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Shakeel Iqbal et Ijaz A. Qureshi

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Résumé de l'article

M-learning is the style of learning for the new millennium. Decreases in cost and increases in capabilities of mobile devices have made this medium attractive for the dissemination of knowledge. Mobile engineers, software developers, and educationists represent the supply side of this technology, whereas students represent the demand side. In order to further develop and improve this medium of learning it is imperative to find out students' perceptions about m-learning adoption. To achieve this objective a survey was conducted among the students of 10 chartered universities operating in the twin cities of Rawalpindi and Islamabad in Pakistan. The results indicate that perceived usefulness, ease of use, and facilitating conditions significantly affect the students' intention to adopt m-learning, whereas perceived playfulness is found to have less influence. Social influence is found to have a negative impact on adoption of m-learning. The findings of this study are useful in providing guidance to developers and educators for designing m-learning courses specifically in the context of developing countries.

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M-Learning Adoption: A Perspective from a Developing Country


Shakeel Iqbal and **Ijaz A. Qureshi**
Iqra University, Pakistan

Abstract

M-learning is the style of learning for the new millennium. Decreases in cost and increases in capabilities of mobile devices have made this medium attractive for the dissemination of knowledge. Mobile engineers, software developers, and educationists represent the supply side of this technology, whereas students represent the demand side. In order to further develop and improve this medium of learning it is imperative to find out students' perceptions about m-learning adoption. To achieve this objective a survey was conducted among the students of 10 chartered universities operating in the twin cities of Rawalpindi and Islamabad in Pakistan. The results indicate that perceived usefulness, ease of use, and facilitating conditions significantly affect the students' intention to adopt m-learning, whereas perceived playfulness is found to have less influence. Social influence is found to have a negative impact on adoption of m-learning. The findings of this study are useful in providing guidance to developers and educators for designing m-learning courses specifically in the context of developing countries.

Keywords: M-learning; mobile learning; technology adoption; technology acceptance model

Introduction

The concept of distance learning during the 1960s mostly involved distributing learning material to help educate the geographically scattered masses through prerecorded lectures on audio/video tapes or live lectures delivered via radio or television. With the emergence of the World Wide Web, e-learning, which is learning supported by digital electronic tools and media, became popular (Peng et al., 2009). In the last decade the number of mobile

devices (e.g., mobile phones, personal data assistants [PDAs], laptop computers, and pen tablet computers) increased drastically (Wali et al., 2008). This increase in the number of mobile devices led researchers to focus on using these devices as a medium of learning (Koszalka & Ntloedibe-Kuswani, 2010).

Various research studies were conducted in developed countries to find out the factors affecting acceptance of e-learning and m-learning among students (see Concannon et al., 2005; Davies & Graff, 2005; Huang et al., 2007; Wang et al., 2009). However, limited research is available on the issue from the perspective of developing countries. The state of technology and the social structure of developing countries are different from developed countries. Therefore research specifically identifying motivating factors for m-learning in developing countries is needed. The present study was conducted to fill this research gap. The outcomes of this study are likely to be useful for the developers and designers of m-learning.

Literature Review

Mobile learning or m-learning has been defined differently in different studies, which indicates that m-learning is still in an evolving phase (Peng et al., 2009). M-learning has been defined as "e-learning using mobile devices and wireless transmission" (Hoppe et al., 2003; Chang et al., 2003). Two important aspects of m-learning are its ubiquity and mobility. Ubiquitous computing is access to computing technologies whenever and wherever they are needed and mobility can be defined as learning on the go (Peng et al., 2009). While e-learning is mostly dependent upon desktop personal computing (PC) technology, m-learning is dependent upon mobile devices (Orr, 2010).

One of the main reasons for increased attention paid towards m-learning is the increase in the number of mobile devices (such as mobile phones, PDAs, laptops, and iPads) as well as enhancements in the technological capabilities of these devices. With decreasing costs these mobile devices are becoming accessible to more people. These mobile devices offer multiple features and capabilities such as making phone calls, recording audio/video, capturing pictures, storing data, and accessing the Internet. All of these functionalities can be used in an educational context (Maccallam & Jeffery, 2009). A review of the literature on m-learning reveals several initiatives, such as the implementation of m-portals (Mitchell, 2003), classrooms of the future (Dawabi et al., 2003), and practical scientific experimentation and teaching (Milrad et al., 2004).

