

Saudi Higher Education Student Acceptance of Mobile Learning

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Abstract—This research defines the mobile learning (m-learning) acceptance and outlines the critical factors affecting m-learning adoption among higher education students in Saudi universities. This research employed qualitative and quantitative approaches with 683 randomly sampled student participants from public and private universities. This research used questionnaire for collecting data, and the research framework was based on the Unified Theory of Acceptance and Use of Technology (UTAUT) model. The model was used to outline the factors affecting student intention to use m-learning. The output of statistical analysis showed high student acceptance of m-learning.

Index Terms—Higher education, m-learning, Saudi Arabia, user acceptance, UTAUT.

I. INTRODUCTION

While the potential for e-learning solutions has long been recognized, the COVID-19 pandemic from 2020 onwards exposed the laggardly progress made in actual adoption and application of related solutions worldwide, as educational institutions scrambled to provide services without reliance on traditional campuses. The main reliance for accessing e-learning material prior to the pandemic was the use of PCs, with little focus on the usage of other portable devices that have become more pertinent and widespread (such as laptops, smart phones, and tablets), which were traditionally overlooked due to different limitations related to screen size, battery life, and provided internet bundle services, all of which have greatly improved in recent years due to consumer-driven developments [1]. Social distancing measures responding to the COVID-19 included the closure of educational institutions in Saudi Arabia, preventing traditional interactions in classroom and campus settings among students and tutors. Many companies and businesses shifted their work online, and necessity forced many organizations and employees to buy PCs, laptops, and smart devices and to adopt to unfamiliar online communication for professional undertakings, such as Skype and Zoom, in order to be able to stay connected with their business and professional [2]. Smart phones have become ubiquitous and their applications and features are immeasurably more advanced nowadays compared to the PC era of early e-learning development, and accessing e-learning resources

through mobile devices is clearly the way e-learning is headed = in other words, mobile learning (m-learning) is likely to be the default of modern cross-platform e-learning solutions [3]. Numerous studies have investigated different areas related to m-learning and associated factors in Saudi Arabia, such as user acceptance [4], [5], environmental setting for m-learning [6], [7], and implementation of m-learning in Saudi Arabia [8]-[10]. In Saudi universities, the use of m-learning was not within the focus of learning solutions and learning objects creation and utilization, even though many available and used learning management systems, support the delivery of learning objects in m-learning layout and preferences [9]. However, during the COVID-19 lockdowns, the limitations of time and preparation to support faculty members with appropriate knowledge on creating suitable learning objects posed dilemmas and challenges, which affect student acceptance of m-learning [1]. Therefore, this research study focuses on investigating and defining student acceptance of m-learning for higher education in Saudi Arabia during the COVID-19 lockdown [10].

This model used to define and predict user acceptance of new technology. The research methodology is then presented, along with the research hypotheses and instruments used for measuring reliability. The results are then presented and discussed, and the study conclusions are subsequently drawn. It is believed that this research paper is structured as follows. The following section reviews literature on the theoretical background of this study and research study can lead to better understanding of m-learning acceptance in Saudi Universities during the COVID-19 lockdown, which will result in better preparedness and engagement with m-learning.

II. THEORETICAL BACKGROUND

Over the years, numerous theories have been used and employed to investigate and explain users' acceptance, intentions, and adoption of new technologies. Some of the different theories that were used throughout the literature are shown in Table I. From the listed theories, the most pertinent in relation to this research study are the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT).

A. Technology Acceptance Model (TAM)

TAM was developed from the Theory of Reasoned Action (TRA) by Davis (1989) and Davis et al. (1989, 1992). The proposed model was used by different research studies from different disciplines. The purpose of TAM was to investigate the effect of users' beliefs and resultant

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attitudes that affect the acceptance or rejection of novel technologies being adopted in their organizations. The model was validated and used with different types of technologies, including the use of mobile technology in learning [20], [21] and e-commerce [22], [23]. TAM posits that user acceptance is based on two main principles: the perceived usefulness (PU) and perceived ease of use (PEOU) of the technology being adopted. PU is defined as “the extent to which an individual believes that adopting and utilizing a specific technology would improve his or her job performance,” while PEOU is “the extent of to which an individual believes that adopting and utilizing a specific technology would be free of effort” [8]. Further development was made on TAM in the TAM2 revised model, which included subjective norms as an additional predictor of intention to use. Fig. 1 shows the original TAM suggested by Davis (1989).

