learning adoption, according to the perception of university management.

Hypothesis 6. The university conflict management practices have a positive relationship to m-Learning adoption.

University management is both the initial and final decision making authority for policies and practices. They are also responsible for platform upgrades, and as system administrators, they form one of the user groups of the system. In our research, we investigated all six factors that affect the overall attitude towards m-Learning adoption according to the perception of university management. To determine the management satisfaction levels we have conducted a detailed survey (as illustrated in Appendix III) for assessing the factors affecting perception of university management regarding the success of the m-Learning platform.

Overall the objective of the research was to determine the answer to the following question:

"To what extent do the CSFs have an impact on m-Learning adoption based on the perception of university management?"

6.3 Research Methodology

For collecting the data, an electronic questionnaire was sent to upper-level managerial staff working in various departments within the five universities in Saudi Arabia based on the research ethics approval (Appendix IV). The responses and personal details of the respondents were kept confidential as per the ethical guidelines of the research. We received a total of 24 completed questionnaires from three out of five universities. The characteristics of users and their response pattern is analyzed in the data analysis section below.

6.3.1 Data Collection and the Measuring Instrument

As mentioned above, the present study involved getting responses from the university management level regarding their opinions on the issues affecting the success of m-Learning within their institution, and assessing their views on the subject. The data analysis was performed using quantitative tools, specifically Minitab v.17.

The measuring instruments presented in (Appendix III) were used to study the perceived level of management satisfaction as well as the extent to which these CSFs were important for the management in adopting m-Learning. The questionnaire required participants to indicate the extent of their agreement or disagreement with statements using a five-point Likert Scale. For all of the items associated with each variable, the scale ranged from (1=Strongly Disagree, 2= Disagree, 3= Neither Agree or Disagree, 4=Agree, 5= Strongly Agree).

6.3.2 Reliability and Validity of Measuring Instrument

As the present survey was comprised of a set of demographic information, the questionnaire comprised a series of questions to determine the validity of the six hypotheses illustrated in Figure 6.1.

In each of the six hypotheses, the overall factor was determined using multi-item scales. Further, the dependent variable (m-Learning adoption) also comprised multi-item scales. Hence, in all these cases it was important to assess the reliability of the measurement scales. This was done to quantify the reproducibility of a measurement and was performed using an internal consistency analysis by calculating the Cronbach's Alpha. Satisfactory levels of this coefficient are reported to be 0.55 or higher by Van de Ven and Ferry (2008) and 0.6 and higher by Osterhof (2001). In our case, the reliability coefficient in all cases is > 0.7, which means that the measuring instruments used are highly reliable.

Table 6.1. Cronbach's Alpha for Multi-Measuring Rating Scales

Factors	Item Numbers	Cronbach's Alpha	PCA Eigen Value
University organizational structure	H1	0.8089	1.051
University organizational culture	H2	0.8922	1.038
University commitment to m-Learning	H3	0.8436	1.456
University organizational learning practices	H4	0.8849	1.402
University change management practices	H5	0.9141	1.399
University conflict management practices	H6	0.7299	1.315

The PCA was obtained for all six factors as reported in Table 6.1 (Kaiser, 1970). He argued that the Eigen Value was used as an indication point to identify the construct validity with PCA. We used the Eigen Value One criterion, which is known as the Kaiser Criterion (Kaiser, 1960; Stevens, 1986), which indicated that any component having an Eigen value greater than one should be retained. Eigen-value analysis revealed that all six variables form a single factor, as presented in Table 6.1. Consequently, based on our statistical analysis, the convergent validity of our measuring instrument can be considered as sufficient.

6.3.3 Data Analysis Procedure

For the present study, the data analysis process consisted of the following three steps. In the first step, a statistical check was performed to determine if there was a parametric correlation between the dependent variable and the independent variable. This was done to check if any of the CSFs or hypotheses could be accepted statistically. In the second step, a non-parametric test was conducted between the dependent and independent variables. This was done in order to reduce the external validity threat (Raza et al., 2012 a/b). The third and final step of the statistical analysis comprised the regression analysis. This was done in order to determine the regression equation as discussed in the following section, which gives the value and sign of the coefficients for each of the variables.

6.4 Hypothesis Test and Result

Before conducting the regression analysis, statistical tests were conducted to determine whether the relationships between the dependent variable and various independent variables were significant. This was done for each of the six hypotheses, using both

parametric and non-parametric tests, by examining the Pearson and Spearman correlation coefficients. Further, it is a known fact that the lower the p-value the better chance there is of rejecting the null hypothesis and, hence, the result in terms of its statistical significance is more significant (Stigler, 2008). These two values were tested. The results are shown in Table 6.2 below.

Table 6.2. Hypothesis Testing Using Parametric Test and Non-Parametric Statistical Testing

Hypothesis	Critical Success Factors	Pearson Coefficient	Spearman Coefficient
H1	University organizational structure	-0.051*	0.127*
H2	University organizational culture	-0.039*	0.108*
H3	University commitment towards m-Learning	0.457**	0.407**
H4	University organizational learning practices	0.402**	0.457**
H5	University change management practices	0.399**	0.420**
H6	University conflict management practices	0.316*	0.238*

** Significant at $P < 0.05$. * Insignificant at $P > 0.05$.

The results of the research show that the three factors – university commitment to m-Learning, university learning practices, and change management practices – were critical to the success of m-Learning from the university management perspective.

Hypothesis H1, which denotes the relationship between the university organizational structure and m-Learning adoption, yields a Pearson correlation coefficient of (-0.051) at $P = 0.27$, and thus, this hypothesis is statistically insignificant; consequently, it was rejected. For H2, the relationship between the university organizational culture and the m-Learning adoption, the Pearson correlation coefficient was (-0.039) at $P > 0.05$; hence, it was found to be insignificant and, consequently, was rejected as well. The Pearson correlation coefficient between the university commitment towards m-Learning and m-Learning adoption was positive (0.457) at $P < 0.05$, and, hence, hypothesis H3 is justified. For H4, the relationship between university organizational learning practices and the m-Learning adoption, the Pearson correlation coefficient was 0.402 at $P < 0.05$, and, hence, it is found to be significant as well. Furthermore, hypothesis H5 was accepted based on the Pearson correlation coefficient of 0.399 at $P < 0.05$, which represents the

relationship between the university change management practices and the m-Learning adoption according to the perception of university management. Contrary to that, hypothesis H6 was rejected based on the Pearson correlation coefficient of 0.316 at P > 0.05, which represents the relationship between the university conflict management practices and the m-Learning adoption according to the perception of university management. Hence, as observed and reported, hypotheses H3, H4, and H5 were found to be statistically significant and were accepted, while H1, H2, and H6 were not supported and were, consequently, rejected.

In the second phase, non-parametric statistical testing was conducted by examining the Spearman correlation coefficient among the individual independent variables, the CSFs, and the dependent variable – m-Learning adoption according to the perception of university management – as displayed in Table 6.2.

Initially, for hypothesis H1, which involves university organizational structure and the m-Learning adoption, the Spearman correlation coefficient of 0.127 was observed at P >0.05. Since no significant relationship was found between the university organizational structure and the m-Learning adoption, H1 was rejected.

For H2, the relationship between the university organizational culture and the m-Learning adoption, the Spearman correlation coefficient was (0.108) at P > 0.05, and, hence, it was found to be insignificant; consequently, it was rejected too. The Spearman correlation coefficient between the university commitment towards m-Learning and the m-Learning adoption was found to be positive (0.407) at P < 0.05, and hence, hypothesis H3 was justified. For hypothesis H4, which examined the relationship between university organizational learning practices and the m-Learning adoption, the Spearman correlation coefficient of 0.457 was observed at P < 0.05, and, hence, this hypothesis is significant. Moreover, hypothesis H5 was accepted based on the Spearman correlation coefficient of 0.420 at P < 0.05, demonstrating a statistically significant relationship between university change management practices and the m-Learning adoption as per the perception of university management.

Finally, hypothesis H6 was rejected based on the Spearman correlation coefficient of 0.238 at $P > 0.05$, which represents the relationship between the university conflict management practices and the m-Learning adoption according to the perception of university management.

Hence, as observed and reported, H3, H4, and H5 were found to be statistically significant and were accepted, though H1, H2, and H6 were not supported and, hence, rejected in both parametric and non-parametric analyses.

6.5 Testing of the Research Model Using Regression Analysis

The multiple linear regression equation of the model is as follows:

University management perception $= c_0 + c_1f_1 + c_2f_2 + c_3f_3 + c_4f_4 + c_5f_5 + c_6f_6$. (6.1)

In the equation c_0, c_1, c_2, c_3, c_4, c_5, and c_6 are coefficients and f_1, f_2, f_3, f_4, f_5, and f_6 are the six independent variables.

In order to determine the coefficients of the equation above, we ran a regression analysis. As can be seen from the model equation, all the CSFs were assumed to have a positive association with the m-Learning adoption as per the perception of university management by default. The results are given in Table 6.3 below.

The results of the regression analysis offer interesting insights into the model. First, not all the coefficients are positive. This means that three CSFs – university organizational structure, university organizational culture, and university conflict management practices – all have negative association with university management's perception. This deviates from the expected relationship. The final regression equation is as follows (6.1):

$$m - Learning\ adoption\ as\ per\ University\ management\ perception$$

$$= 3.420 - 0.162(organizational\ structure)$$

$$- \ 0.051(organizational\ culture) + 0.389(commitment)$$

$$+ 0.263(learning\ practices)$$

$$+ 0.036(change\ managment\ practices)$$

$$- 0.334(conflict\ managment\ practices)$$

From the regression analysis, it is seen that the model accounts for only 37.01% variability in the dependent variable, i.e., m-Learning adoption.