Learners can create and share their own knowledge through the use of interactive games installed on their mobile devices. M-learning provides a tool for brainstorming, quizzing, and voting through integration with online management systems in classrooms (Goh & Kinshuk, 2006), while in the laboratory it bridges individual and collaborative learning. It helps users take graphic and textual data on field trips and supports the delivery of learning, whether the users are sitting in the same place at the same time or not; this access to information anytime and all the time is the greatest advantage of m-learning. M-learning can be

seen as a further extension of its predecessor, e-learning (Wang et al., 2009).

Engines of M-Learning

There are four key-players in m-learning: hardware developers (engineers), software developers, educators, and students. There are many challenges for all the key players to make m-learning a preferred mode of transmitting and acquiring information. From a technology perspective, there are many technical restrictions that may cause resistance to m-learning adoption (Wang et al., 2009).

Technological challenges faced by software developers are mainly due to the limitations of commonly used mobile devices as compared to personal computers (Wang et al., 2009). Unless these developers are well versed in the capabilities as well as the limitations of specific mobile devices, they will not be able to develop something of value for the users (Georgiev et al., 2006). Software developers need to realize that mobile devices have less processing speed, less memory, no keyboard (in most cases), and smaller displays when compared to PCs; though every new product being introduced to the market is superior compared to its predecessors in these aspects.

Educators will be interested in m-learning only if they are comfortable using mobile devices. If they are well versed in using mobile devices they can provide valuable input to the m-learning software developers. Knowledge about the capabilities and limitations of mobile devices and their frequent usage by educationists is a prerequisite for developing m-learning content (Georgiev et al., 2006). Mobile engineers, developers, and educationists work on the supply side while students represent the demand side of m-learning. As mentioned earlier more students can access mobile devices mainly due to their decreasing costs. At present, these devices are mostly being used for gaming, music sharing, and connecting to social Web sites like Facebook, YouTube, and MySpace. If students are provided with educational content in an appropriate manner which is exciting and novel they will be more inclined to use these devices. However, designing a device compatible with m-learning and making it affordable for students and educators is a challenging task.

Successful measurement of m-learning depends upon three factors: technical-level success, semantic-level success, and effectiveness-level success of the information system. Separate success measures are used to measure each level (DeLone & McLean, 1992). Technical-level success can be measured by system quality, semantic-level success can be measured by information quality, and effectiveness-level success can be measured by user satisfaction.

Different factors have been studied in previous research, which are considered to be important from the adoption point of view. In one of the studies on this topic, Phuangthong and Malisawan (2005) presented a model of m-learning adoption and concluded that people's attitude towards m-learning was influenced by perceived enjoyment. In another study, Ju et al. (2007) pointed out that perceived usefulness has a significant impact on users' attitudes, which further affects the users' intention to adopt m-learning. In their study, Wang et al. (2009 indicated the following factors as important determinants of users' intentions to adopt m-learning: learning at a self-managed pace, perceived usefulness, social influ-

ence, performance expectancy, and effort expectancy.

Perceived Usefulness, Perceived Ease of Use, and Intention to Use

The technology acceptance model (TAM) was first proposed by Davis (1989) and consists of two major constructs: perceived ease of use (PEOU) and perceived usefulness (PU). Later, Venkatesh et al. (2003) proposed a unified model based on the two TAM constructs, the unified theory of acceptance and use of technology (UTAUT). Several other studies have used these two concepts to demonstrate their impact on intention; for example, studies conducted on e-commerce (Gefen & Straub, 2000), Web 2.0 (Shin & Kim, 2008), broadband Internet (Oh et al., 2003), digital libraries (Hong, 2002), and virtual communities (Lin, 2006) can be considered. In some recent studies PEOU and PU have been demonstrated to have an impact on intention to adopt e-learning. Based on the relevance of these two variables to the adoption of new technology we propose our first two hypotheses as follows.

H1: Perceived usefulness (PU) positively influences intention to adopt m-learning.

H2: Perceived ease of use (PEOU) positively influences intention to adopt m-learning.

Facilitating Conditions

Acceptance of any new technology largely depends upon the supporting conditions/environment. Venkatesh et al. (2003) defined facilitating conditions as "the degree to which an individual believes that an organizational and technical infrastructure exists to support use of the system." In the context of m-learning these facilitating conditions include factors which can contribute to the adoption of m-learning, such as resources, knowledge, Internet speed, and support personnel.