TABLE I: TECHNOLOGY ADOPTION THEORIES

Theory	Proposed by	References
Theory of Planned Behavior (TPB)	Icek Ajzen (1985)	[11], [12]
Technology Acceptance Model (TAM)	Davis (1989)	[13], [14]
Theory of Reasoned Action (TRA)	Fishbein and Ajzen (1991)	[15]
Innovation Diffusion Theory (IDT)	Rogers (1995)	[16]
Extended TAM (TAM2)	Sharifzadeh et al. (2017)	[17]
Unified Theory of Acceptance and Use of Technology (UTAUT)	Williams et al. (2015) Venkatesh et al. (2003)	[18], [19]

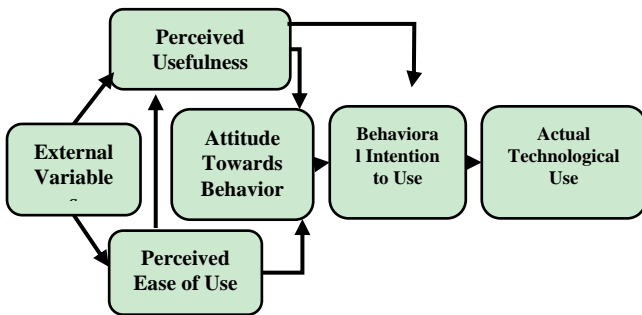


Fig. 1. Original technology acceptance model [12].

B. Unified Theory of Acceptance and Use of Technology (UTAUT)

UTAUT has been heavily used in the field of information and communication technology. Originally developed by Venkatesh et al. (2003), UTAUT arose from the TAM model, which it extended with regard to focusing more on the explanation of user intentions to adopt new technologies and their consequent usage behaviors. Moreover, an empirical study found that the UTAUT model was successful in explaining 70% of technology acceptance behavior [19]. The main components found in the UTAUT are (performance expectancy (PE), effort expectancy (EE), social factors (SFs), facilitating conditions (FCs), behavioral intentions, and use behavior). According to the structure, it is evident that PE, EE, and SF have direct impacts on behavioral intentions, and facilitating conditions have an impact on use behavior, which

also is affected by behavioral intentions. Moreover, different factors such as gender, age, experience, and voluntariness of use affect the structure, shown in Fig. 2.

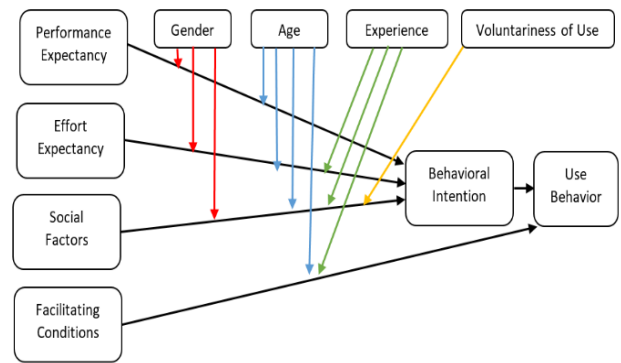


Fig. 2. UTAUT model.

The UTAUT model structure may be broadly compatible with different theories in some contexts, although it was built upon the TAM model. For example, the PE construct is comparable to PU, and EE is comparable to PEOU from the TAM model. Moreover, SF is comparable to Subjective Norm Adopted by the Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB) [18].

C. Mobile Learning

M-learning is defined by the literature as using mobile devices for e-learning materials delivery, using wireless connection, and without the constraints of time or space [24]. This may include the use of laptops, tablets, smart phones and pocket PCs [7], [24]. Throughout the literature, many researchers investigated the use of m-learning in different contexts, either around world or more specifically in Saudi Arabia, addressing topics including different frameworks, applications, usefulness, features, and platforms. Research studies unanimously note that m-learning is developing continually due to consumer-driven market development, and education and other fields can benefit from the rapid proliferation and relatively reduced costs of mobile-based solutions [25], [26].

