Original Article

Factors Affecting the Acceptance of Mobile Health by Medical Sciences Students: A Cross-Sectional Study

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Abstract

Background: The use of mobile health has a pivotal role in the prevention and treatment of many diseases. This study aimed at determining the affecting factors in acceptance of mobile health by using a modified acceptance model, among medical sciences students in the south-west of Iran. **Materials and Methods:** This cross-sectional, analytical study was conducted in 2017. The research population included all the students of Lorestan University of Medical Sciences (LUMS). The 352 of students selected as the samples of study through a stratified sampling method. Data gathering was done through a valid and reliable questionnaire. The data was analyzed using Linear Structural Relations (LISREL) and Statistical Package for the Social Sciences (SPSS) software. **Results:** The findings showed that perceived usefulness ($t_{7, 38} = 2.16$, $p = 0.03$), performance expectancy ($t_{7, 70} = 3.18$, $p = 0.01$), facilitating conditions ($t_{10, 61} = 4.17$, $p < 0.001$), and attitude to use ($t_{7, 14} = 5.49$, $p < 0.001$) were effective in the behavior intention of mobile health. Moreover, the results showed that the behavior intention of mobile health applications ($t_{10, 77} = 8.10$, $p < 0.001$) is effective on its user behavior. **Conclusions:** The results of our study showed that perceived usefulness, performance expectancy, facilitating conditions, and attitude to use of technology were the affecting factors in the acceptance of mobile health by the students. It is suggested that the policymakers and authorities comprehensively consider these important factors when introducing new technologies.

Keywords: *Adoption, cell phone, mobile health units, students*

Introduction

The considerable growth in the rate of mobile phone penetration and its various capabilities have already contributed to the rapid development of mobile communications and wireless technologies.[1] One of the most important types of mobile communication is the use of mobile phones for health services, which is capable of exchanging information related to the health condition of patients.[2,3] In the health system, mobile health has an important role in the improvement of the quality of health services.[4-7] The applications of mobile health, from the use of Personal Digital Assistants (PDA) to mobile phones can be included in a wide range from the Clinical Decision Support System (CDSS) to using it as a data collection tool for health care professionals.[8,9] Mobile-based technology development is an opportunity to develop educational programs with many potential benefits.[10]

Mobile health is a method for providing health care services to people and patients through smart mobile phone devices such as cell phones, patient monitoring devices, PDAs, and other wireless devices.[11] Moreover, the use of mobile health potentials, can be helpful for preventing communicable and infectious diseases, particularly through accurate education and interventions.[4] The use of information and communication technology, especially mobile health, will be a very effective way to provide health care services with access to remote areas. Moreover, the mobile health has provided the exchange of valid information as well as diagnosis and treatment of diseases.[12] However, despite all these capabilities and applications, mobile health services will come up with many human and attitudinal problems in the implementation phase. One of the most important factors for the successful implementation of health information technologies, especially mobile health is its

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acceptance and proper use by potential users.[13-17] In that regard, a large number of published studies have examined factors affecting the acceptance of mobile health in recent years.[17,18] In this study, we employed a combination of Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) models, as these two models are the most important ones for determining the factors affecting the acceptance of mobile health along with the fact that a combination of them can provide a more suitable model.[13] Presented in 1989 by Davis, TAM consists of four main variables including Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Attitude To Use (ATU), and use behavior.[19] The UTAUT model was presented by Venkatesh *et al*. in 2003 and takes into account six main variables such as Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), Facilitating Condition (FC), Intention to Use (IU), and User Behavior.[20] As these two models share some similarities, we attempted to integrate them and eliminate the overlaps and contradictions, introduced in the previous studies.[21-23] A search of the literature revealed that there was no research investigating the acceptance level of mobile health by medical students as future health care workers in Iran. With regard to the importance of determining the factors affecting such as issue, and the application of TAM and UTAUT models as the most applicable models in acceptance of health information technology, the present study was conducted using TAM and UTAUT models for determining the factors affecting the acceptance level of mobile health by medical sciences students in Lorestan University of Medical Sciences (LUMS).