There are many technical challenges that make adaptation of the present e-learning services to m-learning difficult, and due to these technical restrictions users will be reluctant to adopt m-learning (Wang et al., 2009). Some of these restrictions as noted by Maniar and Bennett (2002) are a lack of standardization, low bandwidth, limited processor speed, small screen size, low storage, short battery life, lack of data input capability, and software issues and interoperability. In addition to these, other limitations of the mobile devices have been pointed out by Shiau, Lim, and Shen (2001): unfriendly user interfaces, lower display resolution, limited memory and disk capacity, less surf-ability, and less computational power. Due to the importance of facilitating conditions, we propose our third hypothesis as follows.

H3: Facilitating conditions positively influences intention to adopt m-learning.

Perceived Playfulness

In previous studies, perceived playfulness was found to have positively influenced the adoption of IT-based innovations (e.g., mobile Internet and Internet-based learning media) (Lee

et al., 2005; Liu & Li, 2010). Moon and Kim (2001) added perceived playfulness to the TAM as an intrinsic motivation factor. An intrinsic motivator refers to an individual's performance or engagement in an activity due to his or her interest in the activity. Perceived fun, enjoyment, and playfulness are all examples of intrinsic motivation related to technology acceptance (Davis, Bagozzi, & Warshaw, 1992; Moon & Kim, 2001). Perceived playfulness being a source of intrinsic motivation is included as one of the variables in this study leading to our fourth hypothesis.

H4: Perceived playfulness positively influences intention to adopt m-learning.

Social Influence

It has been demonstrated in previous studies that social influence has a significant impact on an individual's intention to adopt a new technology (Matthieson, 1991; Harrison et al., 1997). Venkatesh et al. (2003) have defined social influence as the "degree to which an individual perceives that important others believe he or she should use the new system." Research suggests that social influence in a mandatory context is an important determinant in user acceptance of information systems/technology (Davis, 1989; Venkatesh, 2003). It also suggests that this may be due to mandatory compliance in behavior acceptance, which causes social influence to affect intention. However, other research (Venkatesh, 2003) indicates that social influence is strongest during the initial stages of technology use and decreases over time. Furthermore, UTAUT seems to show that the effect of social influence on behavior increases with age (Morris & Venkatesh, 2000).The fifth hypothesis to be tested is as follows.

H5: Social influence positively influences intention to adopt m-learning.

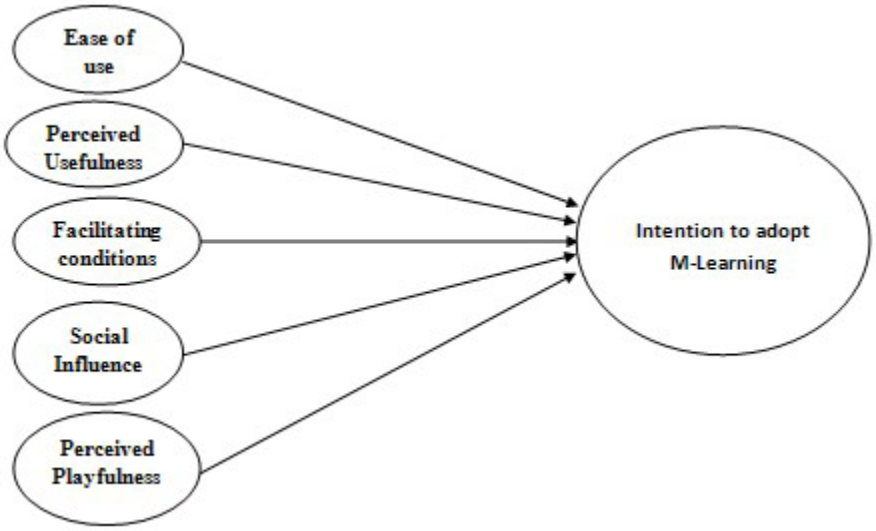

Figure 1. Graphical sketch of theoretical model.

Method

This is a survey-based study conducted through a structured questionnaire. The target population for this survey is the students of chartered universities operating in the twin cities of Rawalpindi and Islamabad in Pakistan. Ten universities were selected based on a convenient sampling technique. Both public and private universities were included in this survey since public universities outnumber the private universities in the twin city area; six of the selected universities belong to the public sector. The questionnaires were personally administered and distributed among the students of management sciences in the selected universities. The reason for conducting this survey among the students is that they represent the user side of m-learning and it is a commonly used approach in a distance learning context (see Biner, 1993; Roberts et al., 2005; Abbad et al., 2009). Before asking students to fill in the questionnaire, the researchers ensured that they were familiar with Internet usage on mobile phones.

