

Mobile Learning Among University Students: Adoption and Application of M-Learning

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Abstract- The successful implementation of mobile learning is mainly impacted by learners' attitudes to accepting and applying mobile learning systems. In the current study, an m-learning application was developed and implemented for university students, and their perspective toward the adoption and application of m-learning was investigated. This cross-sectional study was carried out in 2020. The participants were 114 university students at Abadan University of Medical Sciences. Data were collected by means of a valid questionnaire containing 42 questions in 13 subscales in addition to an open-ended question about the positive and negative aspects of the m-learning application. There was a significant relationship between acceptance and major ($P=0.001$), mobile usage ($P=0.035$), and familiarity with m-learning ($P<0.001$). The total mean of m-learning application acceptance was 3.95 ± 0.32 , which shows a good level. Self-efficacy, perceived ease of use, and user interface were, respectively, the most influencing factors; mobile device limitation and governmental support were the least influencing factors. "Direct communication with the teacher/instructor" and "Internet disconnection during video teaching" were among the positive and negative aspects of applying the m-learning application, respectively. The m-learning application was well adopted among the students. Mobile device limitations are a reason for the student's concerns. "Usability features" can be a point for covering mobile device limitations.

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Introduction

In the current century, technological and scientific development has brought about new educational changes and reforms at the global, national, and individual levels. Development in information and communication technologies provides an opportunity for creating a learning environment that is well-designed, interactive, creative, and flexible (1,2). Last decade the emergence of the Knowledge Economy combined globalization with information and communication technology (3). The

knowledge economy has influenced modern learning systems besides the integration of mobile devices into the educational setting. Educational institutions are interested in applying the new technologies in order to support face-to-face education (4).

M-learning is a subset of e-learning which itself is a subset of distance learning. M-learning is wireless communication between individuals using portable learning tools such as mobile phones, personal digital assistants, and tablet PCs (5). M-learning can provide learning opportunities independent of time and place. The

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most important advantage of m-learning compared to e-learning, according to Korucu and Alkan (2), is accessibility by students to the required information anytime and anywhere. Due to the introduction of new generations of mobile communication networks like 4G and 5G over the past decade, m-learning has become more feasible. Al-Jundi *et al.*, (6) and Triantafyllou *et al.*, (7) found that using m-learning for conducting tests was more effective and efficient, and students got better grades. Moreover, it is reported that m-learning can increase students' participation and achievement (8,9). Despite the aforementioned advantages of m-learning, researchers have pointed to some challenges. For instance, Odukoya *et al.*, (10) call m-learning a double-edged sword since it can provide positive learning performance and negative activities. Negative activities include downloading a film or music, chatting on social networks, or playing games which decrease academic productivity (10,11). These findings suggest that it is necessary to investigate the environment and the pedagogical factors before implementing m-learning.

Nowadays, with the emergence of the COVID-19 pandemic disease, using distance learning and, more specifically, m-learning seems inevitable. Almost all universities in Iran hold online or virtual courses. Thus, less attention has been paid to implementing mobile devices, which are a more accessible tool among students. However, the successful implementation of e-learning and m-learning is mainly impacted by learners' attitudes toward the adoption and application of m-learning/e-learning. Previous pieces of literature have found that user acceptance is significantly affected by individual, social, and organizational background within a specific culture (12,13). M-learning acceptance varies in different contexts, especially in developing countries, and needs policymakers to understand the factors influencing m-learning (14). Although m-learning is not widely implemented in developing countries, some studies have explored effective factors on m-learning acceptance before its implementation. For instance, Kanwal *et al.*, (14) examined the adoption of e-learning in Pakistan. They stated that self-efficacy, Internet experience, enjoyment, and system characteristics are influential features of e-learning systems. Chavoshi *et al.*, (15) also explored the factors influencing the acceptance of m-learning in Iran and found that a combination of pedagogical, technological, social, and individual factors seems effective. Nevertheless, previous studies explored students' perceived satisfaction with using an m-learning application without implementation. In the current study, we developed an m-learning application, and it was used

by university students. Then their perspective toward the adoption and application of the m-learning app was investigated.