Materials and Methods

This is a cross-sectional study, which was done through Structural Equation Modeling (SEM) in 2017. The research population included all the students from the LUMS. We selected 352 subjects based on Morgan sample size table (from the all 2500 students), using proportional stratified random sampling for different schools of LUMS. The subjects included 124 students from the school of medicine, 62 students from the school of nursing and midwifery, 13 students from the school of pharmacy, 22 students from the school of dentistry, 72 students from the school of allied medical sciences, and 59 students from the health and nutrition school. The most important inclusion criteria were the interest of students to take part in the study, having a smartphone and actively using that, and being above at least a third-semester students. For medical students we select those between third semester and preinternship course at the hospital. Data gathering was performed after obtaining the necessary permits and in coordination with the school officials and lasted for two months. The questionnaires were then distributed among the qualified subjects, and 300 out of 352 distributed questionnaires were collected with a total response rate of 85.22%.

Data collection instruments: Data gathering tool was an integrated version of the TAM and UTAUT standard questionnaires.[19,20] Validity and reliability of the questionnaire: In order to assess the validity of the questionnaire, its English version was first translated to Persian using the forward- backward translation technique, and then translated it back to English by two English language experts. The English versions of the vquestionnaire were revised by comparing the original and translated versions. Moreover, in order to assess the content validity of the questionnaire, seven health information management experts (two faculty members from LUMS, one faculty member from Iran University of Medical Sciences, one from the Ministry of Health, and one from the authorities responsible for the Hospital Information Management unit), and two medical informatics experts (one from the faculty members of Tehran University of Medical Sciences and one from the Ministry of Health) were consulted. The questionnaire was then fully revised according to their comments. Also, to assess the reliability of the questionnaire, 30 questionnaires were distributed in a pilot test in a sample out of the original sample. The questionnaires were analyzed by Cronbach's alpha ($\alpha = 0.94$), and indicated a high internal consistency. The reliability of the questionnaire dimensions is shown in Table 1.

The questions contained scores from very low to very high (1 to 5) in Likert Five-Point scale. According to Figure 1, 10 hypotheses were examined, including all the hypotheses contained in the TAM and UTAUT models. Furthermore, statistical analyses were performed based on these relationships.

Data analysis was performed by SEM, using Linear Structural Relations (LISREL) 8.8 (produced by Scientific Software International (SSI)) and Statistical Package for the Social Sciences (SPSS) version 16 (produced by IBM SPSS Statistics) statistical software. Both applications were used to analyze the relations and hypotheses of the study. Describing the variables was done by using the frequency and Mean (SD) indexes. The univariate analyses including the relationship between demographic

Table 1: The reliability of the questionnaire dimensions

Dimensions	No. of questions	Cronbach's alpha
Performance Expectancy (PE)	4	0.85
Effort Expectancy (EE)	3	0.86
Social Influencing (SI)	5	0.84
Facilitating Conditions (FC)	5	0.86
Perceived Ease Of Use (PEOU)	5	0.84
Perceived Usefulness (PU)	5	0.84
Attitude To Use (ATU)	5	0.84
Intention to Use (IU)	3	0.85
Use Behavior (UB)	5	0.85
Total	40	0.94

Table 2: The relation between demographic variables and independent variables

Variable	Gender (Independent sample *t* test)						School (ANOVA)	
Test	Male		Female		*p*	*t*	*p*	*p*
	Mean (SD*)	*n*	Mean (SD)	*n*				
Attitude to Use (ATU)	19.47 (3.23)	88	19.46 (4.10)	212	0.77	0.02	0.001	2.34
Use Behavior (UB)	17.65 (3.76)		18.24 (4.13)		0.89	-1.18	0.042	4.23
Behavioral Intention (BI)	10.57 (2.45)		10.28 (2.53)		0.19	0.92	0.01	7.79

*SD=Standard Deviation, **ATU=Attitude To Use; *p* value= 0.77 ($P < 0.05$)