A total of 300 questionnaires were distributed since a sample size of 200 is considered to be reasonable for structural equation model (SEM) research (Kenny, 2011), and ordinary least square (OLS) multiple regression is a special case of SEM (Kelley & Maxwell, 2003). Two hundred and sixty-one questionnaires were received, out of which 250 were found to be complete and useful for the purpose of further analysis. The response rate was 83%.

The questionnaire was divided into two parts: demographic information of the participants and responses regarding the five predictors, that is perceived usefulness (PU), perceived ease of use (PEOU), social influence (SI), perceived playfulness (PP), and facilitating conditions (FC), and one dependant variable, the intention to adopt m-learning (IML). PU consisted of four items (adapted from Venkatesh et al., 2003), which mainly focused on increases in productivity and effectiveness. PEOU consisted of five items (adapted from Venkatesh et al., 2003) and enquired about ease of access and learning. FC was measured using four items (adapted from Hung et al., 2003), mainly focusing on hardware and software support and Internet speed. PP was measured using three items (adapted from Moon and Kim, 2001) and focused on the enjoyability of the experience of learning through mobile devices. SI consisted of three items (adapted from Park et al., 2007) and focused on peer/superior and organizational pressures in adopting m-learning. IML was measured using four items, which mainly focused on the respondent's intention to use m-learning as a medium of learning (adopted from Venkatesh et al., 2003).

All the retrieved questionnaires were entered in the Statistical Package for Social Sciences (SPSS) version 17.0 for carrying out the statistical analysis. The data was screened to find outliers and missing values. All the out coded variables were rectified and data normality was checked by means of skewness and kurtosis (DeCarlo, 1997). Data reliability for each variable was checked by means of Cronbach's Alpha (Cronbach, 1951), which was found to be as follows: PU = .819, PEOU = .865, FC = .918, PP = .873, SI = .852, and IML = .807. Since all of these values are greater than 0.70 they fall in an acceptable range (Nunnally, 1978).

Results and Discussion

The demographic profile of the respondents is given in Table 1.

Table 1

Demographic Profiles of Respondents

		Frequency	Percent
Program enrolled	Undergraduate	50	20
	Graduate	125	50
	Postgraduate	75	30
	Total	250	100
Mobile device	Mobile phone	175	70
	PDA/palmtop	50	20
	Both mobile phone and PDA/ palmtop	25	10
	Total	250	100
Mobile capabilities	Large screen display	50	20
	External memory card	50	20
	Internet browsing	100	40
	Edge technology	50	20
	Total	250	100
Internet subscriber	Yes	175	70
	No	75	30
	Total	250	100
Internet plan	Prepaid	175	70
	Postpaid	75	30
	Total	250	100

Descriptive statistics for all the items used in this study are given in Table 2.

Table 2

Descriptive Statistics of Factors affecting M-Learning

	Mean	*SD*
Perceived Usefulness (PU)		
M-learning tools help in accomplishing tasks more quickly than doing them through computers	2.8280	.95186
M-learning increase the job performance	3.2440	1.10877
Use of M-learning will result in increased productivity	3.4880	1.04221
Use of M-learning will increase effectiveness	3.6080	1.17467
Perceived Ease of Use (PEOU)		
M-learning make learning easier	3.8200	1.25934
M-learning is very much useful for students	3.5840	1.24303
It is easy to access information in M-learning	3.5600	.85400
It is easy to get things done using M-learning tools then by doing otherwise.	3.7400	.89195
It is easy to become skilful at using M-learning tools	3.4200	1.06213
Facilitating Conditions (FC)		
I have the resources necessary to use m-learning	3.0720	1.16974
I had the knowledge necessary to use m-learning	3.2320	1.06145
Internet speed is appropriate for m-learning	3.4360	1.01688
A specific person (or group) was available for assistance with m-learning difficulties or queries	3.5120	1.06884
Perceived Playfulness (PP)		
When using m-learning, I will not realize the time elapsed	3.9880	1.06602
When using m-learning, I will not forget the work I must do	3.9600	.97684
Using m-learning will give enjoyment to me for my learning	3.9440	.95945
Social Influence (SI)		
People who influence my behavior will think that I should use m-learning	3.1200	1.31167
People who are important for me will think that I should use m-learning	3.4080	1.08362
In general, the organization supported the use of m-learning	3.5160	1.14849
Intention to use M-Learning (IML)		
I intend to use mobile devices for educational purposes	3.1400	.86452
I have the sufficient knowledge and skills to use mobile devices for educational purposes	3.4200	1.04689
I will prefer m-learning over other mediums of learning	3.2480	1.02308
I will recommend other colleagues to use mobile devices for educational purposes	3.1880	1.10886

