

Exploring the Major Determinants of Mobile Learning Adoption

Nuri Başıođlu and M. Kubilay Özdođan

Abstract

From notebook computers to mobile phones, wireless devices have become affordable and popular. With rapidly improving Internet capabilities, the demand for mobility has spread to education. Mobile learning (m-learning) combines individualized learning with anytime and anywhere learning. MLARG is an application designed to support the learning of a foreign language. It provides course content and examinations in various formats. The purpose of this research was to identify independent and intermediary factors that could contribute to the adoption and success of MLARG. A list of likely factors influencing adoption was developed by modifying and extending the Technology Adoption Model (TAM). Feedback concerning the application was gathered from 9th grade students in a tourism vocational high school in Istanbul, the students for whom the application was intended.

Keywords: Mobile learning, Technology Adoption Model (TAM).

Introduction

The field of education has channeled considerable resources to facilitate the adoption of technological innovations (Vinu & Sherimon, 2011). Over the years, developments in Information and Communication Technology (ICT) have helped to make teaching and learning more effective (Chang, Chen, & Kao, 2008). An early innovation in the 20th century was the broadcasting of educational programs on radio and television (Karagiannidis, Koumpis, & Lekakos, 2009). Then came the delivery of learning materials via CD ROMs (Suo & Shi, 2008). With the rapid development of the Internet in the 90's, a number of web-based e-learning environments were developed (Karagiannidis et al., 2009). E-learning now comprises all forms of electronically supported teaching and learning, a new branch of which is mobile learning, also known as m-learning. Driving the development of m-learning and the expansion of wireless communication is the increasing processing power and the enhanced technical features of handheld devices. M-learning is not hampered by inefficient classroom equipment and the difficulties of accessibility associated with traditional classroom instruction (Karagiannidis et al., 2009). In addition, it provides an opportunity to support learning activities with activities outside the classroom (Özdamlı & Çavuş, 2011). Thus, in many educational institutions m-learning is attracting attention because it gives students access to learning materials from anywhere and at any time (Nagella & Govindarajulu, 2009).

Mobile technologies have become indispensable because they connect us to vast numbers of information sources and enable instant and ubiquitous communication. By the end of 2010, there were 5.3 billion mobile cellular phone subscribers, including 940 million subscriptions to 3G services (ITU, 2011). Ninety percent of the world's

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population and 80% of the population living in rural areas have access to mobile networks (ITU, 2011).

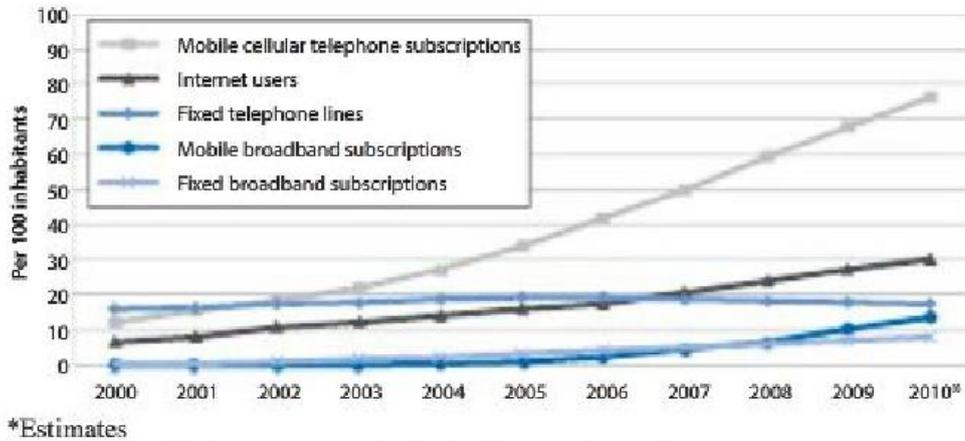


Figure 1. Global ICT growth, 2000-2010* (ITU, 2011)