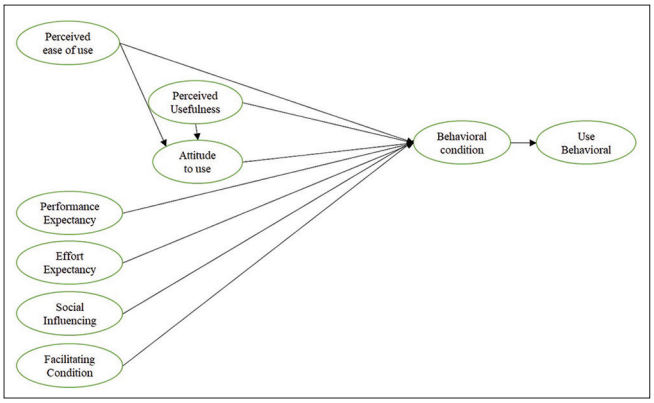

Figure 1: The Study hypotheses

and all model variables were tested by independent t-tests and One-Way ANOVA using SPSS. Moreover, LISREL was employed to examine the fit of the model. These fit indices were χ^2/df (acceptable >3), Goodness of Fitness Index (GFI), and Adjusted Goodness of Fitness Index (AGFI) as absolute indexes, and, Normed Fit Index (NFI) was used as an adaptive fit index. Furthermore, the Root Mean Square Error Estimation (RMSEA) (acceptable >0.80) and Parsimonious Normed Fit Index (PNFI) as Parsimony Fit Indices.

Ethical considerations

This study is a part of the research project conducted and supported by the deputy of research and technology of LUMS. Data gathering was performed consciously and with necessary consent. Moreover, all the respondents were assured that the information will remain confidential until the end of the study. In this study, the principles of ethics in the research were considered and informed consent was received from the participants. The whole process of study was also approved by the ethical committee of LUMS (LUMS. REC.1395.1330).

Results

Of the 300 participants, 70.66% (212 people) were female, and the rest were male. The mean (SD) age was 22.53 (2.41). The results showed that there was no significant relationship between gender, school, and the nine main variables included in the model such as perceived ease of use, performance expectancy, and user behavior ($p > 0.05$) [Table 2].

According to Table 3, the fit of the initial model was examined, which, indicated the good fitness of the model. According to Figure 2, all the relationships and hypotheses of the study were investigated based on SEM using the LISREL. Based on Figure 2, there is a significant relationship among behavioral intention and effort expectancy, facilitating conditions, perceived usefulness, and attitude to use as the independent variables. Moreover, the behavioral intention may lead to mobile health applications usage among medical sciences students.

Discussion

Due to the wide variety of information technology, especially in the health care area, its acceptance is associated with considerable challenges and depends on many contributing factors. The study results showed that the demographic variables have not affected the main variables of the study. Nematollahi *et al.* in their study concluded that demographic variables do not impact the adoption of electronic medical records;[24] a finding, which is similar to the results of the present study. With regard to the study population features, for medical students who had similar educational levels and were most familiar with mobile health technology, the demographic information had no effect on their mobile health acceptance. Due to the fact that the most of the disciplines in the allied medical sciences school such as operating-room-technician and anesthesia technician are under the supervision of the Iranian Nursing Organization,[25] a large group of the subjects of the present study sample was from the nursing population (38%). To improve the compatibility of the results with the other conducted studies, we included a large number of studies about the acceptance of technology conducted among the nursing population. The results from this study also showed that the integration and modification of TAM and UTAUT models can be considered as an acceptable measure for examining the effective factors in the use of mobile health among different groups of health care providers.

