A Model for Medical Students’ Behavioral Intention to Use Mobile Learning

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ABSTRACT: The use of mobile devices that have high technical capabilities has increased in the last years. These devices are appropriate instructional tools that are reflecting the trends in modern education by providing instant access to information that is used with mobile learning purposes. As is in many areas of education, m-learning has been becoming widespread in medical education. Therefore, medical students’ readiness for m-learning is highly important. This study aims to investigate how medical students’ beliefs influence their behavioral intention to use mobile devices for learning purposes. The 376 medical students (222 juniors, 154 sophomores; aged between 18 and 24 years; 214 males, 162 females) participated in this study. All participants had mobile devices. Data were collected through a survey. Structural equation modeling was used to analyze the findings. The proposed model, which is created based on the theory of planned behavior, was tested in the study. Based on the findings, the medical students’ perceived ease of use, perceived usefulness, learning autonomy, intention to use, perceived self-efficacy toward mobile devices, and m-learning are found to be high level. However, according to medical students, instructors’ readiness to apply m-learning has been found to be low level. The findings showed that the proposed model explains medical students’ behavioral intention to use m-learning reasonably well. The behavioral intention is explained with a variance of 76% in the model. Subjective norm is the main indicator of behavioral intention, followed by perceived behavioral control and attitude. The proposed model in the study could be useful to design m-learning applications, environments, and implementation plans effectively in medical education.

KEYWORDS: Mobile learning, medical students, technology acceptance, structural equation modeling

Introduction

The use of mobile devices, with high technical capabilities has increased considerably in recent years. These devices are appropriate instructional tools that are reflecting the trends in modern education by providing instant access to information to be used with mobile learning (m-learning) purposes. M-learning is a method of learning that enables learners to have access to information anytime and anywhere through mobile technologies. As in many areas of education, m-learning has been becoming widespread in medical education in the past decade.1-3 M-learning enhances learner-centered education, improves the quality of content delivery, and provides rapid access to clinical information. Students learn in a flexible way anywhere and anytime, and thus interactive, effective, and more interesting learning occurs.4-5 Students’ attitudes and beliefs are important factors in using mobile technologies effectively for learning purposes. In the literature, many studies examine college students’ acceptance of m-learning. Many of these studies have used the technology acceptance model (TAM) or unified theory of acceptance and use of technology (UTAUT) as a theoretical framework.4-9 However, the lack of consideration of students’ perceptions of the ease of use of mobile technologies in these theoretical frameworks is criticized. The students’ judgments about their capability to perform in a m-learning environment have an important influence on the acceptance of m-learning.10 Therefore, the theory of planned behavior (TPB) framework was used in the sample of medical students in this study.

Research model and hypothesis development

This study is based on TPB which is one of the theories toward diffusion and adoption of innovations. According to this theory, the social behaviors of people are under the control of certain factors and arise from certain causes and occur in a planned way. In this theory, the realization of behavior has been assessed cognitively and socially. The determinants of behavioral intention are the individual’s attitude toward the behavior, subjective norms, and perceived behavioral control.11 Based on this theory, a conceptual model is proposed to explain how college students’ beliefs influence their intention to use mobile devices in their coursework.10 In this study, this model is tested with a sample of medical students. The model and formulated hypotheses are explained in Figure 1. The arrows indicate the hypotheses.

Method

In this study, a structural equation modeling (SEM) approach was used to test the model. We collected data through a survey and included questions for each variable in the research model. The participants filled the survey voluntarily. Necessary
permissions were obtained from the ethics committee of the university.

**Participants**

The participants of this study are the students of the Medical Faculty at a large public university in Turkey. The data were collected from 390 students but 14 students were removed due to their missing responses. Three hundred and seventy-six students (222 junior, 154 sophomores; aged between 18 and 29 years; 214 males, 162 females) participated in this study. All participants had mobile devices (Operating systems: 290 Android, 86 iOS). And, Table 1 shows the purpose of using participants’ mobile devices.

**Data collection and analysis**

A survey, which is previously developed for a similar study10 that is also ensuring reliability and validity, was used in the study. The survey comprised of 30-items (3 items for each of the 10 constructs which are indicated in Figure 1) on a 5-point Likert scale, ranging from totally disagree (1) to totally agree (5). The data were analyzed using SPSS 24.0 to conduct descriptive analyses to test the validity and reliability of the

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### Table 1: Purpose of Using Participants' Mobile Devices

| Purpose of Using Mobile Devices | Participants |
|---------------------------------|--------------|
| Learning autonomy               | 214 males, 162 females |
| Self-efficacy                   | 376 students |
| Perceived ease of use           | 376 students |
| Perceived usefulness            | 376 students |
| Subjective norm                 | 376 students |
| Behavioral intention            | 376 students |
| Perceived behavioral control    | 376 students |
| Instructor readiness            | 376 students |
| Student readiness               | 376 students |
| Attitudinal beliefs             | 376 students |
| Normative beliefs               | 376 students |
| Control beliefs                 | 376 students |

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**Figure 1. Research framework.**

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Table 1. The purpose of using participants' mobile devices.