To find out if there is any difference in the intention to use m-learning among students belonging to different degree programs, an analysis of variance (ANOVA) test was applied (Table 3). It was discovered that the students belonging to undergraduate degree programs had a relatively greater intention to use m-learning. This finding is in line with recent research on audience characteristics published by the British Broadcasting Corporation (BBC), which shows that British youngsters in the 16-24 age group (university age group) mostly own mobile devices. This research characterizes a mobile phone as a necessity and not a luxury (Keegan, 2012). The relationship between age and intention to use m-learning is also confirmed in other research (e.g., White & Weatherhall, 2000).

Table 3

Intention to use M-Learning and Program Enrolled

	N	Mean	Levene Static	*F*	Sig
Undergraduate	50	3.3950			
Graduate	125	3.2300			
Postgraduate	75	3.2533			
Total	250	3.2700	.019	.833	.436

Spearman's Rho test was applied to find if there is any relationship between Internet plan and intention to use m-learning. The result (shown in Table 4) indicates an insignificant relationship between these two variables. This result also falls in line with those research studies in which service availability was found to have an insignificant impact on behavioral intention to adopt m-learning (Fadare et al., 2011). Despite the diffusion of advanced mobile phones with third generation (3G) technology, advanced mobile services have not yet found their way into consumers' daily lives and consumers in general are reluctant to adopt these services (Carlsson et al., 2005, 2006a; Walden et al., 2007).

Table 4

Correlation between Internet Plan and Intention to use M-Learning

	Intention to use m-learning	Internet plan
Correlation coefficient	1.000	
Correlation coefficient	.004	1.000

The relationship between mobile devices owned, perceived playfulness (PP), and intention to adopt m-learning (IML) was analyzed by means of correlation. The results of the test are summarized in Table 5.

Table 5

Correlation between IML, Mobile Device, and PP

		IML	Mobile device	PP
IML	Pearson correlation	1		
Mobile device	Pearson correlation	-.025	1	
PP	Pearson correlation	-.328**	-.019	1

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

The results indicate a negative correlation between the mobile device and IML as well as between PP and IML, which is consistent with previous research on the topic:

> Realistically though, for students or company staff, since any learning needs effort and brainwork, how many of them want to study or learn rather than relax on the bus or in the car on the way home after a long day of work or study? On the way back home from school or office, most people prefer to listen to music, the radio news, or sports programs. When they get home, if they want to learn, mobile devices are not likely to be their main choice. The more likely choices would be DVD/CD Players, videotapes, computers installed with learning software or computers with high speed access to the Internet for e-learning. (Shudong & Hiddings, 2006, p. 4)

In order to examine the hypothesized relationship, ordinary least square regression (OLS) is used. The results of the regression test are given in Table 6.

Table 6

Regression Results: Coefficient, Standard Error, T-Value, and P-Value

	Const.	Perceived Usefulness	Ease of Use	Facilitating Conditions	Perceived Playfulness	Social Influence
Coefficient	1.222	.195	.217	.249	.018	-.074
Std. errors	.316	.067	.048	.061	.064	.060
T-stats	3.872	2.890	4.473	4.080	.282	-1.230
P-value	.000	.004	.000	.000	.778	.220
F-stats	47.310					
P-value	.000					
Adj. R square	.482					

Dependent variable: intention to use m-learning; level of significance = 0.05

Overall the model was found to be significant (P-value = .000). The above table shows that perceived usefulness (.004), ease of use (.000), and facilitating conditions (.000) significantly affect the adoption of m-learning; whereas, perceived playfulness (P-value = .778) has a less significant impact on the intention to adopt m-learning. Social influence (P-value = .220) has a negative impact on the intention to adopt m-learning.