Likewise, results indicated that there is no significant relationship between the PEOU and the Behavioral Intention (BI), which is not consistent with the study by Zhao and Tahamtan *et al*.[17,26] Nevertheless, it might be due to the ease of learning to use smartphones as well as its

Table 3: The actual and recommended values of fit indices in LISREL

	AGFI*	GFI**	RMSEA***	*p*	NFI****	PNFI*****	χ^2/df
Actual	0.81	0.80	0.06	<0.001	0.81	0.79	2.08
Recommended	(0.8-1)	(0.8-1)	(0-0.1)	<0.05	(0.8-1)	(0.8-1)	(1-3)
Fit status	✓	✓	✓	✓	✓	✓	✓

*AGFI=Adjusted Goodness of Fit Index, **GFI=Goodness of Fit Index, ***RMSEA=The Root Mean Square Error of Approximation, ****NFI=Normed Fit Index, *****PNFI=Parsimonious Normed Fit Index

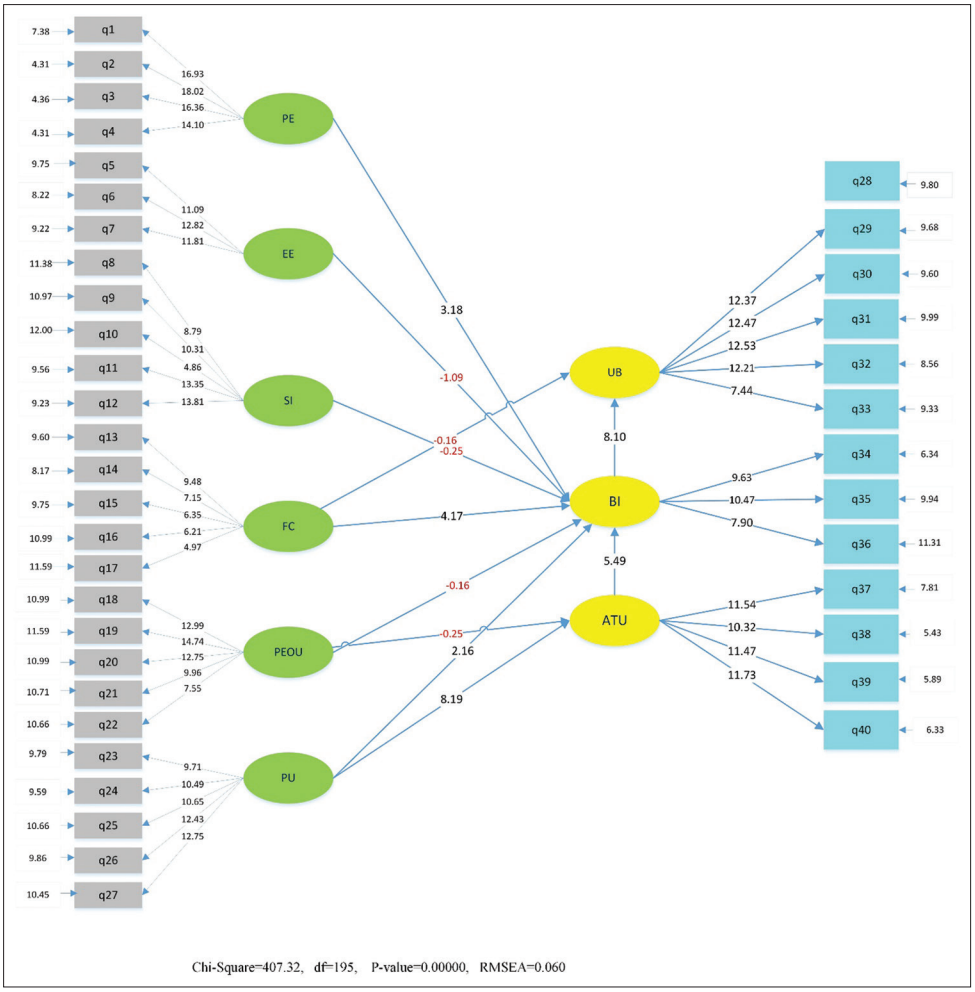

Figure 2: Hypotheses testing based on LISREL*
*** Linear Structural Relations**

accessibility. Moreover, our results demonstrated that there is a significant relationship between the PU and the BI of mobile health. Zhao *et.al*.[17], in their study reported that PU is an effective factor in the acceptance of mobile health services. Referring to the obtained results, it can also be concluded that the students of medical sciences, as future health care personnel, should accept and use mobile health services in order to improve their performance in various areas such as providing health care and educational and research purposes. Other results revealed that there is a significant relationship between the PE and the BI of mobile health among students. The result of the Sharifian *et al*. study[18] is consistent with our results as well. From the student groups' point of view, PE has an important effect on BI of information technology; hence providing mobile health tools while tailored to the needs is a key component for their successful implementation. Also in this study, it was determined that there is no significant relationship between SI and the BI of mobile health among students. No consistency of course was found with the studies conducted by Maillet *et al*. and Rahimi *et al*.[23,27] Considering the high accessibility of smartphones, using mobile health by students is not effective on other their intention to use. According to the results, the EE is not effective on the BI of mobile health among students. The results reported by Shiferaw *et al*.[28] were not in agreement with the present study results. The present study indicated that future health care providers expect mobile health technology to help

them reduce the effort made by the personnel and make the daily routines much more tolerable. Because of the pivotal role of nurses in health care system and their high level of clinical knowledge, it is suggested managers and policymakers in the Iranian Ministry of Health firstly begin applying mobile health services for the nurses working in health care centers and medical universities. Moreover, the results showed that the FC of using mobile health is effective on its BI from the student point of view. Khatun *et al*. considered that FC as one of the most important factors in the use of services dependent on mobile health cloud computing in primary care.[29] Oumlil *et al.* in their study conducted similar results.