Materials and Methods

Study design and participants

This cross-sectional study was carried out in 2020. The participants were 114 students at Abadan University of medical sciences. Since the emergence of the COVID-19 pandemic, online or virtual courses in Iran universities have been held through different tools or websites, including the Navid website and adobe connect software for holding classes, Faradid, SABA, and SAJAB systems for conducting exams. In a pilot study, one lesson was held by the m-learning application. We asked the students to use the application for downloading the educational content of other lessons and communicating with their teachers, besides the aforementioned systems, which were used nationally, for one semester. The application and a comprehensive explanation of how to use it were presented to the students. They were asked to use the application and raise their questions. Moreover, the application admin answered the students' probable questions about the application during the semester.

Data collection

Data were collected by means of an Iranian questionnaire developed in a previous study (15). This instrument contained 42 questions in 13 subscales, including user interface (UI; 3 items), Mobile Device Limitations (ML; 3 items), facilitating condition (FC; 2 items), interactivity (INT; 3 items), learning content quality (LCQ; 4 items), Social Influence (SI; 3 items), Government Support (SUP; 3 items), Personal Innovativeness (PI; 2 items), Self-efficacy (SE; 4 items), Trust (TR; 3 items), Perceived Ease of Use (PEOU; 3 items), Perceived usefulness (PU; 4 items), and behavioral intention to use (BI; 4 items). INT and LCQ have been considered as pedagogical factors that influence m-learning acceptance; UI, ML, and FC were considered as technological factors; SUP and SI were considered as social factors; SE, TR, and PI were considered as individual factors.

The instrument was an Iranian questionnaire, and Hamidi *et al.*, (15) examined the validity and reliability of the questionnaire. The reliability of the questionnaire was checked using Cronbach's alpha ($\alpha=0.914$) (15). The validity of the questionnaire was confirmed using two methods of convergent validity and discriminant validity (15). We added two sections to the questionnaire: the

“student’s demographic information” section at the beginning of the questionnaire as well as an open-ended question at the end of the questionnaire for “positive and negative aspects of the m-learning technology.” Each question was answered based on a five-point Likert scale ranging from “strongly agree” (1) to “strongly disagree” (5). The questionnaire was shared via email or Whatsapp groups each class had made to communicate with each other. The responses via Whatsapp were received through a private account.

Ethical consideration

The research is conducted according to the principles stated by the Vice-Chancellorship for Research Affairs of the Abadan University of Medical Science and approved by the Ethics Review Board of the Vice-Chancellorship for Research Affairs of Abadan University of Medical Science (ethical code: IR.ABADANUMS.REC.1399.038).

Consent to participate

Online data gathering through social media lets individuals participate based on willingness. A person receiving the questionnaire could ignore it if he/she was not willing to participate. Opening the questionnaire, reading the statement explaining the study at the beginning of the questionnaire, and completing the questionnaire are considered consent to participate. This is accepted by the ethics review board

Data analysis

Data were analyzed using SPSS.22. Descriptive statistics were used to report the frequency and percentages. After checking the normality of the data, the Mann Whitney U was used to compare the score of student's m-learning acceptance according to gender, major, and familiarity with m-learning technology. The Spearman correlation coefficient was used to compare the score of student's m-learning acceptance according to age, and the ANOVA test was used to examine the score of student's m-learning acceptance according to educational level, income level, and skill in using a computer. To interpret the acceptance rate, the acceptance means between 1-1.79 was considered as strongly disagree, 1.8-2.59 as disagree, 2.6-3.39 as neutral, 3.4-4.19 as agree, and 4.2- 5 as strongly agree.

Results

Demographic data of the students showed that the mean age was (19.86±1.41). Most of the students were

female (53.4%), in their fourth year of bachelor science (28.8%), familiar with m-learning (77.1%), with medium income level (49.2%), and intermediate skills in using a computer (44.9%). Most of the participants were HIT students (54.2%), and the rest were medical librarians. Most of the participants (52.5%) reported that they often use mobile devices (Table 1).

Investigating the relationship between the mean score of acceptance and demographic characteristics of the students showed that there was a significant relationship between the mean score of acceptance and major ($P=0.001$), mobile usage ($P=0.035$), and familiarity with m-learning ($P<0.001$). Accordingly, HIT students reported more m-learning acceptance. Furthermore, the students who use mobile more reported more m-learning acceptance. Also, m-learning familiarity has resulted in more m-learning acceptance. The relationship between the mean score of m-learning acceptance and age, gender, education level, income level, and computer skill were not significant (Table 2).