Table 7

Overall Results of Hypotheses Testing

#	Hypothesis	Supported?
H1	Perceived usefulness (PU) positively influences intention to adopt m-learning.	Yes
H2	Peceived ease of use positively (PEOU) positively influences intention to adopt m-learning.	Yes
H3	Facilitating conditions positively influences intention to adopt m-learning.	Yes
H4	Perceived playfulness positively influences intention to adopt m-learning.	No
H5	Social influence positively influences intention to adopt m-learning.	No

The purpose of this study was primarily to extend the understanding of student's m-learning adoption. PEOU and PU had a significant impact on behavioral intention which is consistent with other studies conducted on acceptance of technology. Ju et al. (2007), based on 245 completed questionnaires, concluded that PU significantly affects users' attitudes which further influence the users' intention to adopt m-learning. Moreover, we found that per-

ceived playfulness had no significant impact on adoption behavior, which is not in line with some of the previous studies (Huang et al., 2007; Wang et al., 2009). The main reason for this difference could be unfamiliarity with smart phones. As indicated in the demographic profile data only a small percentage of students owned smart phones. Once a greater proportion of the student population owns mobile phones with advanced technology features the impact of this variable is likely to change. Also in Pakistan most of the telecommunication networks are still operating on 2G (second generation) mobile technology, which is far inferior to 3G technology. This can also be a limiting factor for the perceived playfulness of m-learning. System quality depends a lot on the underlying mobile technology and with 3G technology (third generation mobile communication) becoming popular the possibility of bringing new function modules for m-learning has increased. The transmission speed as well as presentation of multimedia content is much superior in 3G as compared to the previous two generations. This technology enables the users to see images more fluently and hear voices more clearly and browse the Internet more quickly (Zhuang & Xiaoyan, 2009). With widespread usage of 3G the scope of m-learning would further expand.

The negative but insignificant impact of social influence on student intention is somewhat inconsistent with those studies that emphasize the role of social influence in adoption of technology (McInerney, 2005). In the context of students' perceptions these findings look into the role of schools, teachers, and peers. It can be concluded that in developing countries such as Pakistan where m-learning is still in an embryonic stage the influence of peers, teachers, and schools on m-learning adoption is insignificant. The main impediments could be the high cost of smart phones and nonavailability of supporting technology.

Facilitating conditions, such as Internet speed, hardware, and software support, are very important for m-learning adoption. This suggests that students will not be inclined towards m-learning adoption in the absence of these facilitating conditions. Limited access to broadband wireless may prohibit ready access to mobile content (Lawrence et al., 2008). Students' perceptions about m-learning usefulness and ease of use as well as facilitating conditions to support m-learning are the main driving forces; whereas, social influence and perceived playfulness will play their part in motivating students once the smart phones as well as 3G technology become easily accessible to the vast majority.

The TAM and unified theory of acceptance and use of technology (UTAUT) model were developed to describe IT innovation adoption in organizational contexts, "but the mobile technology adoption is more individual, more personalized and focused on the services made available by the technology" (Carlsson et al., 2006b, p. 8). While applying TAM and UTAUT to m-learning, certain points need to be considered. Firstly, the users are the learners and not employees, and, secondly, m-learning is an education service which is different from traditional services. Based on an extensive review of the literature, the proposed model extends the well-established technology acceptance model for m-learning adoption. The model addresses the weakness of TAM to include social contexts where technology users are treated as learners and not employees.

Conclusion and Recommendations

M-learning has the potential to become an effective partner for providing education along with traditional methods. Particularly, it can be a medium of interest in developing countries where the number of mobile users is far greater than the number of wire users (Yu, Wang, & Chen, 2007). If any student fails to attend a class and he does not have access to an Internet-enabled PC, he can access the information delivered in the class using his mobile device. M-learning can be used to leap-frog over existing e-learning in developing countries (Motlik, 2008).

The concepts and instructional issues related to m-learning are evolving (Kukulska-Hulme, 2007). This research adds to the existing literature on student acceptance and intention to adopt m-learning. Understanding the factors affecting mobile learning will help the stakeholders (i.e., educators, software developers, and technicians) to incorporate these factors in their design and implementation of m-learning initiatives. This medium can become successful only if there is a positive contribution from all stakeholders. Students' interest in mobile devices and m-learning is clear from the findings of this study; the educationists and software developers can attract more users by providing content and information on resources formatted for mobile devices and by educating students on its benefits. The key is to understand students' needs and concerns and the factors affecting their acceptance.

Limitations of the Research and Future Direction

Future studies can focus on specific disciplines such as engineering, medicine, humanities, and arts to figure out the ideal disciplines for adoption of this medium of education. Effectiveness of m-learning programs depends on the field of study. For example, courses related to business and liberal arts require a limited set of software, which can either be acquired free of cost or at a very low price; whereas, courses related to information technology (IT) and engineering require a much larger set of applications, which generally are expensive and require frequent updating (Percival & Percival, 2008). Moreover, the types of students that will be more comfortable with this medium can be identified in future research.

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