| Purpose of Use                                                                 | NEVER | %    | ONCE A WEEK | %   | SEVERAL TIMES A WEEK | %   | ONCE A DAY | %   | SEVERAL TIMES A DAY | %   |
|--------------------------------------------------------------------------------|-------|-------|-------------|-----|----------------------|-----|------------|-----|----------------------|-----|
| Listening to voice recordings about courses                                   | 184   | 48.9  | 118         | 31.4| 45                   | 12.0| 17         | 4.5 | 4                    | 1.1 |
| Watching videos/animations about courses                                       | 71    | 18.9  | 178         | 47.3| 94                   | 25.0| 22         | 5.9 | 7                    | 1.9 |
| Watching/listening to online courses                                          | 238   | 63.3  | 84          | 22.3| 36                   | 9.6 | 12         | 3.2 | 3                    | 0.8 |
| Scheduling academic duties/works                                              | 159   | 42.3  | 92          | 24.5| 65                   | 17.3| 26         | 6.9 | 13                   | 3.5 |
| Taking notes about medical                                                    | 22    | 5.9   | 83          | 22.1| 125                  | 33.2| 71         | 18.9| 68                   | 18.1|
| Taking pictures/videos in courses                                            | 58    | 15.4  | 88          | 23.4| 11                   | 29.5| 48         | 12.8| 65                   | 17.3|
| Investigating unknown medical terms and concepts                              | 16    | 4.3   | 83          | 22.1| 114                  | 30.3| 51         | 13.6| 106                  | 28.2|
| Access to clinical data (CT, MR images, patient information, etc.)            | 195   | 51.9  | 80          | 21.3| 54                   | 14.4| 22         | 5.9 | 15                   | 4.0 |
| Using as a medical calculation tool (drug doses, etc.)                         | 275   | 73.1  | 52          | 13.8| 22                   | 5.9 | 7          | 1.9 | 9                    | 2.4 |
| Reading medical news                                                          | 71    | 18.9  | 147         | 39.1| 84                   | 22.3| 49         | 13.0| 21                   | 5.6 |
| Reading medical research journals                                             | 179   | 4.6   | 105         | 27.9| 51                   | 13.6| 20         | 5.3 | 12                   | 3.2 |
| Using other mobile apps for medical education                                 | 116   | 30.9  | 141         | 37.5| 67                   | 17.8| 22         | 5.9 | 25                   | 6.6 |
| Communicating with friends for academic purposes (Whatsapp, Facebook, email, etc.) | 21    | 5.6   | 39          | 10.4| 68                   | 18.1| 39         | 10.4| 203                  | 54  |
| Communicating with academic members of the course for academic purposes (Whatsapp, Facebook, email, etc.) | 214   | 56.9  | 66          | 17.6| 25                   | 6.6 | 17         | 4.5 | 42                   | 11.2|
scores. First, outliers were determined and 14 extreme values that are preventing assumptions for the SEM were excluded from the data set of 390 (n = 376). The data met all of the assumptions for the SEM; normal distribution, linearity, multicollinearity. AMOS 24.0 was used for the SEM to assess the fit of the proposed model.

Findings
The proposed model included Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Attitude (ATT), Instructor Readiness (IR), Student Readiness (SR), Subjective Norm (SN), Perceived Self-efficacy (PSE), Learning Autonomy (LA), Perceived Behavioral Control (PBC), and Behavioral Intention (BI) variables. The descriptive findings are presented in Table 2. PEOU (M = 4.42) has the highest average, IR has the lowest average (M = 3.75).

The significance of paths and the standardized coefficient are given in Table 3. All the paths among variables are significant except for 3 paths. Figure 2 shows the visual standardized path coefficients of the model in the study. Medical students' beliefs influence their behavioral intention to use mobile devices for learning purposes according to Figure 2. However, PEOU, which means easy use perception of mobile devices, does not affect the attitude toward the use of mobile applications. Also, SN, belief about whether most people approve or disapprove of the behavior, is not influenced by IR. Besides, PBC, a person's perception of the ease or difficulty of performing the behavior of interest, is not influenced by LA that is the extent to which students are responsible and have control over the process of learning with mobile devices.

As a result of the analysis, \( \chi^2 = 769.408 \) (df = 380, \( P < .05 \)) value was obtained, the chi-square value is insignificant. Besides, RMSEA (root mean square error of approximation), CFI (comparative fit index), Comparative Fit Index (CFI), Normed Fit Index (NFI), and Root Mean Square Residual (RMR) were calculated in the study.\(^\text{17}\) The obtained values indicated that the proposed model is acceptable (Table 4).

The subjective norm (\( \beta = .436 \)), perceived behavioral control (\( \beta = .320 \)), and attitude (\( \beta = .255 \)) have direct influences on the medical students' behavioral intention to use m-learning. The behavioral intention was explained with a variance of 76%. In addition to this, perceived self-efficacy (\( \beta = .240 \)), student readiness (\( \beta = .405 \)), and perceived usefulness (\( \beta = .214 \)) have indirect influences on its. The direct, indirect, and total influences on dependent variables are presented in Table 5.