Table 6.3. Multiple Regression Analysis of the Research Model

Critical Success Factor	Coefficient term	Coefficient value	t-value
University organizational structure	f_1	-0.162	-1.37**
University organizational culture	f_2	-0.051	-0.45**
University commitment towards m-Learning	f_3	0.389	1.66*
University organizational learning practices	f_4	0.263	1.71*
University change management practices	f_5	0.036	0.20*
University conflict management practices	f_6	-0.334	-1.13**

*Significant at P < 0.05. ** Insignificant at P >= 0.05*

6.6 Discussion

The data analysis section started with a detailed analysis of the demographic variables. This gives a snapshot of the population dynamics and characteristics. As the sample population of the study is only 24, it is not advisable to take this snapshot as a feature of management staff and their responses in a generic university setting. However, this can be taken as a case study. This is also one of the reasons demographic interrelationships have not been analyzed statistically as part of this study.

As all variables in the study comprised responses from multiple items in the survey, the reliability of the measuring instrument was tested first. This was done by determining the

Cronbach's alpha for these multiple items. It was found that the value of Cronbach's alpha was, in most cases, > 0.7. As this is higher than the acceptable threshold of 0.6, using the average response for determining the individual variable coefficients could be done.

The next step was to determine if each of the independent-dependent variable pairs were correlated by finding out correlation coefficients. Both parametric and non-parametric studies were carried out to remove threats to external validity. It was found that the variables – university organizational structure, university organizational culture, and university conflict management practices – were not statistically significant as the p-values in each case were significant at > 0.5.

Following this step, all six CSFs were used for determining the regression model. It was found that the sign of the coefficients was negative for the three variables – university organizational structure, university organizational culture, and university conflict management practices. Interestingly, all other relationships were found to be positive though none of them had coefficients higher than 0.4. Also, the highest correlation value was for university commitment to m-Learning followed by university learning practices and change management practices. So the results of the chapter show that university commitment to m-Learning, university learning practices, and change management practices are the factors critical to the success of m-Learning from the university management perspective.

6.7 Limitation of the Study

Empirical studies are subject to some limitations. In our study, the first limitation is the selection of independent factors. Only six independent variables were used to relate to the dependent variable of university management perspective. Although other factors might influence the university management perspective in addition to these six, we maintained the scope of this study within organizational management and behavior as a base for the theoretical foundation. Despite the detailed nature of statistical analysis, this study has not explored the entire interrelationship between the demographic factors and the university management perception of the adoption of m-Learning within a tertiary

learning institutions. Some factors – such as gender, age group, management level, and even the department where the staff worked – might have an impact on the adoption of the new platform. Another limitation of this study involves its relatively small sample size and representatives from only from three Universities in Saudi Arabia.

The next step would have been the analysis of these variables. This means that, based on the present results, a further study on how various demographic variables might have affected the perception of factors affecting m-Learning is redundant at this stage.

6.8 Conclusion

The management level in a university is generally the ultimate authority regarding all decisions about if, when, and how a new learning platform has to be adopted. This research facilitates better understanding of the university management perspective about m-Learning adoption. Our main objective in this part of the research was to empirically investigate the effect of university factors on the adoption of m-Learning and find answers to the research question put forward in this investigation. Results of the research show that university commitment to m-Learning, university learning practices, and change management practices were the factors critical to the adoption of m-Learning from the university management perspective. A deeper understanding about the thought process of management staff is sure to help the adoption process of m-Learning. This was the core purpose behind conducting a study in this area.

The results of this investigation provide empirical evidence and further support the theoretical foundations that in order to have m-Learning within a university, the stated factors play an important role. This empirical investigation provides us some justification to consider these key factors as metrics and measuring instruments for an MLMM; more details will following in chapter 7.

Chapter 7

7   M-Learning Maturity Model[7]

The innovation of the 21th century managed to bring about greater advancements in technology, such as mobile devices, and these have provided great opportunities to enhance, endow, and broaden the educational experience. Mobile computing is dynamic and is developing at a rapid pace by providing quality, efficiency, and ease of use. It is also helping in delivering learning content and expanding learning experience through the use of different applications that are widely and constantly available for mobile devices. Improvements in smartphones and tablets have provided great help in education. These innovative improvements and capabilities are of vital importance in m-Learning. Consequently, this chapter presents MLMM, which examines the degree of coordination between m-Learning adoption and the CSFs of m-Learning. The measuring instrument of the MLMM contains factors that have been selected from three of our empirical studies, which examine the perspectives of students, instructors, and university management, as described in chapters 4, 5, and 6 respectively. In addition to presenting the MLMM, this chapter discusses assessment questionnaires, a rating methodology, and two case studies.

7.1 Theoretical Framework

The process of innovation is an uncertainty reduction process. The five attributes of innovations that are helpful in decreasing uncertainty about the innovation are

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[7] Part of this chapter was published in i-Society and the sixth international conference of MIT's learning international networks consortium, and extended version has been submitted to IEEE Transactions on Emerging Topics in Computing.

1. Alrasheedi, M., & Capretz, L. F. (2013c). An M-Learning Maturity Model for the Educational Sector, the Sixth International Conference of MIT's Learning International Networks Consortium, MIT, Cambridge, Massachusetts, USA, June 16-19, 2013.

2. Alrasheedi, M., & Capretz, L. F. (2013a). Applying CMM Towards a Mobile Learning (M-Learning) Context, IEEE International Conference on Information Society, Toronto, Canada, June 24-26, pp. 146 -153.

3. Alrasheedi, M., Capretz, L. F. & Raza, A. (2015c). Mobile Learning Maturity Model, *in preparation*.

complexity, trialability, relative advantage, compatibility, and observability. The rate of adoption of innovations is predicted by an individual's perceptions of these characteristics (Rogers, 2010). The rate of innovation is the relative speed with which members of a social system adopt an innovation. Optional and personal innovations are adopted faster than the innovations that involve a collective innovation decision or an organizational decision (Rogers, 2010).

Complexity: The degree of difficulty which an innovation is recognized to comprehend and utilize is complexity (Rogers, 2010). A technological innovation can be challenging in the sense of changing the technique and teaching methodology for faculty members for their instruction to be integrated with the innovation. So innovations can have diverse levels of complexity.

Trialability: The degree to which an innovation can be tested is trialability. Trialability is also positively correlated to the adoption rate (Rogers, 2010).

Relative Advantage: The degree to which an innovation may make a distinction better than the scheme it delivers is relative advantage (Rogers, 2010). Different elements of relative advantage include the social status motivation and cost. Faculty members adopt the technology when they are facing new demands (Casmar, 2001). Technology should be provided by the faculty when there is a need to provide helpful experience.

Compatibility: Relative advantage and compatibility, although they are conceptually different, have been viewed as similar in some research if the innovation is perceived to be consistent with past experience, potential adopter needs, and existing values (Rogers, 2010). There would be a negative effect of the use of IT by the individual if no compatibility exists.

Observability: This is the last characteristic of innovations, and it is the extent to which the outcome of an innovation is discernible to others (Rogers, 2010). In other words, the innovations that are understood to offer more compatibility, trialability, observability, relative advantage, and simplicity are adopted faster than other innovations.

So the proposed framework of MLMM based on our previous studies (Alrasheedi et al., 2015d; Alrasheedi et al., 2015a; Alrasheedi et al., 2015b) with different perspectives, show a total of nine significant CSFs evaluated as a part of study along with measurement of perspectives of the university management, instructors, and students towards the adoption of m-Learning. In Chapter 4, three factors were found to be significant from student perspectives; they are increased productivity, learning made interesting, and Internet access. Three significant factors from instructor perspectives given in Chapter 5 are the technical competence of the instructor, blended learning, and instructor autonomy. Results of the study as discussed in Chapter 6 show that university commitment to m-Learning, university learning practices, and change management practices are the factors critical to the adoption of m-Learning from the university management perspective. These nine CSFs from the theoretical framework that can be assigned to the attributes of innovations are given in Table 7.1 below. Further, we can see that the following types of decisions can be attributed to these CSFs:

- Authority decision – Technical competence of instructors, university commitment to m-Learning, and blended learning.
- Collective decision – Internet access, university learning, and change management practices.
- Personal decision – Increased productivity, instructor autonomy, and learning made interesting.

Table 7.1. Framework of m-Learning Maturity Model

No.	Dimension	Practice No.	CSFs of m-Learning
1	Relative Advantage	1	Learning made interesting
		2	Increased productivity
2	Compatibility and Complexity	3	Blended Learning
		4	University learning practices
		5	Internet access
3	Trialability	6	Instructor autonomy
		7	University commitment to m-Learning
4	Observability	8	Change management practices
		9	Technical competence of instructors

Table 7.1 also shows the set of four dimensions that incorporate the nine different success factors.

The degrees to which management and faculty members are in agreement with each statement in the questionnaire determine the m-Learning maturity of the university. Each factor will be identified by the use of the following set of abbreviations: learning made interesting (LMI), increased productivity (IP), blended learning (BL), university learning practices (ULP), Internet access (IA), instructor autonomy (IAU), university commitment to m-Learning (UC), change management practices (CMP), and technical competence of instructors (TCI).

7.2 Mobile Learning Maturity Model

The five proposed levels of the MLMM and the questionnaire for each level are listed below. The questionnaires were also scrutinized and improved by taking into consideration comments provided by m-Learning and e-Learning experts from the Faculty of Education and the Teaching Support Center at Western.

7.2.1 First Level: Preliminary

This level is known as the preliminary level and it could be one of two cases. In the first one, universities and the institutions do not consider mobile devices to be important in the provision of their services and products. The second case is a reactive and experimental stage that, once initiated by the learning institution, recognizes the need to improve the provision of information to students through mobile devices.

In this level, the institution has a pilot program for implementation but there is the lack of a vision to guide the implementation. The institution does not develop measures to facilitate the implementation of the prototypes. Although this is done experimentally it can be hampered for a number of reasons. For instance, the mobile device coverage might be limited or students might not understand the value of the m-Learning environment.