Table 3 shows the descriptive statistics of acceptance subscales. The total mean of m-learning application acceptance was 3.95 ± 0.32 . According to the students’ perspective, self-efficacy, perceived ease of use, user interface, and behavioral intention to use were the most influencing factors on acceptance of the m-learning application. The least influencing factors were mobile device limitation (3.30 ± 0.34) and governmental support (3.48 ± 0.57). As shown in figure 1, the averages of most of the responses to the domains are in the “agree” and “strongly agree” range.

The percentage of students’ responses for each factor based on a 5-point Likert scale is presented in figure 1. As indicated in figure 1, the averages of most of the responses to the domains are in the “agree” and “strongly agree” range. About 80 percent of the students believed that the application user interface had been well designed. According to the students’ perspective, mobile devices may have some limitations. About 70 percent of the students stated that there are facilitating conditions (ICT infrastructure and required resources) for using m-learning applications. Half of the students believe that the m-learning application has improved their interaction with their instructors and their classmates, in addition to better sharing of knowledge. They also reported that the application had provided course-related content with well quality. More than 90 percent stated that social recommendations could influence their decision to use an m-learning application. Moreover, governmental support (Ministry of Health, Ministry of ICT, etc.) will not much influence the m-learning acceptance; however, a trusted

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third-party guarantee of the application is required. Personal interest in using new technologies, as well as self-efficacy for using new technologies, had affected the m-learning application acceptance. Most students believed that the use of the m-learning application was simple. According to the students using the application has been useful for accomplishing their course-related tasks, and they intend to use similar applications in the

future.

Table 4 shows the other pros and cons of the m-learning application based on the students' perspective. "Direct communication with the teacher/instructor" was a positive aspect of applying m-learning, as mentioned by nine students. "Internet disconnection during video teaching" was a negative aspect of applying m-learning, as mentioned by six students.

Table 1. Demographic data of the participants' students

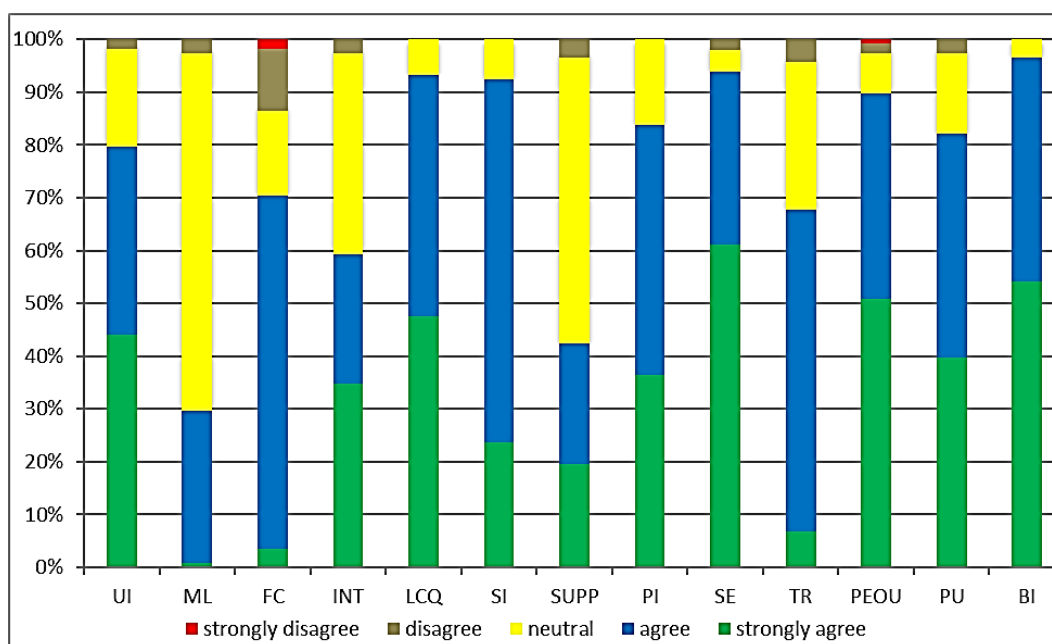
Characteristics		Number	Percent
Gender	Female	63	53.4
	Male	55	46.6
Education level	First	25	21.2
	Second	31	26.3
	Third	28	23.7
	Fourth	34	28.8
Income level	low	48	40.7
	medium	58	49.2
	high	9	7.6
Major	Health information technology	64	54.2
	Medical librarian	54	45.8
	Almost always	12	10.2
Mobile usage	Often	62	52.5
	Sometimes	33	28.0
	Seldom	11	9.3
	Never	0	0
Familiarity with m-learning	Yes	91	77.1
	No	27	22.9
Skill in using computer	Elementary	19	16.1
	Intermediate	53	44.9
	Advanced	45	38.1