As in the rest of the world, the use of mobile phones has significantly increased in Turkey. As of March 2011, the penetration rate in Turkey was 84% (61.7 million users), compared to 49% in 2004 (Information and Communication Technologies Authority, 2011). Concerning Internet use in households, the ratio for connection over mobile phones with WAP and GPRS technologies is 23.8%, and the connection over mobile phones with 3G technology is 5.6%. Mobile connection over 3G modems is 2.3% (State Planning Organization, 2011). The total number of mobile Internet users increased to 1.863 million in the first quarter of 2011, up from 640,580 in the first quarter of 2010, a 190% growth rate (Information and Communication Technologies Authority, 2011). Considering the 16,137,436 students in formal education and the 7,062,429 students in non-formal education (as of 2009–10), the use of mobile technologies for learning offers great potential (Ministry of National Education, 2011).

Although there are various types of mobile technologies available, including laptops, Personal Digital Assistants (PDAs), electronic dictionaries, and notebooks, educators are now attracted to the potential of mobile phones (Hashemi & Ghasemi, 2011). One of the reasons for their popularity is the widespread infiltration of the market, particularly in Japan and the US (Hashemi, Azizinezhad, Najafia, & Nesari, 2011). Another is the rapid development of mobile phone technology in the past 10 years, from plain and simple cell phones to the current high-tech devices that can serve as a PDA, mini-computer, camera, video and audio recorder in addition to being a telephone. There is a stream of new technology breaking into the mobile phone market (Hashemi et al., 2011). New multimedia applications allow learners to have access to a wide variety of richly diversified resources (Hashemi et al., 2011).

Mobile learning, also known as m-learning, has been made possible by advances in the design of operating systems, less expensive hardware, and the broad acceptance of mobile phone technologies (Hashemi et al., 2011). The new mobile devices must meet three criteria: They must have communication and information functions, they must be carried easily, and for extended periods of time they must be functional without a physical connection to power or to a telecommunications provider (Hashemi et al., 2011). Such devices facilitate learning by providing personalized access to learning materials anywhere and anytime (Lan & Sie, 2010; Yi, Ming, & Hsiu, 2009; Homan & Wood, 2003). Seppälä and Alamäki (2003) claim that mobile technology enhances the joy of learning. Using one easily operated device, learners can get information about courses, attend exams, download notes, and share information. Thus learners can study during periods of free time, because they usually have their mobile devices with them (Evans, 2008; Vavoula & Sharples, 2009). Additionally, using the same technology, teachers can get reports of learners' progress.

Mobile learning is ubiquitous, blended, private, interactive, and collaborative (Özdamlı et al., 2011).

- *Ubiquitous/spontaneous.* Mobile learning is more spontaneous than other learning types and this spontaneity is probably the most defining characteristic of mobile learning. Mobile learning is context aware, meaning that students can learn everywhere (Çavuş & İbrahim, 2009).
- *Portable.* Mobile learning devices are small and easily carried (Çavuş & İbrahim, 2009).
- *Blended.* Blended learning, which combines classroom instruction and m-learning, can maximize the benefits of both face-to-face and online methods (Bonk & Graham, 2006).
- *Private.* Usually, only one learner at a time has access to the mobile device. The learner gains access to and downloads information independently from other learners (Zhang, 2003; Virvou & Alepis, 2005).
- *Interactive.* The learners are not passive; the functions of mobile tools and environments allow varying levels of interactivity. M-learning environments utilize the latest technologies to bring an interactive learning environment into learning and teaching activities (Çavuş & Uzunboylu, 2009).
- *Collaborative.* Mobile technologies support communication among students, so mobile technologies may be used for collaborative learning activities (Uzunboylu, Çavuş, & Erçağ, 2009; Virvou & Alepis, 2005).
- *Instant information.* Using a mobile device is all about immediacy (Eteokleous & Ktoridou, 2009; Çavuş & İbrahim, 2009). It provides quick answers to specific questions (Cohen, 2010). Learning content must reflect this requirement by providing easily accessed material (Özdamlı & Çavuş, 2011).

Although all of these characteristics are advantageous, we should keep in mind that m-learning devices may also have some disadvantages. The screen size of mobile phones and PDAs limit the amount and type of information that can be displayed. The

devices have limited storage capacity and battery life, which can result in the loss of data. Lack of a common operating system and common hardware make it difficult to develop common software. Under pressure from a large number of users, wireless bandwidth may degrade (Hashemi et al., 2011).