7.2.2 Second Level: Established

The next m-Learning maturity level, defined as the established level, is based on the recognition of the opportunity provided by mobile devices in the education system and, particularly, in blended learning. This resulted in the investment of m-Learning technologies to realize the opportunities where students and instructors find it interesting to use mobile devices for academic purposes. In this stage, institutions prepare several objectives to guide m-Learning implementation and offer an Internet connection with sufficient bandwidth to support students using an m-Learning platform. However, those institutions do not have m-Learning mechanisms to evaluate their systems. This brings the need for improvements to the existing and implemented pilot prototypes. The following measuring instrument uses nine m-Learning CSFs to illustrate the set of statements that must be satisfied for m-Learning maturity to achieve this level.

MF.2.1 Learning Made Interesting

S.2.1.1 Students and instructors find it interesting to use mobile devices for academic purposes.

S.2.1.2 University management is working on a strategy to acquire student and instructor perspectives.

MF.2.2 Increased Productivity

S.2.2.1 University management realizes that m-Learning success is mainly dependent upon student responses and feedback.

S.2.2.2 There is still a lack of guidelines in m-Learning implementation.

MF.2.3 Blended Learning

S.2.3.1 Instructors and students are acquiring knowledge about the domain of m-Learning.

S.2.3.2 About 30% of the courses use a blended learning model.

MF.2.4 University learning practices

S.2.4.1 Faculty members share knowledge and experience by having discussions with each other.

S.2.4.2 Formal training periods are scheduled to impart knowledge about m-Learning.

MF.2.5 Internet access

S.2.5.1 The university offers an Internet connection with sufficient bandwidth to support students using an m-Learning platform.

MF.2.6 Instructor autonomy

S.2.6.1 Instructors are generally willing to improve their way of teaching through m-Learning.

MF.2.7 University commitment to m-Learning

S.2.7.1 M-Learning is considered as an option in the strategic plans of the organization.

S.2.7.2 On average, faculty members remain in the university for more than three years.

S.2.7.3 Decision makers are working on a strategic plan to enhance the operability of their m-Learning.

MF.2.8 Change management practices

S.2.8.1 Most of the m-Learning changes introduced to the university are on an ad hoc and as-needed basis.

S.2.8.2 Changes in m-Learning functionalities are documented.

S.2.8.3 m-Learning plans are reviewed frequently and updated based on new released software and student orientations.

MF.2.9 Technical Competence of Instructors

S.2.9.1 Difficulties faced by instructors in reporting errors related to m-Learning are realized by the development team.

S.2.9.2 The m-Learning development team is working on plans to provide end instructors with a convenient way to report any defect in the m-Learning system.

7.2.3 Third level: Defined

In the defined level, a mobile device is considered as a critical tool in the interaction among students, instructors, and administrative staff. Learning institutions must link their m-Learning strategies with core and technical visions, and they must invest heavily in this type of system to achieve success. The university has a well-defined change management plan by establishing clear guidelines to reach the desired level of success. The measuring instrument for assessing the m-Learning maturity, when it is at the "defined" level, is illustrated below.

MF.3.1 Learning Made Interesting

S.3.1.1 The mobile device is considered as a critical tool in the interactions among students, instructors, and administrative staff.

S.3.1.2 University management link their m-Learning strategies with core and technical visions and a systematic procedure has been defined to gather both student and instructor feedback.

MF.3.2 Increased Productivity

S.3.2.1 Instructors collect and analyze feedback from most of the students involved in the m-Learning in order to evaluate student productivity.

S.3.2.2 A planned strategy has been developed for m-Learning management to measure student progress in order to increase their productivity.

MF.3.3 Blended Learning

S.3.3.1 Instructors and students are committed to acquire knowledge about the domain of m-Learning.

S.3.3.2 At least 40% of instructors have adequate resources to allocate some amount of interaction by m-Learning within blended classes.

MF.3.4 University learning practices

S.3.4.1 Necessary training for m-Learning is provided to faculty members.

S.3.4.2 Faculty members have opportunities to participate in problem solving and idea generation activities for m-Learning.

S.3.4.3 Faculty members have access to information from external resources, and management encourages experimenting with such knowledge to improve the m-Learning.

S.3.4.4 The university encourages faculty members to join formal and informal discussion forums for m-Learning outside the university.

MF.3.5 Internet access

S.3.5.1 The university offers free mobile broadband for instructors and students enrolled in any course delivered through m-Learning.

MF.3.6 Instructor autonomy

S.3.6.1 At least 30% of the instructors make their own pedagogical choices by using the m-Learning platform.

S.3.6.2 Instructors also encourage students to make use of the m-Learning platform.

MF.3.7 University commitment to m-Learning

S.3.7.1 Weak areas related to m-Learning operability are identified and essential steps are taken for improvement.

S.3.7.2 Keeping in mind student limitations, faculties have developed a strategic plan to enhance the operability of their m-Learning.

MF.3.8 Change management practices

S.3.8.1 The university has a well-defined change management plan to switch from a bad m-Learning platform to a better system.

S.3.8.2 Resistance to changes within the university is gradually decreasing.

S.3.8.3 The change management plan is well communicated to all faculty members of the university.

MF.3.9 Technical Competence of Instructors

S.3.9.1 At least 30% of the instructors have acquired sufficient knowledge and technical abilities to use the m-Learning system.

S.3.9.2 Difficulties faced by instructors in using m-Learning functionality are recorded and maintained by the development team.

7.2.4 Fourth Level: Structured

In the structured level, m-Learning is characterized by optimization and innovation. The optimization results in a rich, dynamic, and flawless experience for students and instructors in the use of the system. The university uses techniques to refine procedures and policies to control any changes experienced in m-Learning that help and increase student and instructor engagement. The use of mobile device applications allows students to provide feedback, give comments, and share information. As a result, institutions refine and improve procedures and policies to control any changes experienced in mobile

changes. The following measuring instrument illustrates the set of statements designed for Level 4.

MF.4.1 Learning Made Interesting

S.4.1.1 The use of mobile device applications allows students to provide feedback, give comments, and share information.

S.4.1.2 The university uses techniques to refine procedures and policies to control any changes experienced in m-Learning; these techniques help and increase student and instructor engagement.

MF.4.2 Increased Productivity

S.4.2.1 Student feedback measures are recorded and maintained regularly.

S.4.2.2 A m-Learning strategy has been implemented to increase student productivity.

MF.4.3 Blended Learning

S.4.3.1 Instructors and students have successfully adopted an m-Learning platform in their blended classes.

S.4.3.2 At least 60% of the instructors have allocated some amount of time to interaction by m-Learning within blended classes.

MF.4.4 University learning practices

S.4.4.1 Formal and informal mechanisms are used to disseminate learning and knowledge within the university / department.

S.4.4.2 The university / department learns from its experience and avoids repeating its mistakes.

S.4.4.3 The innovations to m-Learning are aligned with the existing educational goals of the university / department.

MF.4.5 Internet access

S.4.5.1 Free Internet access is available to all instructors, staff, and students to encourage use of m-Learning.

MF.4.6 Instructor autonomy

S.4.6.1 Instructors use more varied m-Learning applications to meet the specific learning needs of their students.

S.4.6.2 At least 60% of the instructors collect feedback to improve work quality related to m-Learning.

MF.4.7 University commitment to m-Learning

S.4.7.1 Faculty members feel a sense of belonging to the university.

S.4.7.2 Faculties consider m-Learning to be a vital entity to achieve their long-term goals.

S.4.7.3 Metrics have been developed to quantitatively measure the m-Learning operability level.

MF.4.8 Change management practices

S.4.8.1 The m-Learning change management plan is implemented to increase its attractiveness.

S.4.8.2 Faculties understand the importance and impact of change with respect to m-Learning.

S.4.8.3 Student feedback about the m-Learning practices is collected and maintained regularly.

MF.4.9 Technical competence of instructors

S.4.9.1 At least 50% of instructors have sufficient knowledge and technical abilities to use and improve the m-Learning system.

S.4.9.2 The m-Learning development team monitors the use of m-Learning for an effective and easy way of reporting system defects in the m-Learning system.

7.2.5 Fifth Level: Continuous Improvement

Finally, the highest m-Learning maturity level is the continuous improvement level. In this stage, a mobile offering has already been accepted as the best approach to provide knowledge and exchange of information between students and instructors. In this stage, institutions are constantly evaluating themselves to ensure continuous improvement and optimization. This helps to identify any changes that might limit or change the manner in which m-Learning is used. The following measuring instrument illustrates the set of statements that must be satisfied for a university to achieve this level.

MF.5.1 Learning Made Interesting

S.5.1.1 m-Learning has already been adopted to provide knowledge and exchange of information between students and instructors.

S.5.1.2 Incorporating requirements from students and instructors has become an essential part of the m-Learning development team to improve the m-Learning platform.

MF.5.2 Increased Productivity

S.5.2.1 Regularly collected feedback is used to improve m-Learning quality to increase student productivity.

S.5.2.2 A well-established measurement matrix is kept to regularly record m-Learning strategy outcomes and take appropriate actions based on these outcomes.

MF.5.3 Blended Learning

S.5.3.1 Instructors are committed to m-Learning and adopt most practices in their teaching (regardless of teaching approach) in an equal mix of face-to-face setting and blended classes.

S.5.3.2 The m-Learning practices are used to generate new and innovative ideas for teaching in blended classes.

MF.5.4 University learning practices

S.5.4.1 Research in m-Learning is a continuous process within the university / department.

S.5.4.2 The university / department is committed to improving the level of knowledge in m-Learning.

S.5.4.3 The university / department has successfully used innovations in the m-Learning platform.

MF.5.5 Internet access

S.5.5.1 The university makes efficient use of the Internet by implementing a state of the art infrastructure to provide high-speed Internet access for all instructors, staff, and students. The university also provides eduroam network services[*].

[*]Eduroam: "*(education roaming) is an international roaming service for users in research, higher education and further education. It provides researchers, teachers and students easy and secure network access when visiting an institution other than their own. Authentication of users is performed by their home institution, using the same credentials as when they access the network locally, while authorization to access the Internet and possibly other resources is handled by the visited institution. Users do not have to pay for using eduroam.*"
(Wikipedia, 2015)

MF.5.6 Instructor autonomy

S.5.6.1 All instructors provide an interactive help to students to improve student learning in classes.