Table 2. Mean score of students' acceptance of m-learning by demographic information

Characteristics		Mean (SD)	P
Mean age		3.92 (0.32)	0.807
Gender	Female	3.95 (0.33)	0.347
	Male	3.94 (0.32)	
Education level	First	3.99 (0.30)	0.825
	Second	3.96 (0.34)	
	Third	3.93 (0.32)	
	Fourth	3.91 (0.33)	
Income level	low	3.92 (0.31)	0.598
	medium	3.95 (0.32)	
	high	4.04 (0.39)	
Major	Health information technology	4.08 (0.30)	0.001
	Medical librarian	3.79 (0.28)	
	Always	4.20 (0.31)	
Mobile usage	Often	3.93 (0.33)	0.035
	Sometimes	3.90 (0.29)	
	Seldom	3.90 (0.32)	
Familiarity with m-learning	Yes	3.99 (0.34)	<0.001
	No	3.80 (0.23)	
Skill in using computer	Elementary	3.88 (0.28)	0.136
	Intermediate	3.90 (0.31)	
	Advanced	4.02 (0.34)	

Table 3. Descriptive statistics of the acceptance subscales

Acceptance subscales	Mean	Std. Deviation
Self-efficacy	4.3475	0.5401
Perceived Ease of Use	4.2994	0.61385
user interface	4.2599	1.11464
behavioral intention to use	4.2436	0.45346
learning content quality	4.1504	0.53223
Social Influence	4.048	0.37306
Acceptance	3.9508	0.32836
Interactivity	3.9322	0.82524
Perceived usefulness	3.9216	0.5165
Personal Innovation	3.8814	0.54958
Trust	3.6864	0.46998
facilitating condition	3.5805	0.59186
Government Support	3.4859	0.57923
Mobile Device Limitations	3.3051	0.34767

**Figure 1.** Distribution of the students' responses for each factor**Table 4. Advantages and disadvantages of the m-learning application**

Additional comments	Number of students
Direct communication with the teacher/instructor	9
No stress regarding being infected by the coronavirus	7
Educational materials are on their phone, which is more available	7
Internet disconnection during video teaching	6
Audio/video recording the lectures/practical instructions and listen/watch whenever needed	5
Chatting for asking questions distracts the other students	5
Self-examination through quiz-builder	5
If a student is late for a particular class, his or her classmates remind him or her to attend the class.	3
Save time by taking a screenshot of important educational notes like algorithms/protocols instead of writing/drawing them in the notebook	2

Discussion

According to the findings of the current study, the m-learning application is accepted among students. HIT students showed more acceptance in comparison with

medical librarian students. Meanwhile, students who were familiar with m-learning showed more acceptance. The students also believed that using the application was easy and useful. According to the students' perspective, the user interface of the m-learning application was well

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designed; in addition, the learning content was suitable, but there may be some limitations with mobile phones. Governmental support, in addition to a guarantee of the application by a trusted third party, is required for the application acceptance. Students reported that “direct communications with their instructors,” “no stress regarding being infected by the coronavirus,” and “more availability of the educational content” were amongst the positive aspects of using the m-learning application. Meanwhile, “disconnection of the internet which interrupts the instructors’ video” may disrupt learning the topic, as well as “chatting of other students to ask questions,” which distract students, are mentioned as negative aspects of the application.

Consistent with similar studies (16-18), the findings showed that the m-learning application was accepted by the students, and they believed that it was useful and easy to use. Ease of use is one of the key factors influencing the success and acceptance of educational applications (4,19). A well-designed user interface is easy to learn and use (20); Further, it decreases errors, costs, and learning time (20). A complex environment and confusing and unattractive user interface of applications can result in losing out even if the application is high quality (21). To develop the m-learning application in the current study we based guidelines developed for mobile device interface design and usability (22-26). According to the guidelines, the factors bore in mind included design based on the small screen of devices, fast running and recovery, attractive and interactive user interface, connectivity, different display resolutions, consistency (e.g., Consistency in size, color, font, and arrangements), easy navigation, presenting informative feedback, allowing easy reversal of actions, personalization and permitting users to configure outputs according to their needs, making user input as simple as possible and where possible providing selection instead of entering text input. These factors could have contributed to the students’ satisfaction and acceptance of the m-learning application. Mobile device limitations are a point for the students’ concerns. Limitations in memory, battery life, computational capacity, small size, low resolution, and security are among the challenges that may cause technical issues (27,28). For instance, an issue with small size in m-learning applications is a reduced context which makes the overview of the content difficult. In this case, a fixed header, as well as a review or summary screen, may help users (29). However, it is reported that the participating nursing and medical students preferred to have a smaller device with a colorful screen rather than a faster one indicating that usability features may generate