The use of mobile technologies in language teaching has received a lot of attention, resulting in research studies pertaining to mobile assisted language learning (MALL). An EU Lifelong Learning Programme-Leonardo Innovation Transfer project entitled MLARG (Mobile Learning for Young-People-at-Risk Groups), led by Boğaziçi University, involves the implementation of m-learning technologies for teaching English as a foreign language to students from lower socioeconomic backgrounds. The project is both innovative in its use of mobile technology in foreign language education and inclusive in that it is designed for young people at risk. The focus on m-learning is justified by the project team as follows:

- M-learning helps learners to develop positive attitudes towards school subjects and technology
- Learners are motivated to take part in learning activities
- M-learning provides “anywhere, anytime and personalized” learning for all.

Since the participants are given the use of m-learning devices during the implementation of the project, it is believed that the resulting feeling of being valued will lead to increased self-esteem and self-confidence.

The purpose of the research was to identify independent and intermediary factors contributing to the adoption and success of the innovation. Before and after feedback via surveys was intended to guide modifications to the design for better implementation and quality of service.

Literature Review

A number of theories attempt to explain the process of adopting a new technology. The Theory of Reasoned Action (TRA) was proposed by Ajzen and Fishbein (1975). TRA suggests that one's intention to behave in a certain way depends on one's attitude toward the behavior and certain subjective norms (Ajzen & Fishbein, 1980). Behavioral intention is a measure of the strength of intention. One's attitude consists of beliefs about the consequences of the behavior multiplied by one's valuation of the consequences. The subjective norm is seen as a combination of the perceived expectations of others along with intentions to comply with their expectations (Fishbein & Ajzen, 1975). In other words, one's behavior can be predicted by one's attitude toward the behavior in question and the anticipation of what other people would think if one were to go ahead and perform the behavior.

The Technology Acceptance Model (TAM) is a widely applied model used in studies of IT adoption. It emphasizes two theoretical constructs, perceived usefulness and perceived ease of use, which are considered to be fundamental determinants (Davis, 1989). Altogether, TAM includes five constructs: ease of use, usefulness, attitude toward use, intention to use and actual use. One study confirmed that usefulness has a stronger influence than ease of use (Lederer, Maupin, Sena, & Zhuang, 2000); and in

some cases the influence of ease of use on acceptance could not be demonstrated (Kargin, Başoğlu, & Daim, 2009).

TAM is extended by explaining perceived usefulness and usage intentions in terms of social influence and cognitive instrumental process (Venkatesh & Davis, 2000). TAM demonstrated that both social influence process (subjective norm, voluntariness, and image) and cognitive instrumental process (job relevance, output quality, result demonstrability, and perceived ease of use) significantly influence user acceptance (Venkatesh & Davis, 2000).

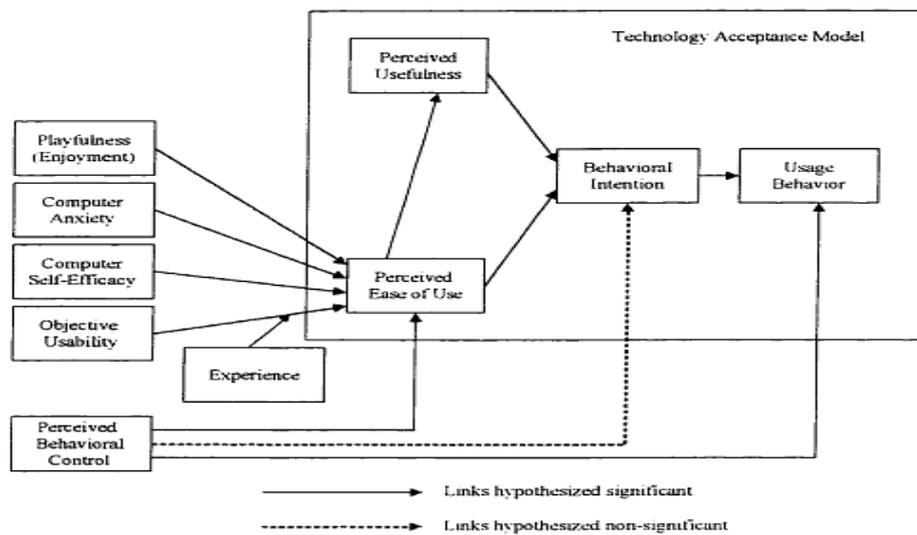


Figure 2. Model of the determinants of Perceived Ease of Use (Venkatesh, 1998)