S.5.6.2 At least 80% of the instructors collect feedback from students and peers to improve work quality related to m-Learning.

MF.5.7 University commitment to M-Learning

S.5.7.1 The University strategic planning includes consideration of m-Learning as being an important and even strategic asset and provides a special fund to support m-Learning.

S.5.7.2 Faculties share a high degree of commitment to make the university's strategic vision a reality.

MF.5.8 Change management practices

S.5.8.1 The university / department regularly conducts reviews of the changes made in the m-Learning practice.

S.5.8.2 The university is constantly evaluating its m-Learning practice to ensure continuous improvement and optimization.

MF.5.9 Technical competence of instructors

S.5.9.1 At least 75% of instructors have sufficient knowledge and technical abilities to use and improve the m-Learning system.

S.5.9.2 The m-Learning development team regularly responds, maintains, and improves the already developed functionalities for effective and easy use of the m-Learning platform.

Table 7.2 summarizes the number of items in the assessment questionnaires for each CSF related to all five maturity levels.

Table 7.2. Framework of m-Learning Maturity Model

Maturity Level	m-Learning CSFs & Number of items in assessment questionnaire									
	LMI	IP	BL	ULP	IA	IAU	UC	CMP	TCI	Total
Preliminary	No questions									0
Established	2	2	2	2	1	1	3	3	2	18
Defined	2	2	2	4	1	2	2	3	2	20
Structured	2	2	2	3	1	2	3	3	2	20
Continuous improvement	2	2	2	2	1	2	2	2	2	17
Total of questions in the questionnaire										75

7.3 Performance Scale and Rating Methodology

7.3.1 Performance Scale

The ability to show the m-Learning factors determines the maturity level of m-Learning. There is a five-level scale to rate the performance of the university and establish the maturity level. The extent to which the m-Learning achieves the specific maturity level, achieving the requirements as well, and the extent to which the university agrees with the statements in the questionnaires show the quantitative rating. The ratings used to determine each m-Learning factor – such as "Completely Achieved," "Largely Achieved," "Partially Achieved," "Unachieved," and "Inapplicable" – are shown in Table 7.3. The rating of "Inapplicable" has also been included in the model to enhance the flexibility of our process. However, to maintain the consistency of our assessment of m-Learning with already validated and accepted popular scales, we have structured performance scales and their limits close to the BOOTSTRAP methodology (Wang and King, 2000). However, according to the design of the questionnaires in our model, MLMM, the linguistic expressions have been slightly changed. So we used the self-assessment approach in our methodology.

Table 7.3. Performance Scale

Scale No.	Linguistic Expression of Performance		Rating Threshold (%)
	MLMM	**BOOTSTRAP**	
4	Completely Achieved	Completely Satisfied	≥ 80
3	Largely Achieved	Largely Satisfied	$66.7 - 79.9$
2	Partially Achieved	Partially Satisfied	$33.3 - 66.6$
1	Unachieved	Absent / Poor	≤ 33.2
0	Inapplicable	Does not apply	–

7.3.2 Rating Methodology

We have used terms, such as m-Learning factors Rating (mLRt), Number of Achieved Statements (NAS), Passing Threshold (PT), and MLMM. In the statistical equation for our maturity model, the following abbreviations and symbols are used:

MF = m-Learning Factor

MFN = M-Learning Factor Number (an integer)

ML = Maturity Level (an integer)

S = Statement

SN = Statement Number (an integer)

NAS = Number of Achieved Statement

Let MFt [i, j] be a rating of the ith CSFs of the jth maturity level. Subsequently, according to the scales defined in Table 7.3, it can be summarized as:

mLRt [i,j]= 4, if the Achievement of the condition / statement is at least 80%

= 3, if the Achievement of the condition / statement is from 66.7 to 79.9%

= 2, if the Achievement of the condition / statement is from 33.3 to 66.6%

= 1, if the Achievement of the condition / statement is less than 33.3%

= 0, if the condition - statement is not applicable.

An ith condition/statement at the jth maturity level is considered Achieved if mLRt [i, j] ≥ 3 or mLRt [i, j] is 0. The number of conditions/statements achieved at jth maturity level is defined as:

$$NAS\ [j] = \ Number\ of\ \{mLR_t[i,j] \geq |Achieved\}$$
$$= Number\ of\ \{mLR_t[i,j]|\ mLR_t[i,j] \geq 3\ or\ mLR_t[i,j] = 0\}$$

The m-Learning maturity is considered to be achieved if 80% of the conditions or statements in the questionnaire are achieved. Thus, if TNS [j] is the Total Number of Statements at the jth maturity level, then the passing threshold (PT) at the jth maturity level is defined as:

$$PT\ [j] = TNS[j]\ * 80\ \%$$

Table 7.4 shows the passing threshold of 80% at each m-Learning maturity level with the values calculated to the nearest tenth.

Table 7.4. Rating Threshold for the m-Learning Maturity Assessment

m-Learning Maturity Level	Total Questions	Pass Threshold (PT) 80%
Preliminary	0	Not Valid
Establishment	18	14
Defined	20	16
Structured	20	16
Continuous improvement	17	14

The MLMM is defined as the highest maturity level at which the number of achieved conditions or statements is greater than or equal to the passing threshold (PT) [j]; hence:

$$MLMM = \max\{\ j\ |\ TNS[j]\ \geq PT[j]\}$$

7.3.3 Reliability and Validity Analysis of Questionnaires

Reliability and the validity are two necessary characteristics of any experimental study. Reliability is referred as consistency. We selected five universities that are implementing an m-Learning platform to carry out a study guide. First, we established contacts with the deans of department in these universities. Emails were sent personally to describe the objectives and scope of the study. As a result, responses were received from 20 participants (dean and faculty members) from three universities. They gave us their consent to each condition in the questionnaire. The construct validity and the reliability of the questionnaire designed were analyzed with the help of a pilot study. First of all, the reliability of the multiple-item measurement scales for the four maturity levels (levels 2, 3, 4, and 5) were estimated by means of an internal consistency analysis, which was executed with the coefficient alpha (Cronbach, 1951). Our evaluation showed that the

coefficient alpha varied from 0.91 to 0.96, as shown in Table 7.5. Nunnally et al. (1994) have maintained that a reliability coefficient higher than 0.70 for a measuring instrument is acceptable.

Our analysis shows that the questionnaire developed for our maturity model was approved by the criteria of Nunnally et al. (1994). So we have concluded that all the items built for this experiment are dependable.

Table 7.5. Reliability Analysis of m-Learning CSFs Using Coefficient Alpha

Maturity Level	m-Learning CSFs								
	LMI	IP	BL	ULP	IA	IAU	UC	CMP	TCI
Level (2) Established	0.93	0.93	0.92	0.92	0.93	0.94	0.93	0.93	0.93
Level (3) Defined	0.92	0.93	0.91	0.91	0.92	0.91	0.91	0.91	0.92
Level (4) Structured	0.95	0.94	0.95	0.94	0.95	0.94	0.94	0.94	0.94
Level (5) Continuous improvement	0.95	0.96	0.95	0.96	0.95	0.95	0.95	0.96	0.96

Validity, which means the degree to which a measurement replicates the accurate value, was performed in the second step. According to Campbell and Fiske (1959), when scale items associate and move in a similar direction for a provided assembly then the convergent validity will occur. PCA by Campbell and Fiske (1959) was performed for all nine of the m-Learning CSFs in each maturity level and reported in Table 7.6. Precisely as a reference point, we have utilized the Eigen value by Kaiser (1970) to observe the construct validity using PCA. This study shows that the Eigen value-one criterion has been used, which is also called the Kaiser Criterion proposed by Kaiser (1960, 1970), and the components maintain an Eigen value larger than one. Eigen value analysis shows that a single factor can change items in questionnaires completely. Hence, we arrived at the conclusion that the convergent validity can be observed as enough.

Table 7.6. Validity Analysis of m-Learning CSFs Using (PCA Eigen value)

Maturity Level	m-Learning CSFs								
	LMI	IP	BL	ULP	IA	IAU	UC	CMP	TCI
Level (2) Established	1.75	1.80	1.77	1.79	1.24	1.47	1.66	1.87	1.59
Level (3) Defined	1.64	1.57	1.77	1.65	1.86	1.68	1.73	1.64	1.46
Level (4) Structured	1.81	1.69	1.64	1.74	1.63	1.79	1.67	1.60	1.50
Level (5) Continuous improvement	1.84	1.79	1.83	1.73	1.83	1.89	1.69	1.71	1.65

7.4 Case Studies

A case study cannot provide sufficient information that will also be reliable about a class, but it can be helpful in the beginning steps of a study because it gives a hypothesis which can be experimented with scientifically (Flyvbjerg, 2006). Furthermore, Flyvbjerg (2006) stated that: "*The case study is useful for both generating and testing of hypotheses but is not limited to these research activities alone.*" (p. 222)

7.4.1 Evaluation Process

Our model was applied to m-Learning programs in two universities in Saudi Arabia to perform the m-Learning maturity assessment. The universities will be referred to as "University A" and "University B", to protect the privacy of the two universities. According to their websites, these universities are conscious of m-Learning and realize its importance. The participants who were a part of research in assessment were informed that an individual's identity cannot be made known in any subsequent publication. Using a Likert scale ranging from 0 to 4, the participants were requested to provide the degree of agreement with each statement for the questionnaires designed as illustrated in Table 7.3: [(0 Inapplicable), (1 Unachieved), (2 Partially Achieved), (3 Largely Achieved) and (4 Completely Achieved)]. Consequently, the questionnaire was completed by the participants starting from Level 2 and finishing at Level 5.

The respondents of this study were the dean, higher management staff, or a faculty member. Survey link (SoGoSurvey tools) and email was the means of all communication with the respondents. The participants in the study had consented to their involvement and they were not paid any reimbursement. In the following sections, both case studies are discussed. Bias in the sample is limited because multiple responses were received from each university. A more accurate description of the m-Learning was provided by different respondents. Inter-rater agreement analysis has also been performed and the degree of agreement among all the raters within each university is known and provided information in Table 7.10 and Table 7.11. The following section describes the analysis.