Discussion and Conclusion
This study investigated how medical students' beliefs influence their intention to adopt mobile devices for their education. In the literature, many studies have examined the use of mobile devices

| Hypothesis | Path | Standardized Coefficient | P | Results |
|------------|------|--------------------------|---|---------|
| H1         | PEOU→ATT | −.092                   | .146 | Unsupported |
| H2         | PU→ATT    | .838                    | .000 | Supported |
| H3         | IR→SN     | .033                    | .588 | Unsupported |
| H4         | SR→SN     | .926                    | .000 | Supported |
| H5         | PSE→PBC   | .750                    | .000 | Supported |
| H6         | LA→PBC    | .146                    | .157 | Unsupported |
| H7         | ATT→BI    | .255                    | .000 | Supported |
| H8         | SN→BI     | .436                    | .000 | Supported |
| H9         | PBC→BI    | .320                    | .000 | Supported |

Table 2. Descriptive results of medical students' beliefs.

| Dimensions | M  | SD  |
|------------|----|-----|
| PEOU       | 4.42 | .63 |
| PU          | 4.33 | .63 |
| LA          | 4.26 | .63 |
| BI          | 4.25 | .64 |
| PSE         | 4.21 | .67 |
| SR          | 4.17 | .65 |
| PBC         | 4.15 | .71 |
| ATT         | 4.10 | .75 |
| SN          | 4.08 | .66 |
| IR          | 3.75 | .74 |

Table 3. The results of the tested hypotheses.

Abbreviations: PEOU, perceived ease of use; PU, perceived usefulness; LA, learning autonomy; BI, behavioral intention; PSE, perceived self-efficacy; SR, student readiness; PBC, perceived behavioral control; ATT, attitude; SN, subjective norm; IR, instructor readiness.
for learning. However, the results need to be extended in different education areas and be interpreted from different aspects.4

Based on the findings, the medical students’ perceived ease of use, perceived usefulness, learning autonomy, intention to use, perceived self-efficacy toward mobile devices, and m-learning are found to be high level. However, according to medical students, instructors are not exactly ready to apply m-learning yet. The findings showed that the TPB explained medical students’ acceptance of m-learning reasonably well. In parallel with the literature,8-10 this study revealed that the main indicator of attitude is perceived usefulness. Contrary to previous studies4,10,12 perceived ease of use does not influence the medical students’ attitudes toward m-learning. A possible explanation for this might be that all students are digitally native and they frequently use these devices in their daily life. Therefore, they already perceive mobile technologies’ ease of use and this situation may not have been influencing their attitude. Another important finding is that subjective norm is the main indicator of behavioral intention, followed by perceived behavioral control and attitude. Contrary to this result, Cheon et al10 found that subjective norm had the lowest impact on behavioral intention. This inconsistency may be due to the sample difference. In general, therefore, it seems that people of importance for medical students greatly influence their behaviors. Perceived behavioral control, which is the second key determinant of behavioral intention, is mainly influenced by perceived self-efficacy. Namely, if students feel confident to use mobile applications, they will have behavioral control and they will intend to use it for m-learning purposes. On the other hand, the subjective norm is influenced by student readiness whereas it is not influenced by instructor readiness. A possible explanation for this might be that the peers may significantly influence medical students’ behavioral intention to use m-learning. The medical students tend to use their mobile devices for learning anytime and anywhere by influencing each other even if the instructors do not use m-learning activities in class.
This study revealed that medical students perceive m-learning as easy to use and useful. Their attitude toward m-learning is highly positive. They use many mobile applications for academic purposes in their daily life. Their perceived self-efficacy and readiness to m-learning is found to be at high level. Moreover, they have a great intention to adopt m-learning in their coursework. The proposed model in this study explained medical students’ behavioral intention to use m-learning with a variance of 76%. Therefore, the variables, which have direct and indirect influences on behavioral intention, should be considered while designing m-learning applications, environments, and implementation plans. However, without a doubt, the “human factor” is the essence of teaching and learning as well as that of clinical care. With technological advancement, technology-enhanced learning environments are increasing but the importance of face-to-face interaction in medical education should be not ignored. Medical training must incorporate an understanding of the unique value of different interactions.21

There are some limitations to this study. First, the sample of the study constituted of one university’s sophomore and junior medical students. Also, the students can have different backgrounds regarding m-learning activities independent from their medical courses. This situation can limit the general inference of the results. Also, the second limitation is that
self-reported data were collected within the scope of the study. In future studies, the data can be collected from larger samples from different universities and levels through various data collection tools. Experimental studies can be designed to examine m-learning effectiveness in medical education. The professional development training in m-learning topics could be presented to the medical instructors. In future studies, medical instructors’ acceptance of m-learning can be examined. Moreover, the proposed model in the study can be tested by adding external variables such as profile, age, gender in different groups.

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Authors’ Contributions
All authors contributed to the design and implementation of the study. All authors discussed the results and contributed to the final manuscript. First author designed the questionnaire and third author collected the data. Second author conducted SEM analysis and wrote findings. First author wrote the manuscript with support and reviews from second and third author.

Ethical Approval
All procedures performed in studies involving human participants were under the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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