The Unified Theory of Acceptance and Use of Technology (UTAUT) took TAM as a starting point and reconceptualized constructs from other user acceptance research as the determinants of perceived usefulness and perceived ease of use. Subjective norm and innovation characteristics are the proposed determinants of perceived usefulness while perceived behavioral control, computer anxiety, enjoyment, computer self-efficacy, objective usability, and experience are the proposed determinants of perceived ease of use (Venkatesh & Davis, 2000).

We used an extended list of factors in addition to those used in TAM (see Table 1).

Research Framework

To identify the independent and intermediary factors that contribute to the adoption and success of the m-learning application, we examined the connections between satisfaction, facilitating conditions, reward/motivation, peer influence, external

influence, computer self-efficacy, personal innovativeness, interface, mobility, perceived usefulness, perceived ease of use, and attitude towards use.

Table 1. The constructs and related publications

Constructs	Publication
Facilitating Conditions	Venkatesh, Morris, Davis, & Davis, 2003
Reward	Julnes & Holzer, 2001
Peer Influence	Kelman, 1958; Warshaw, 1980; Venkatesh, & Morris, 2000; Teo & Pok, 2003
External Influence	Venkatesh, Morris, Davis & Davis, 2003; Teo & Pok, 2003 Hung, Ku, & Chang, 2003)
Computer Self-efficacy	Venkatesh, & Davis, 1994, 1996; Bandura, 1977; Bandura, 1982
Personal innovativeness	Rogers, 1995; Lu, Yaob, & Yua, 2005
Interface	Pagani, 2004
Mobility	Kleinrock, 1996; Mallat, 2007; Mallat, Rossi, Tuunainen, & Öörni, 2006
Perceived Usefulness	Davis, 1989; Venkatesh, Morris, Davis, & Davis, 2003; Lu, Yu, Liu, & Yao, 2003; Mallat, Rossi, Tuunainen, & Öörni, 2006
Perceived Ease of Use	Davis, 1989; Troshani & Rao, 2007; Keil, Beranek, & Konsynski, 1995; Mallat, Rossi, Tuunainen, & Öörni, 2006)

Based on previous research we proposed thirteen hypotheses for the model.

1. Attitude Towards Use significantly and positively influences Satisfaction
2. Perceived Usefulness significantly and positively influences Satisfaction
3. Perceived Usefulness significantly and positively influences Attitude Towards Use

A system high in perceived usefulness is one which, in a user's opinion, has a positive use-performance relationship (Davis, 1989). Perceived usefulness is also known as performance expectancy (Venkatesh, Morris, Davis, & Davis, 2003). When a potential adopter believes that there is a direct relationship between use on the one hand and productivity, performance, effectiveness, or satisfaction on the other, it is said that the usefulness is high (Lu, Yu, Liu, & Yao, 2003).