7.4.2 Case study –"University A"

University "A" has a blackboard system, and we have received a total number of 8 complete responses from university A. Table 7.7 shows the extent of each maturity level to which university A matches with different conditions mentioned in the questionnaire. So, as proposed by the rating method conferred in Section above (7.3), if the performance scale is larger than or equal to 3 or 4, then statements are considered to be agreed upon as shown in Table 7.7.

We have calculated NAS (the Number of Achieved Statements), for all the levels. NAS is 14 for Level 2, 15 for Level 3, 1 for Level 4, and 1for Level 5 from the data which is presented in Table 7.7. NAS at Level 2 has a pass limit of 80% according to the rating limit for our MLMM.

University (A) is therefore at the "Established" maturity level. As the value of the statement is 3, it is considered that level 2 is largely achieved.

Table 7.7. Details of Assessment Results of "Case Study A"

Level 2 "Established"		Level 3 "Defined"		Level 4 "Structured"		Level 5 "Continuous improvement"	
Q.#	Value	Q.#	Value	Q.#	Value	Q.#	Value
2.1.1	3	3.1.1	3	4.1.1	2	5.1.1	2
2.1.2	3	3.1.2	3	4.1.2	2	5.1.2	2
2.2.1	2	3.2.1	2	4.2.1	2	5.2.1	2
2.2.2	3	3.2.2	3	4.2.2	2	5.2.2	2
2.3.1	3	3.3.1	3	4.3.1	2	5.3.1	2
2.3.2	3	3.3.2	3	4.3.2	2	5.3.2	2
2.4.1	3	3.4.1	2	4.4.1	2	5.4.1	2
2.4.2	2	3.4.2	3	4.4.2	2	5.4.2	1
2.5.1	3	3.4.3	3	4.4.3	2	5.5.1	1
2.6.1	3	3.4.4	2	4.5.1	2	5.6.1	1
2.7.1	3	3.5.1	3	4.6.1	2	5.6.2	1
2.7.2	3	3.6.1	3	4.6.2	2	5.7.1	1
2.7.3	3	3.6.2	3	4.7.1	2	5.7.2	1
2.8.1	3	3.7.1	3	4.7.2	2	5.8.1	1
2.8.2	2	3.7.2	3	4.7.3	2	5.8.2	1
2.8.3	3	3.8.1	3	4.8.1	3	5.9.1	3
2.9.1	2	3.8.2	3	4.8.2	2	5.9.2	2
2.9.2	3	3.8.3	3	4.8.3	2		
		3.9.1	2	4.9.1	2		
		3.9.2	2	4.9.2	2		

*Level 1 doesn't have any measurement

7.4.3 Case Study –"University B"

University "B" has their own Learning Management System and we have received a total number of 8 complete responses from university B. Table 7.8 shows the degree of each maturity level to which university B matches with different conditions given in the questionnaires. So, according to the rating method discussed in Section 7.3 above, if the performance scale is larger than or equal to 3 or 4 then a statement is considered to be agreed upon, as shown in Table 7.4. We have calculated NAS, for all the levels. NAS is 17 for Level 2, 2 for Level 3, 0 for Level 4, and 0 for Level 5 from the data, which is

presented in Table 7.8. NAS at Level 2 has a pass limit of 80% according to the rating limit for our MLMM. University (B) is therefore at the "Established" maturity level.

Table 7.8. Details of Assessment Results of "Case Study B"

Level 2 "Established"		Level 3 "Defined"		Level 4 "Structured"		Level 5 "Continuous improvement"	
Q.#	Value	Q.#	Value	Q.#	Value	Q.#	Value
2.1.1	3	3.1.1	2	4.1.1	1	5.1.1	1
2.1.2	3	3.1.2	3	4.1.2	1	5.1.2	1
2.2.1	3	3.2.1	2	4.2.1	1	5.2.1	1
2.2.2	3	3.2.2	2	4.2.2	2	5.2.2	1
2.3.1	3	3.3.1	2	4.3.1	2	5.3.1	1
2.3.2	3	3.3.2	2	4.3.2	2	5.3.2	1
2.4.1	3	3.4.1	2	4.4.1	1	5.4.1	1
2.4.2	3	3.4.2	3	4.4.2	2	5.4.2	1
2.5.1	3	3.4.3	2	4.4.3	2	5.5.1	1
2.6.1	3	3.4.4	2	4.5.1	2	5.6.1	1
2.7.1	3	3.5.1	2	4.6.1	1	5.6.2	1
2.7.2	3	3.6.1	2	4.6.2	2	5.7.1	1
2.7.3	3	3.6.2	2	4.7.1	2	5.7.2	1
2.8.1	3	3.7.1	2	4.7.2	2	5.8.1	1
2.8.2	3	3.7.2	2	4.7.3	1	5.8.2	1
2.8.3	3	3.8.1	2	4.8.1	2	5.9.1	1
2.9.1	3	3.8.2	2	4.8.2	2	5.9.2	2
2.9.2	2	3.8.3	2	4.8.3	2		
		3.9.1	2	4.9.1	2		
		3.9.2	1	4.9.2	1		

Level 1 doesn't have any measurement

The numerical values in the cells of Table 7.8 show the extent to which university B corresponds. Summarized assessment results for both case studies are given in Table 7.9.

Table 7.9. Summary of Assessment Results of Case Studies

MLMM	Total Questions	Pass Threshold (PT) 80%	University "A" NAS	University "B" NAS
Preliminary	0	Not Valid	-	-
Established	18	14	14	17
Defined	20	16	15	2
Structured	20	16	1	0
Continuous improvement	17	14	1	0

7.4.4 Analysis of Inter-Rater Agreement

The extent of agreement between different raters within one university is provided by inter-rater agreement (Lee et al., 2001, El Emam, 1999). According to them, the assessment of the identical methodologies adheres to inter-rater agreement and conforms to reproducibility. In cases where data is ordinal, the Cohen's Kappa (1960) is preferred to evaluate inter-rater agreement.

An inter-rater agreement analysis has been conducted in our study using Kappa statistics. 17 respondents participated – 8 from university A and 9 from university B.

Table 7.10. The Inter-Rater Agreement Analysis of University A

MLMM	Fleiss Kappa Statistics		Cohen Kappa Statistics	
	Coef.	Z	Coef.	Z
Established	0.85	36.14	0.85	36.56
Defined	0.73	32.79	0.73	34.15
Structured	0.45	26.40	0.47	36.21
Continuous improvement	0.69	35.71	0.69	36.60

Table 7.10 reports the Kappa statistics for University A. The values of Cohen's Kappa and the Fleiss Kappa coefficients can range from 0 to 1, with 0 indicating perfect disagreement and 1 indicating perfect agreement (El Emam, 1999). In university A, the benchmark for Kappa (El Emam, 1999) does include four level scales, where < 0.44 is poor agreement, 0.44– 0.62 is moderate agreement, 0.62–0.78 is substantial agreement, and > 0.78 is excellent agreement. For University A, the Kappa coefficients range from 0.45 to 0.85, and, therefore, are classified as moderate agreement.

Likewise, the Kappa coefficients ranged from 0.43 to 0.79 when we did the same analysis for university B; these are shown in Table 7.11. Thus, in the case of university B, coefficients are classified as being in moderate agreement.

Table 7.11. The Inter-Rater Agreement Analysis of University B

MLMM	Fleiss Kappa Statistics		Cohen Kappa Statistics	
	Coefficient	Z	Coefficient	Z
Established	0.63	26.99	0.64	29.10
Defined	0.60	38.07	0.61	42.68
Structured	0.79	38.27	0.79	38.56
Continuous improvement	0.43	17.86	0.45	22.26

7.5 Discussion

In software engineering, maturity model information about different processes is provided including their current maturity levels and their related activities. An organization can seek help from this information to upgrade their processes, future activities, and strategic plans. End user experiences can provide great help to improve the software projects. Consequently, m-Learning and correlated problems are the key areas of study in academic society. Assessment is needed to determine particular areas where improvements are compulsory.

m-Learning is a relatively new disciplinary research area, and m-Learning adoption requires a comprehensive strategy due to its continuous adoption. In previous chapters we have examined different key factors of m-Learning adoption. The significant key factors are the measuring instrument to introduce an MLMM in the assessment methodology for m-Learning. The structural MLMM composition consists of the evaluation framework from four dimensions relying on university management approach, and on students and instructors.

Consequently, the current maturity of a m-Learning platform is assessed by this model with assessment methodology of defining and conducting case studies. An integral feature of the MLMM is the methodology for specifically evaluating m-Learning

platform maturity. This model will help university management perform adoption assessments for their m-Learning projects and boost their upgrading strategies.

7.6 Limitation of the Assessment Methodology

Our MLMM is questionnaire-based and, hence, it is vulnerable to certain limitations. Even though our model, which is based on three empirical studies, combines five maturity levels and nine CSFs, we may have inadvertently omitted other factors that affect m-Learning maturity, such as culture. Another limitation of this study involves its relatively small sample size in both case studies.

However, we applied the most commonly used approaches in our reliability and validity analysis, and in our measurements. Since m-Learning is not currently considered a top priority in the educational institution, we obtained a limited amount of data from three universities to implement m-Learning.

Although we recognize the limitations of our model, we believe that the m-Learning CSFs have been validated through empirical investigations. Thus, they provide a comprehensive approach and a firm foundation for future research in this area.

Software vendors or the software developer perspective, such as vendors of an m-Learning management system, which are named as the industrial perspective of the m-Learning platform, have not yet been studied. This will require future investigations.

7.7 Conclusion

The MLMM is based on nine key factors, and we have empirically analyzed and identified them in the three previous studies. The area that is less attractive to the researchers is the CSF assessment of m-Learning, and accordingly, a process that estimates the m-Learning maturity is the main contribution of this work. An evaluation questionnaire for four of the five maturity levels is part of the composition of the framework of this model, as well as a rating methodology and a performance scale. Additionally, we have also studied the execution of two m-Learning projects in two universities and we have discussed case studies. Leaving the limitations aside, this work

has contributed to setting up an all-inclusive approach for m-Learning maturity and addressed the imperative subject of factors of evaluation in m-Learning.