more acceptance in comparison to performance. These finding sheds light on “usability” which can be a point for covering mobile device limitations. On the other hand, nowadays, mobile devices are evolving to cover these limitations, but the affordability of the new smartphones by students should be in policymakers’ minds, especially in our country with its comprehensive economic problems.

Similar to Hamidi *et al.*, research, governmental support was necessary for the acceptance of the m-learning application. Successful implementation of m-learning requires governmental intervention to provide the required infrastructure. Poor connectivity is a constant issue in our country, Iran, as mentioned by the students. However, according to the Internet World Stats report (30), with the emergence of COVID-19 disease, the Ministry of Information and Communication Technology, in collaboration with the Ministry of education, has developed the network infrastructure for a better connection, especially for the determined virtual learning systems. In the current study, there was not much connectivity problem due to the limited required bandwidth, but if the m-learning application is supposed to be widely used by more students in different majors, considering connectivity issues is important. Developing countries can use experiments of educationally developed countries (15). Through investigating m-learning initiatives in educationally advanced countries, Khan *et al.*, (3) found five considerations when implementing m-learning at the national level. These considerations include developing a national strategic plan, collaboration between public and private sectors, developing m-learning content based on users’ characteristics and cultural norms, providing the required infrastructure, and providing awareness to users. Meanwhile, UNESCO policy guideline for m-learning (31) emphasizes providing support and training to teachers, ensuring gender equity and access equity for all students, and improving the safe, healthy, and responsive use of m-learning. Moreover, the finding implied that the guarantee of the application by a trusted third party, like instructors or friends, influences the students’ acceptance of the m-learning application. Similarly, Lin *et al.*, (32) found that students follow their peers’ decisions to use or not use M-Learning.

The finding revealed that acceptance of the application was more among HIT students compared to medical librarian students. A systematic review by Coskunccay and Nurcan (33) confirms that major is an influential factor for m-learning acceptance and specifically for perceived usefulness. The nature of the

HIT major is technology-based, and the students seem more familiar with different technologies and more convenient to accept them. Our finding also showed that familiarity with m-learning affects acceptance. This is consistent with similar studies but inconsistent with Ngampornchai and Adams' research (34) which indicated students' decision to accept e-learning is not dependent on how familiar they are with the technology. Thus, to increase the acceptance rate, it is suggested that in the pilot phase, implement the m-learning technology for the students who are more familiar with the technology. As mentioned before, students follow their peers' decisions to use or not use m-Learning, so those students can affect their peers positively.

Students reported that "disconnection of the internet which interrupts the instructor video" may disrupt learning the topic. Teaching via video conference requires higher bandwidth. Further, the more participants in the class, the more bandwidth is required. As mentioned in the previous paragraph, wide implementation of m-learning requires governmental support. The students also reported "chatting with other students to ask questions" as a negative aspect of m-learning. However, chatting is a required feature in m-learning apps. Chatting to ask a question while the instructor is teaching can distract students and prevent learning. To prevent distracting students, it is suggested that m-learning apps block chatting until the instructor permits it. While the instructor is teaching, no chat is permitted unless someone raises his/her hand by the embedded icon. Then the instructor permits him to write or speak.

The results of the current study have to be considered in light of some limitations. First, the samples are from only one university because it was a pilot study; wide implementation of such applications for other target populations may show different results. Second, the data came from a self-reported questionnaire, and there was no way to verify whether students' answers were correct. Moreover, in the current pilot study, only one lesson was held using the m-learning, and the other lessons were held using the national websites. The capacity of the m-learning application and the required infrastructure should be evaluated for wide implementation.

According to students' perspective, the m-learning application was well adopted among the students. They believed that it was useful and easy to use. Mobile device limitations are a reason for the students' concerns. "Usability features" can be a point for covering mobile device limitations. Government support for providing the required infrastructure in wide implementation is

important. It is suggested to pilot implement m-learning technology for students who are more familiar with technology because they can positively influence their peers' decision to accept m-learning technology later in the complete implementation.

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