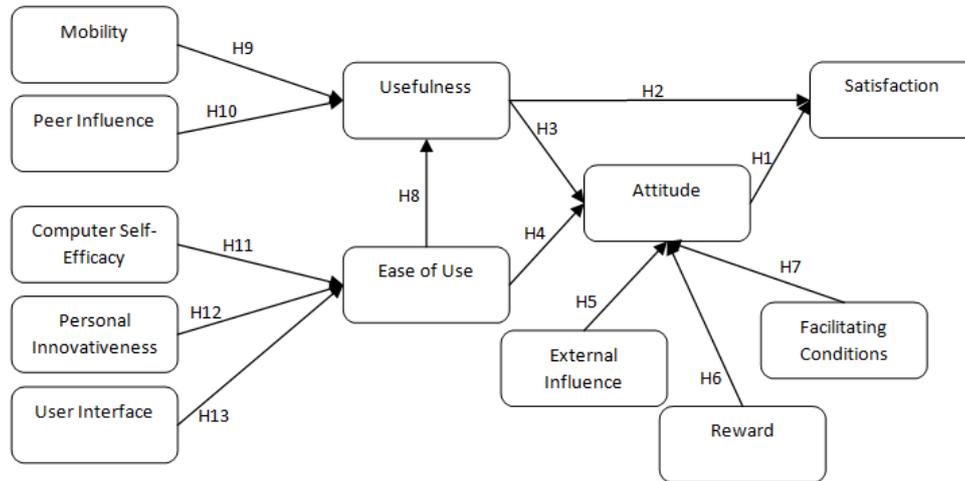


Figure 3. Framework of the proposed model

4. Perceived Ease of Use significantly and positively influences Attitude Towards Use

Perceived ease of use is the “degree to which a person believes that using a particular system would be free of effort” (Davis, 1989). Perceived ease of use and perceived usefulness predict attitudes toward use of innovative technology (Davis, 1989). Based on this evidence, we hypothesize:

5. External Influence significantly and positively influences Attitude Towards Use

Social influence constitutes the degree to which individuals perceive that significant others approve the use of an innovation (Venkatesh et al., 2003). When individuals have little or no experience of an innovation, they will be especially influenced by the opinions of reference groups (Teo & Pok, 2003). Social influences are classified in two groups, peer influence and external influence (Hung, Ku, & Chang, 2003).

6. Reward significantly and positively influences Attitude Towards Use

One can explore an organizations’ potential to manage for results by looking at how open to change it is. Openness may be inferred by the presence of systems that reward innovation and risk taking, and by evaluating the perceptions and attitudes of personnel toward innovation, change, and performance. Organizational incentive systems can be used to control and facilitate the use of information. Thus one would

expect these factors to have an important and positive effect on adoption and implementation (Julnes & Holzer, 2001).

7. Facilitating Conditions significantly and positively influence Attitude Towards Use

Facilitating conditions in the adoption environment refer to external controls intended to facilitate the adoption and diffusion of new technologies. Facilitating conditions are important because they are considered to be direct antecedents, and therefore are likely to facilitate adoption behavior by removing obstacles and acting to sustain usage (Venkatesh et al., 2003).

8. Perceived Ease of Use significantly and positively influences Perceived Usefulness

Perceived ease of use may contribute to performance, and therefore, in the short term, contribute to perceived usefulness. On the other hand, lack of ease of use can cause frustration and impair adoption (Troshani & Rao, 2007). However, Keil, Beranek, and Konsynski (1995) concluded in their study that no amount of ease of use will compensate for low usefulness.

9. Mobility significantly and positively influences Perceived Usefulness

To have real-time information and to keep in touch with colleagues, family, and friends, mobility is essential. Among the benefits of mobile technologies, Kleinrock (1996) listed “anytime and anywhere computing” and identified the most common dimensions of mobility as independence of time and of place.

10. Peer Influence significantly and positively influences Perceived Usefulness

When one learns that an important referent recommends a system, one incorporates the referent’s opinion into one’s own belief structure (Kelman, 1958; Warshaw, 1980). If a co-worker or superior suggests that a particular system might be useful, one may come to believe that it actually is useful and form an intention to use (Venkatesh & Morris, 2000). Peer influence is stronger when one’s behavior is novel and tentative. Teo & Pok (2003) also used social factors in their research model.

11. Computer Self-efficacy significantly and positively influences Perceived Ease of Use

Venkatesh & Davis (1994, 1996) proposed and tested computer self-efficacy as a determinant of ease of use perceptions. Retaining computer self-efficacy and objective usability as determinants of perceived ease of use is based on self-efficacy theory and significant empirical evidence in support of the idea (Venkatesh & Davis, 1994, 1996; Bandura, 1977, 1982).