Chapter 8

8 Research Implications

M-Learning presents a promising, yet nascent, field of educational technology that needs immense theoretical as well as empirical research in order to develop workable models and tools. The research in this domain can never be completed without taking into account all relevant stakeholders including students, instructors, and academic management expectations through empirical investigations and experimentations. However, assessment needs to be performed in order to identify the precise areas where improvement is necessary. Due to a continual increase in the number of both technical and non-technical users, the evaluation of m-Learning requires a comprehensive strategy that has not yet been fully explored.

This thesis contributes towards establishing a comprehensive strategy for m-Learning process maturity, and it addresses the important issue of m-Learning assessment by quantifying most of the related CSFs as metrics. Our proposed MLMM is based on nine CSFs that we have identified and empirically analyzed in three studies. The proposed framework offers assessment questionnaires, a performance scale, and a rating methodology to assess m-Learning maturity. Additionally, two case studies have been discussed where we have examined the maturity level for two universities in term of a m-Learning adoption. Also, other limitation of the proposed model has been based on empirical studies conducted in only one country (Saudi Arabia).

This model has practical implications for future research. First, the model can be used to assess adoption rates at different higher educational institutions by other researchers as well. At the same time, the model can be used for further investigations and improvements to come up with a more specific and advanced model of m-Learning adoption. The findings of this study can also be used for comparative study with other m-Learning maturity models.

The finding of this research has implications for universities as well, as they can use the findings to articulate and develop their strategies regarding educational technology. The

research suggests that m-Learning can open new frontiers for universities by essentially transforming the business models of the universities by eliminating the time and space barriers. This has significant implications for the future of higher education.

8.1 Major Contributions

The framework of the thesis was guided by the goal of finding answers to the various research questions identified, and thus providing a comprehensive and unified methodology for assessing the m-Learning maturity within university settings. This thesis aims to increase the available research in the area of m-Learning assessment methodologies and provide a viable solution in the form of MLMM. The research conducted and reported in this thesis provides a comprehensive strategy for adapting MLMM.

The main contributions of the research in this thesis are summarized below:

- Systematic empirical investigations to discover what CFSs the literatures suggest have an impact on the m-Learning adoption (Chapter 3).
- Three empirical investigations to identify factors from the perspective of students, instructors, and university management (Chapters 4, 5, and 6 respectively).
- A framework for MLMM. This model utilizes the empirically validated key factors as a measuring instrument for m-Learning adoptions. In particular, five maturity levels have been used to represent m-Learning maturity. The research also put forward assessment questionnaires, a rating methodology, and two case studies (Chapter 7).

8.2 Conclusions

M-Learning assessment is an area that has received relatively little attention by researchers, and, accordingly, the main contribution of this work is a methodology that evaluates m-Learning maturity. In section 1.6, ten research questions were formulated. The framework of the thesis was guided by the goal of finding answers to those research questions, thus providing a comprehensive and unified methodology for assessing the m-Learning maturity within a university setting. The research conducted

and reported in this thesis provided answers to those 10 research questions, as presented below:

- RQ-1: Is it possible to clearly differentiate between e-Learning and m-Learning platforms based on their characteristics?
- RQ-2: Are there any frameworks available for evaluating m-Learning maturity in the educational setting?
- RQ-3: Is the application of CMM to m-Learning viable?
- ❖ Answers: For the first three research questions (RQ 1, 2, and 3) we illustrated all related issues in Chapters 1 and 2.
- RQ-4: What are the CSFs that successfully affect m-Learning adoption based on the literature?
- ❖ Answer: We conducted a systematic empirical investigation (Chapter 3) and confirmed that 12 CSFs – technical competence of students, technical competence of instructors, personalization, instructor autonomy, user-friendly application design, learning made interesting, assimilation with curriculum, increased productivity, instructor community development, platform accessibility, Internet access, and blended learning – have a theoretically positive impact on the m-Learning adoption. Then we divided those 12 CSFs into student perspectives and instructor perspectives, and empirically studied these two perspectives (Chapters 4 and 5 respectively).
- RQ-5: What are the key factors that contribute towards m-Learning maturity from the perspective of the students?
- ❖ Answer: We identified and examined the effect of CSFs on m-Learning from the viewpoint of students. The empirical study conducted and reported in Chapter 4 of this thesis looked at six CSFs and found that only three of them have a positive effect in promoting m-Learning adoption: learning made interesting, increased productivity, and Internet access.
- RQ-6: How can we assess the success of m-Learning from instructor perspectives?
- ❖ Answer: In Chapter 5, a research model was presented to investigate and establish a relationship between the CSFs from the instructor perspectives. The empirical

results of the study strongly supported the hypotheses; according to instructors, only three out of the six factors analyzed – the technical competence of instructors, instructor autonomy, and blended learning – were found to be statistically significant.

- RQ-7: What are the CSFs that contribute towards m-Learning adoption from the perspective of the university management?

❖ Answer: In Chapter 6, an empirical analysis examined the impact of CSFs on m-Learning adoption from the perspective of the university management. The results of the research show that university commitment to m-Learning, university learning practices, and change management practices were the factors critical to the adoption of m-Learning from the university management perspective.

- RQ-8: How can we perform the assessment of m-Learning capability within a university environment?

❖ Answer: In Chapter 7, this thesis presented an MLMM that is intended to assess the m-Learning maturity within the university environment.

- RQ-9: Can we develop a methodology for evaluating the maturity level of m-Learning initiatives in higher education?

❖ Answer: In Chapter 7, this thesis presented five performance scales and a rating methodology for assessing the m-Learning maturity. Due to the paucity of research in this extremely important area, the primary objective of this thesis was to propose an MLMM. This thesis identified three research problems in Section 1.5 and this thesis has provided solutions to those problems.

- RQ-10: What are the future implications from the development of MLMM?

❖ Answer: As the beginning of Chapter 8 describes, the MLMM model also has practical implications for universities, as they can use the findings to articulate and develop their strategies regarding educational technology. The research suggests that m-Learning can open new frontiers for universities by essentially transforming the business models of the universities and eliminating the time and space barriers.

8.3 Future work

This work has been primarily focused on two objectives: to identify certain factors that affect m-Learning adoption from the perspective of different stakeholders (student, instructors, and the university management), and to propose the MLMM. The leading research areas and suggested future work in those areas are presented as follows:

- This research used a self-assessment method to perform case studies. We are planning to enhance the assessment methodology by introducing on-site assessment, identifying documents to review, interview questions, and mapping replies to the measuring instrument of our proposed maturity assessment model. Also, there is a need for an external audit approach.

- Performing an additional statistical analysis using ANOVA would make it possible to segment the student and instructor using the data provided regarding the usage of mobile-smartphones (specifically data related to questions 14 and 15 in student and instructor questionnaires). This data might lead to confirmation that one or more factors are statistically significant and are relevant to the assessment of m-Learning maturity.

- Regarding the factors that have not been validated in our empirical studies, especially the technical (industrial) perspective, further studies may be needed to establish whether these factors are relevant or not to the assessment of m-Learning maturity.

- The proposed model has been based on empirical studies conducted in one country, Saudi Arabia. More case studies in other counties are required to improve and generalize this initial model.

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Appendices

Appendix I: Students Perspectives Questionnaire

Survey Questionnaire on Learner's Perspective: An Empirical Investigation

Dear participant,

My name is Muasaad Alrasheedi. I am a Ph.D. candidate at the University of Western Ontario, London, Ontario, Canada. My area of interest is Software Engineering, and my special interest is in studying Mobile Learning. I am currently working on my research thesis that focuses on attempts to understand and evaluate the Critical Success Factors (CSFs) for Mobile Learning (m-Learning). Educational institutions all over the world are now realizing the importance of m-learning. Many universities have also started implementing the m-learning philosophy to leverage the advantages it provides. I feel that it is important to address this issue through academic research.

My research will investigate the CSFs that are essential for m-Learning. Being in an academic environment places you in the right position to give us the information we need for this research.

The questionnaire should take about 5 to 10 minutes to complete. In completing the questionnaire, I request that you kindly answer the questions frankly and honestly to serve as an expert resource for this study. Your responses will be kept strictly confidential and the information you provide will be used only in connection with the research just mentioned. An attempt will also be made to share the aggregate results of this study with the respondents.

Should you require additional information, please do not hesitate to contact me ▬▬▬▬▬▬▬▬▬▬▬ . You are also welcome to contact my supervisor: Professor Luiz Fernando Capretz at ▬▬▬▬▬▬▬▬ if you wish further information.

Thank you very much for your time and cooperation.
Your help in carrying out this endeavor is greatly appreciated.

Muasaad Alrasheedi (Ph.D. Candidate)
University of Western Ontario
Canada

Part I: Demographic Information

Please check the boxes as applicable. This information will only be used to profile and group the responses.

1. **You are:**   Male   [ ]   Female [ ]

2. **Age Group:**   <25   [ ]   26-35   [ ]
                                    36-55 [ ]   Over 55 [ ]

3. **Study Status:**   Full-time [ ]   Part-time [ ]

4. **Study Level:**   Undergraduate [ ]   Post Graduate [ ]

5. **Please mention your year of study (e.g. 1st or 2nd year).**
   _____

6. **Which of the branches is closest to your current area of study?**

Agriculture, Forestry or fishery   [ ]
Computer, Electrical, Electronic Engineering or IT   [ ]
Other Engineering   [ ]
Health Sciences   [ ]
Social Sciences   [ ]
Others_(Please indicate)_____

Part II: **Equipment Access and Experience**

Please provide information about access to mobile and PC and your experience with the devices.