[22] The facilitating conditions influence the intention to use mobile health among the students. Therefore, the officials and Iranian Ministry of Health policymakers should attempt to provide the technical and organizational infrastructures of mobile health such as planning to use mobile health officially for providing health care, educational programs, and research purposes. It should also bring about facilitating conditions to the target group to implement the mobile health systems successfully among the students as future healthcare professionals. It is also recommended that institutions such as the Iranian Nursing Organization and Iran Medical Council actively cooperate in the process of facilitating the use of mobile health by health care providers through planning appropriate measures.

The results showed that there is a positive and significant relationship between the ATU of mobile health and it's BI. This part of the study is consistent with the studies, which were carried out by Nadri *et al*.[30], and Zhao *et al*.[17] This indicates, the intention for using the technology will ultimately lead to its actual use[20] and the final decision by the subjects to make use of mobile health will contribute to applying such technology. Finally, the results showed that behavioral intention will ultimately lead to the use of mobile health among students of LUMS. The unwillingness of some students, especially medical students, to participate in the study was one of the most important limitations of the study, therefore, by allocating more time and frequent visits to colleges, the required questionnaires were collected. The dispersion of different faculties was also one of the other limitations of the study, which led to additional costs for the research team. Due to the study inclusion criteria, selecting eligible students was also one of the other shortcomings in this study.

Conclusion

Effort expectancy, facilitating conditions, perceived usefulness, attitude to use, behavioral intention, and behavioral use were extracted as affecting factors in acceptance of mobile health. The results of this study can be used as a modified model for investigating the factors affecting the use of mobile health among medical sciences students as the next generation of health staff, in the Iranian Medical Sciences Universities, especially in nurses and medical students and as they are the main groups of health care providers. Moreover, the model can be used by researchers of health information management, health informatics, health policy, and other related areas for assessing mobile health acceptance among health care providers groups. Furthermore, the findings suggest that in using mobile health capabilities the health care providers and students should take into account its usefulness, effort expectancy, facilitating conditions, and the attitude to use as key effective factors. It is also recommended that evaluate the goodness of the fit of the suggested model should be evaluated in future research. The recommendation was in consideration with the specific conditions of medical student communities in medical sciences universities. With regard to the importance of using mobile health for health care provided by nurses, and the wide of nursing population and nursing students, it is suggested that some of the studies should be conducted about the acceptance of mobile health among this group.

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Conflicts of interest

Nothing to declare.

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