12. Personal Innovativeness significantly and positively influences Perceived Ease of Use

Innovativeness is defined as the extent to which an individual, when compared to others, is early to adopt new ideas (Rogers, 1995). Individuals with higher levels of personal innovativeness are more inclined to develop positive beliefs concerning innovative Information Systems (IS) than those with lower levels (Lu, Yaob, & Yua, 2005). A growing set of IS literature indicates that personal innovativeness is a significant predictor for perceived ease of use (Lu et al., 2005).

13. User Interface significantly and positively influences Perceived Ease of Use

Consideration of relatively small screens and miniaturized keypads may adversely affect usage. This suggests that input and output devices are likely to influence perceived ease of use (Pagani, 2004). In addition, user-friendly and usable interfaces, including clear and visible steps, suitable content, graphical layouts, help functions, clear command, symbols, and meaningful error messages, are all likely to influence adoption (Condos, James, Every, & Simpson, 2002). Pagani (2004) argues that response time affects perceived ease of use and that mobile bandwidth, therefore, also becomes important.

Results and Discussion

Participants in the study were eighty one 9th grade students in a tourism vocational high school in Istanbul, 48.1% female and 51.9 % male, all between 15 and 18 years of age. They responded to a questionnaire before starting to use the application M-LARG. Development of the questionnaire was guided by information derived from the literature and from interviews with pioneering students who had early experience of M-LARG.

All 24 items were measured with a five-point Likert-type scale from “1–strongly disagree” to “5–strongly agree.” Some items were worded in reverse. The internal consistency reliabilities of the constructs were tested with Cronbach’s alpha coefficient (α), which should be equal to or greater than 0.50. Items with α value lower than 0.50 were dropped.

Of the 81 respondents, 55.7% were convinced that they could use mobile applications with ease. A majority reported that they feel no stress when adopting new ideas and would be more eager to use an application if they thought that they would get support when encountering problems. The screen size and the design of the application (fonts, menus, colors etc.) were reported to influence ease of use by 80% of the respondents.

All these results are based on the students’ perception of the m-learning application, not their experience of using it, since they were not exposed to the application when the survey was conducted.

Usefulness and facilitating conditions were critical factors for attitude toward use. The results indicate that ease of use does not affect either attitude toward use or usefulness.

Male students, compared to female students, showed higher mean values for facilitating conditions, usefulness, and attitude toward use. They were more eager to use the application if they thought they would get support and they believed that the application would have a positive effect on their learning.

Table 2. Descriptive statistics for the constructs

Construct	Mean	Median	Standard Deviation	Minimum	Maximum
Mobility	4.41	5.00	0.98	1.00	5.00
User Interface	4.27	4.50	0.97	1.00	5.00
Personal Innovativeness	4.05	4.00	1.18	1.00	5.00
Facilitating Conditions	3.92	4.00	1.08	1.00	5.00
Reward	3.65	3.50	1.03	1.00	5.00
Computer Self-Efficacy	3.63	4.00	1.32	1.00	5.00
Peer Influence	3.40	3.50	1.37	1.00	5.00
External Influence	3.37	3.50	1.27	1.00	5.00
Usefulness	3.85	4.00	1.01	1.00	5.00
Ease of Use	3.74	4.00	1.27	1.00	5.00
Attitude Toward Use	3.95	4.00	1.04	1.00	5.00

Although it is not a significant difference, female students had higher mean values on mobility and peer influence than male students. Compared to male students, they seemed to be more influenced by their friends and assigned greater importance on anywhere/anytime availability.

Stepwise linear regression was used to obtain the results, a summary of which is displayed in Table 3.