7. **Do you own a mobile phone?**   **Y**es [ ]   No [ ]
8. **Do you own a Smartphone or PDA?**   Yes [ ]   No [ ]
9. **Do you own a desktop computer?**   Yes [ ]   No [ ]
10. **Do you own a Laptop, tablet PC (desktop) or mini notebook?** Yes []   No [ ]
11. **Do you have internet access on any of your computers?** Yes [ ]   No [ ]
12. **Do you have internet access on any of your phones?**   Yes [ ]   No [ ]
13. **For how many years have you used a mobile phone? (leave blank if never used)**
    < 1year [ ]   1-3 years [ ]   4-6 years [ ]   >6 years [ ]
14. **For how many years have you used a Smartphone? (leave blank if never used)**
    < 1year [ ]   1-3 years [ ]   4-6 years [ ]   >6 years [ ]

15. **For how many years have you used a desktop computer? (leave blank if never used)**
    < 1year [ ]   1-3 years [ ]   4-6 years [ ]   >6 years [ ]
16. **For how many years have you used a laptop, tablet PC or mini notebook PC? (leave blank if never used)**
    < 1year [ ]   1-3 years [ ]   4-6 years [ ]   >6 years [ ]

Part III: **Attitude and usage behaviour towards the university's m-Learning platform**

17. **On a scale of 1 to 5, rate your attitude/behaviour towards the University's m-Learning platform?**

1= Strongly Disagree, 2= Disagree, 3= Neither Agree or Disagree, 4=Agree, 5 = strongly Agree

Questions	*m-Learning factor effect students' perspective*	1	2	3	4	5
1. Learning to operate the University's m-Learning platform is easy for me	**Technical competence of students**					
2. I can customize the m-Learning application to reflect my individual choices	*Personalization*					

3. It is more interesting to learn my subjects using the m-Learning application	*Learning made interesting*					
4. Using the m-Learning application has made it easier to learn the subjects	*Increased productivity*					
5. I find the m-Learning application useful for learning the subjects						
6. Using the m-Learning application has increased my productivity						
7. I can finish learning activities more quickly using the m-Learning platform						
8. It is easy to access the m-Learning platform from the University's website	*Platform accessibility*					
9. The m-Learning platform is accessible from outside the University campus						
10. The m-Learning platform is accessible even when I am on the move						
11. The m-Learning platform is accessible from home						
12. It is easy for me to access the Internet on the University campus	*Internet access*					
13. It is easy for me to access the Internet when I am on the move						
14. It is easy for me to access the Internet when I am home						
15. I plan to use the m-learning platform to learn my subjects in future	*Overall user perception cumulative*					
16. I would like to use the m-Learning platform to learn my subjects in future						
17. I think learning subjects using the m-Learning platform is a good idea						

Appendix II: Instructors Perspective Questionnaire

Survey Questionnaire on Instructor's Perspective: An Empirical Investigation

Dear participant,

My name is Muasaad Alrasheedi. I am a Ph.D. candidate at the University of Western Ontario, London, Ontario, Canada. My area of interest is Software Engineering, and my special interest is in studying Mobile Learning. I am currently working on my research thesis that focuses on attempts to understand and evaluate the Critical Success Factors (CSFs) for Mobile Learning (m-Learning). Educational institutions all over the world are now realizing the importance of m-learning. Many universities have also started implementing the m-learning philosophy to leverage the advantages it provides. I feel that it is important to address this issue through academic research.

My research will investigate the CSFs that are essential for m-Learning. Being in an academic environment places you in the right position to give us the information we need for this research.

The questionnaire should take about 5 to 10 minutes to complete. In completing the questionnaire, I request that you kindly answer the questions frankly and honestly to serve as an expert resource for this study. Your responses will be kept strictly confidential and the information you provide will be used only in connection with the research just mentioned. An attempt will also be made to share the aggregate results of this study with the respondents.

Should you require additional information, please do not hesitate to contact me   . You are also welcome to contact my supervisor: Professor Luiz Fernando Capretz at   if you wish further information.

Thank you very much for your time and cooperation.
Your help in carrying out this endeavor is greatly appreciated.

Muasaad Alrasheedi (Ph.D. Candidate)
University of Western Ontario
Canada

Part – I: Demographic Information

Please check the boxes as applicable. This information will only be used to profile and group the responses.

1. **You are:**   Male   [ ]   Female [ ]

2. **Age Group:**   Younger than 25   [ ] 26-35   [ ]

    36-55 [ ]   Older than 55 [ ]

3. **Teaching status:**   Full-time [ ]   Part-time [ ]

4. **Level of students whom you teach:**   Undergraduate [ ]   Post Graduate [ ]

5. **Please explain the level of students you teach (e.g., 1st or 2nd year)…………….**

6. **Which of these branches is closest to your current area of teaching? (Please check only one)**

    Agriculture, Forestry, or Fishery   [ ]

Computer, Electrical, Electronic Engineering, or IT [ ]

Other Engineering [ ]

Health Sciences [ ]

Social Sciences [ ]

[Other:] …. .. . .

Part – II: Equipment Access and Experience

Please provide information about access to mobile and PC and your experience with the devices.

7. **Do you own a mobile phone?** Yes [ ] No [ ]

8. **Do you own a Smartphone or PDA?** Yes [ ] No [ ]

9. **Do you own a desktop computer?** Yes [ ] No [ ]

10. **Do you own a Laptop, tablet PC or mini notebook PC?** Yes [ ] No [ ]

11. **Do you have Internet access on any of your computers?** Yes [ ] No [ ]

12. **Do you have Internet access on any of your phones?** Yes [ ] No [ ]

13. **For how many years have you used a mobile phone? (leave blank if you have never used)**

   Less than 1year [ ] 1-3 years [ ] 4-6 years [ ] More than 6 years [ ]

14. **For how many years have you used a Smartphone? (leave blank if you have never used)**

   Less than 1year [ ] 1-3 years [ ] 4-6 years [ ] More than 6 years [ ]

15. **For how many years have you used a desktop computer? (leave blank if you never used)**

   Less than 1year [ ] 1-3 years [ ] 4-6 years [ ] More than 6 years [ ]

16. **For how many years have you used a laptop, tablet PC or mini notebook PC? (leave blank if you have never used)**

   Less than 1year [ ] 1-3 years [ ] 4-6 years [ ] More than 6 years [ ]

Part – II: Usage behaviour towards the university m-Learning platform

17. Have you used a Smartphone, laptop, or tablet PC at school? (Check only ONE option in each row)

In the last 3 months	Yes [ ]	No [ ]
In the last 12 months	Yes [ ]	No [ ]
During your entire time in the university	Yes [ ]	No [ ]

18. Have you used the university's Internet on any mobile device? (Check only ONE option in each row)

In the last 3 months	Yes [ ]	No [ ]
In the last 12 months	Yes [ ]	No [ ]
During your entire time in the university	Yes [ ]	No [ ]

19. Have you been a part of your university's m-Learning program?

In the last 3 months	Yes [ ]	No [ ]
In the last 12 months	Yes [ ]	No [ ]
During your entire time in the university	Yes [ ]	No [ ]

Part III: Attitude towards the university's m-Learning platform

20. On a scale of 1 to 5, rate your attitude/behaviour towards the university's m-Learning platform?

1- Strongly Disagree, 2- Disagree, 3- Neither Agree or Disagree, 4-Agree, 5- Strongly Agree

(Please choose only **ONE** option for each question)

	m-Learning factor effect instructors' perspective	1	2	3	4	5
1. Learning to operate the university m-Learning platform is easy for me.	**Technical competence of instructors**					
2. I think the m-Learning application lets students learn subjects at their own pace.	**Instructors' Autonomy**					
3. I find it easy to get the m-Learning application do what I want it to do	**User friendly design**					
4. The m-Learning application contains all related topics, as per the curriculum.	**Assimilation with curriculum**					
5. I allow students to contact me via m-Learning platform about schoolwork	**Instructor community**					

6. I use the m-Learning platform to keep in touch with fellow instructors	**development**					
7. The discussion forum on the m-Learning platform is easy to use						
8. The discussion forum on the m-Learning platform is helpful to students						
9. I combine the m-Learning platform and contact lectures for the best results.	**Blended learning**					
10. I plan to use the m-Learning platform to teach students in the future.	**Over all instructor perspective**					
11. I would like to use the m-Learning platform to teach students in the future.						
12. I think teaching subjects using the m-Learning platform is a good idea.						

Appendix III: University Management Perspectives Questionnaire

Survey Questionnaire on University's Perspective: An Empirical Investigation

Dear Participant,

My name is Muasaad Alrasheedi. I am a Ph.D. candidate at the University of Western Ontario, London, Ontario, Canada. My area of interest is Software Engineering, and my special interest is in studying Mobile Learning. I am currently working on my research thesis that focuses on attempts to understand and evaluate the Critical Success Factors (CSFs) for Mobile Learning (m-Learning). Educational institutions all over the world are now realizing the importance of m-learning. Many universities have also started implementing the m-learning philosophy to leverage the advantages it provides. I feel that it is important to address this issue through academic research.

My research will investigate the CSFs that are essential for m-Learning. Being in an academic environment places you in the right position to give us the information we need for this research.

The questionnaire should take about 5 to 10 minutes to complete. In completing the questionnaire, I request that you kindly answer the questions frankly and honestly to serve as an expert resource for this study. Your responses will be kept strictly confidential and the information you provide will be used only in connection with the research just mentioned. An attempt will also be made to share the aggregate results of this study with the respondents.

Should you require additional information, please do not hesitate to contact ▬▬▬▬▬▬▬▬. You are also welcome to contact my supervisor: Professor Luiz Fernando Capretz at ▬▬▬▬▬▬▬▬ if you wish further information.

Thank you very much for your time and cooperation.
Your help in carrying out this endeavor is greatly appreciated.

Muasaad Alrasheedi (Ph.D. Candidate)
University of Western Ontario
Canada

Part – I Demographic Information

This information will only be used to profile and group the responses.

1. **You are:**   Male   [ ]   Female [ ]
2. **Age group:**   Younger than 25 [ ]   26-35   [ ]
                                       36-55 [ ]   Older than 55 [ ]

3. **Administrative status:**   Department Head [ ]   Manager [ ]
                                      Full-time Staff   [ ]   Part-time Staff [ ]
4. **Which of these branches currently have an active or pilot m-Learning platform?**

   Agriculture, Forestry, or Fishery   [ ]

   Computer, Electrical, Electronic Engineering, or IT   [ ]

   Other Engineering   [ ]

   Health Sciences   [ ]

   Social Sciences   [ ]

[Other]……………..

5. **Which of these branches do you think <u>should have</u> an m-Learning platform in the future?**

Agriculture, Forestry, or Fishery [ ]

Computer, Electrical, Electronic Engineering, or IT [ ]

Other Engineering [ ]

Health Sciences [ ]

Social Sciences [ ]

[Other]…………..

6. **Which of these branches do you think <u>will not benefit</u> from having an m-Learning platform?**

Agriculture, Forestry, or Fishery [ ]

Computer, Electrical, Electronic Engineering, or IT [ ]

Other Engineering [ ]

Health Sciences [ ]

Social Sciences [ ]

[Other] ……………

7. **Are you aware of m-Learning programs in other universities?** Yes [ ]
   No [ ]

8. **Do you think m-Learning platforms in other universities have benefitted the following:**

   Students   Yes [ ]   No [ ]

   The university as a whole   Yes [ ]   No [ ]

9. **Do you think m-Learning platforms in other universities have provided value**

   for money?   Yes [ ]   No [ ]   Not Sure [ ]

Part – II Opinions on the University's Organizational Structure

Please rate the following statements according to your views on the university's current organizational structure. (1- Strongly Disagree, 2- Disagree, 3- Neither Agree or disagree, 4-Agree, 5 - Strongly Agree)

	1	2	3	4	5
1. The roles and responsibilities of individuals and departments are clearly defined and documented.					
2. The university's current organizational structure supports the m-Learning platform.					
3. A strong and open communication channel exists between individuals/departments.					
4. Employees are encouraged to work in interdisciplinary teams across department borders to share, disseminate, and acquire knowledge about the m-Learning platform.					
5. All employees can directly communicate with the m-Learning support team					
6. Cross-functional teams are established to monitor current m-Learning performance and to support management decision-making.					
7. The university's current strategic plan clearly defines how it will gain the technical capability to successfully adopt the m-Learning platform university-wide.					

Part – III Opinions on the University's Culture

Please rate the following statements according to your views on the existing culture within the University

	1	2	3	4	5
1. The university's management welcomes new ideas to improve m-Learning acceptance.					
2. New employees have difficulty in adapting to the university's working environment.					
3. Employee opinions are asked and considered while implementing new ideas.					
4. Employees are empowered to make appropriate decisions regarding job execution.					
5. Employees are encouraged to work in interdisciplinary teams across department borders to share, disseminate, and acquire knowledge about the m-Learning platform.					

	1	2	3	4	5
6. Employees understand and are committed to the university's vision, values, and goals, chiefly in the area of m-Learning.					
7. The university culture supports the reusability of m-Learning assets.					
8. Higher management is generally viewed as approachable, supportive, and helpful.					

Part – IV Opinions on the University's Commitment

Please rate the following statements according to your views regarding the university's

commitment towards m-Learning

	1	2	3	4	5
1. The m-Learning platform is a clear part of the university's strategic vision.					
2. University employees share a high degree of commitment to make the university's strategic vision a reality.					
3. The employees feel a sense of ownership with the university rather than being just employees.					
4. I would accept additional assignment in order to keep working with the university.					
5. Over the last three years, on the whole, the university is steadily moving towards adopting an m-Learning platform as part of its strategic vision.					
6. Employees consider m-Learning as a vital means to achieve the university's long-term goals.					

Part – V Opinions on the University's Organizational Learning Practices

Please rate the following statements according to your views regarding the university's

organizational learning practices for employees.

	1	2	3	4	5
1. Formal and informal learning programs are used to disseminate learning and knowledge within the university for its employees.					
2. The necessary training has been provided to university employees on using the m-Learning platform.					
3. The university is continuously in the process of learning from its experiences and lessons and avoids making the same mistake again and again.					

	1	2	3	4	5
4. Continuous monitoring and modification of the m-Learning platform has been taking place with respect to different comments and requirements.					
5. Formal training sessions are regularly scheduled to train university staff on the m-Learning platform.					
6. Employees share their experiences and knowledge with each other.					

Part – VI Opinions on University's Change Management Practices

Please rate the following statements, stating your views regarding the university's change

management practices.

	1	2	3	4	5
1. The university has a defined change management plan to adopt or switch to a new learning platform (e.g., m-Learning platform).					
2. The change management program is well communicated to all the employees within the university.					
3. The resistance to change to a newer platform (m-Learning) is gradually decreasing.					
4. The changes in the organization with regarding to m-Learning platform adoption are well accepted by the employees.					
5. The university regularly conducts reviews getting feedback from its employees on the m-Learning platform upgrades.					
6. The university learns from the feedback and understands the impact of the newer platform on the organizational performance.					

Part – VII Opinions on University's Conflict Management Practices

Please rate the following statements, stating your views regarding the university's

conflict management practices

	1	2	3	4	5
1. The university has a well-defined conflict management policy.					
2. Management supports positive and constructive conflicts.					
3. Personal conflicts are a major hurdle to the adoption of new practices and platforms.					
4. Employees can successfully handle conflicts on their own.					

Part – VIII Opinions on the advantages of m-Learning platform

Please rate the following statements, stating your views regarding the advantages of the

m-Learning platform.

	1	2	3	4	5
1. The m-Learning platform has increased the capability of the university to manage students.					
2. The m-Learning platform implementation has increased the student intake.					

Appendix IV: Research Ethics Approval

ROYAL EMBASSY OF SAUDI ARABIA

CULTURAL BUREAU
OTTAWA

سفارة المملكة العربية السعودية

الملحقية الثقافية

اوتاوا

16 محرم 1435هـ

إفادة

إلى من يهمه الأمر

السلام عليكم وحمة الله وبركاته،،،

وبعد

تفيد الملحقية الثقافية في كندا بأن الطالب / مساعد محمد مرزوق الرشيدي (سجل مدني رقم 1008865733) مبتعث مرحلة دكتوراه تخصص هندسة برمجيات بجامعة وسترن اونتاريو، تمت الموافقة على اجراء دراسة بحثية حول بناء نموذج نضج للتعليم الجوال على اساس نموذج نضج القدرة ـ CMM ـ نأمل مساعدة المبتعث للقيام بالبحث في مؤسستكم الموفرة .

وقد أعطي هذه الإفادة بناء على طلبه.

مع اطيب تحياتي ،،،

الملحق الثقافـــي

بسفارة المملكة العربية السعودية فى أوتاوا

د. علي بن محمد البشري

د. حامد الزيدي

الرقم:.......... التاريخ:............ الموافق:...... المرفقات:..............

2101 Thurston Drive, Ottawa, Ontario, Canada K1G 6C9 Tel: (613) 238-5555 - Fax: (613) 563-9010 www.saudibureau.org Email: Office@saudibureau.org

ROYAL EMBASSY OF SAUDI ARABIA

CULTURAL BUREAU
OTTAWA

سفارة المملكة العربية السعودية
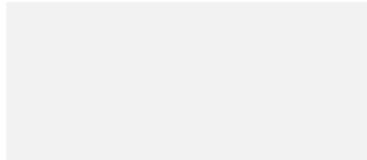الملحقية الثقافية
اوتاوا

June 3, 2015

To Whom It May Concern

This is to certify that MUASAAD MOHAMMED M ALRASHEEDI, a Ph.D. student in Software Engineering at THE UNIVERSITY OF WESTERN ONTARIO, had been approved to conduct research and collect data from Saudi Universities during Winter 2014 regarding his research entitled: Maturity Model for Mobile learning (m-Learning) based on Capability maturity model .

Sincerely;

Saudi Cultural Attache

Saudi Arabian Cultural Bureau

Curriculum Vitae

Name:	Muasaad Alrasheedi

Post-secondary Education and Degrees:

Western University
London, Ontario, Canada
Electrical and Computer Engineering
2011-2015 (Ph.D)

Carleton University
Ottawa, Ontario, Canada
Systems and Computer Engineering
2008-2010
Master of Engineering Innovation and Technology Management

Arab Open University
Riyadh, Saudi Arabia
2003-2007
B.Sc. Information Technology and Computing

Honours and Awards:

King Abdullah Foreign Scholarship Program (2008-2015)

Certificate of Merit (Student) for International Conference on Education and Information Technology 2014; paper title: Learner Perceptions of a Successful Mobile Learning Platform: A Systematic Empirical Study
The International Association of Engineers (IAENG)

Related Work Experience

Teaching Assistant and Research Assistant
Western University
2011-2015

Publications:

Journal publications:

1. Alrasheedi, M., & Capretz, L.F. (2015a). Determination of Critical Factors Affecting Mobile Learning: A Meta-Analysis Approach, Turkish Online Journal of Educational Technology, 14(2), 41 - 51. (Impact factor: 0.96).
2. Alrasheedi, M., Capretz, L.F. & Raza, A. (2015d). Student Perspectives of the Mobile Learning Platform: An Empirical Study, *in preparation*.
3. Alrasheedi, M., Capretz, L.F. & Raza, A. (2015e). Systematic Literature Review of Critical Factors for Effective Mobile Learning from the

Student's Perspective, The Journal of Educational Computing Research, doi: 10.1177/0735633115571928. (Impact factor: 0.66).

4. Ali A., Alrasheedi M., Ouda A. & Capretz L.F. (2014). A Study of the Interface Usability Issues of Mobile Learning Applications for Smartphones from the User's Perspective. International Journal on Integrating Technology in Education, 3(4), 1-16. doi:10.5121/ijite.2014.3401.

5. Alrasheedi, M., & Capretz, L.F. (2013e). Developing a Mobile Learning Maturity Model, the International Journal for Infonomics, 6(4), 771-779.

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