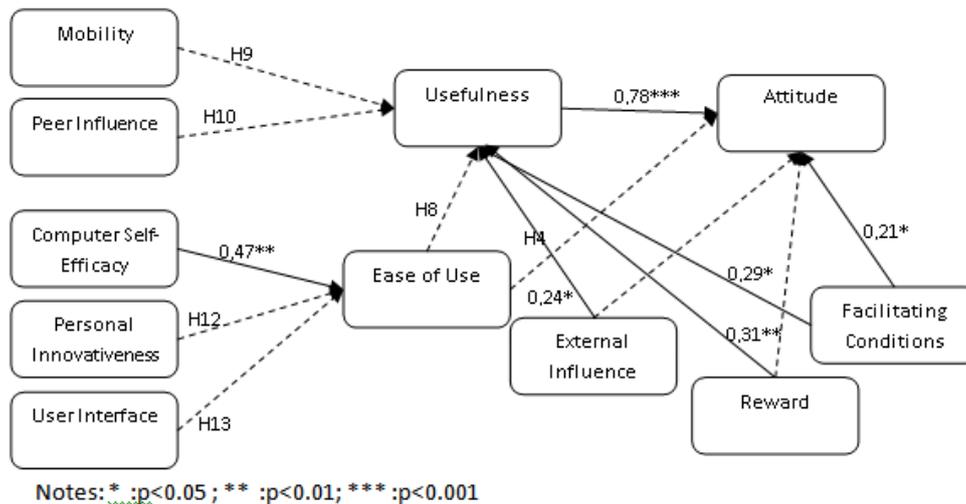
Table 3. Results of regression analysis

Dependent Variable	Independent Variables	Standardized Beta	Significance
Attitude Toward Use	Usefulness	0.68	0.000
	Facilitating Conditions	0.21	0.028
Usefulness	Facilitating Conditions	0.29	0.024
	Reward	0.31	0.010
	External Influence	0.24	0.041
EoU	Computer Self-Efficacy	0.47	0.000

Table 4. Supported and unsupported hypotheses

Hypothesis	Dependent Variable	Independent Variable	Relationship
3	Attitude Toward Use	Perceived Usefulness	Supported
4	Attitude Toward Use	Perceived Ease of Use	Unsupported
5	Attitude Toward Use	External Influence	Unsupported
6	Attitude Toward Use	Reward	Unsupported
7	Attitude Toward Use	Facilitating Conditions	Supported
8	Perceived Usefulness	Perceived Ease of Use	Unsupported
9	Perceived Usefulness	Mobility	Unsupported
10	Perceived Usefulness	Peer Influence	Unsupported
11	Perceived Ease of Use	Computer Self-Efficacy	Supported
12	Perceived Ease of Use	Personal Innovativeness	Unsupported
13	Perceived Ease of Use	User Interface	Unsupported

Results indicate that 3 of the 13 hypotheses from the proposed model were significantly supported. Figure 4 shows the structural relationships in the model. Unsupported hypotheses are shown with dashed lines. The variance in user attitude toward use explained by the model is 66%. Usefulness and facilitating conditions are direct determinants of attitude toward use, whereas external influence and reward are

**Figure 4.** Factors influencing mobile service adoption

indirect determinants. Among all constructs, usefulness has the strongest influence on attitude toward use, as supported with a high beta coefficient (0.68) at a low significance level (0.000).

Contrary to the proposed model, mobility and peer influence have no influence on usefulness. Perhaps, lacking experience of m-learning applications, one cannot form a distinct impression of m-learning and thus influence others' impressions. Although there are other text-based applications available to mobile phone users, such as dictionaries and translators, the respondents could not have experienced the sort of comprehensive application suitable for foreign language learning. On the other hand, it was learned that external influence, facilitating conditions, and reward are the determinants of usefulness.

The model shows that computer self-efficacy has a strong influence on ease of use. One's belief in one's capabilities shapes one's expectation of ease or difficulty. Although personal innovativeness and user interface were proposed determinants of ease of use, the study shows that they have no such influence—not a surprise since the students had no previous experience of the application.

Conclusion

Our intention was to identify the independent and intermediary factors that contribute to the adoption and success of a mobile learning application and to measure the weight of their influence on attitude toward use. We observed that usefulness and facilitating conditions are the key determinants of attitude toward use. External influence, reward, and facilitating conditions are critical factors influencing perceived usefulness; but contrary to the literature, ease of use in this study had no influence on perceived usefulness. According to these results, computer self-efficacy is the only determinant of perceived ease of use.

The major limitation of the study is its emphasis on attitude toward the use of m-learning in the absence of actual use. In addition, the results should not be generalized to users or potential users in other age groups or users from other cultural backgrounds.

In future, we intend to administer the questionnaire, with an extended set of items, to the same subjects after they have actually used the m-learning application MLARG.

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