III. RESEARCH FRAMEWORK AND HYPOTHESES

This research study adopted the UTAUT model for investigating the behavioral intention of using Mobile learning with respect to the main factors defined by the model during the COVID-19 pandemic and its challenges on the educational sector. The moderating factors found in the UTAUT model have not been investigated as the aim and objective of this research study is to outline the main factors affecting the behavioral intention with the current moderate participation of 683 students both male and female. Different research studies suggested and used similar approach [27], [28]. The UTAUT model can be customized towards the aim and scope of research intentions and needs as suggested by [27]-[29]. On the other hand, the demographical information has been analyzed using T-Test, to determine the significant differences between the mean of two groups as suggested with smaller samples. The hypotheses defined for this research study are displayed in Fig. 3.

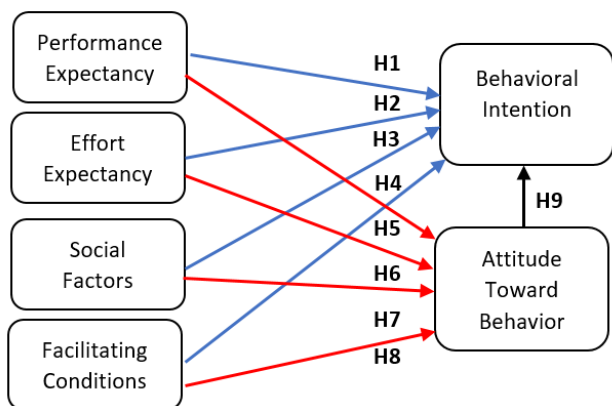


Fig. 3. Research framework.

A. Research Hypotheses

H1: Performance Expectancy (PE) significantly affects Attitude Towards Behavior (AT).

H2: Effort Expectancy (EE) significantly affects Attitude Towards Behavior (AT).

H3: Social Factors (SFs) significantly affect attitude towards behavior (AT).

H4: Facilitating conditions (FCs) significantly affect Attitude Towards Behavior (AT).

H5: Performance Expectancy (PE) significantly affects Behavior Intention to Use (BI).

H6: Effort Expectancy (EE) significantly affects Behavior Intention to Use (BI).

H7: Social Factors (SFs) significantly affect Behavior Intention to Use (BI).

H8: Facilitating Conditions (FCs) significantly affect Behavior Intention to Use (BI).

H9: Attitude Towards Behavior (AT) significantly affects Behavior Intention to Use (BI).

H10: Students in public and private Saudi universities have different levels of m-learning acceptance.

H11: Students are affected by different influencers towards m-learning acceptance.

H12: Students prior use of m-learning have effects on different levels of m-learning acceptance.

H13: Students used devices for m-learning have different effects towards m-learning acceptance.

H14: Students prior use of mobile devices have different effects towards m-learning acceptance.

H15: Students' age has different effect towards m-learning acceptance.

H16: Students' educational level has different effects towards m-learning acceptance.

H17: Students' gender has different effect towards m-learning acceptance.

IV. RESEARCH METHOD

A. Collection and Analysis of Research Data

This research study approached male and female Saudi students at seven different randomly selected public and private universities across the country. After contacting the university administrations, students were emailed via their university email addresses, explaining the nature of the study,

their rights (including voluntary participation and the right to withdraw), and the online questionnaire. Subsequently, 683 students were recruited and completed the questionnaire. The questionnaire was built using Microsoft Forms, which was distributed for students via the email. The collected responses were divided into two groups with respect to each university type. The questionnaire itself was divided into three parts, covering student demographic features, analyzed using frequencies and percentages; factors affecting behavioral intention and level of acceptance (using a five-point Likert scale); and attitudes towards m-learning, analyzed by descriptive statistics.

B. Questions Investigating Factors in Behavioral Intention and Level of Acceptance

The used questions in the second part of the questionnaire related to investigating the likelihood of level of acceptance, adopted from [19], with some additional constructs included with respect to this study objectives. Table II shows the used questions.

TABLE II: QUESTIONS INVESTIGATING LEVEL OF ACCEPTANCE

Item	Measures	Number of Items
PE1	The use of m-learning is useful for your educational requirements	4
PE2	The use of m-learning supports your intention to accomplish your tasks in faster manner	
PE3	You believe that m-learning is capable of enhancing student performance in online settings	
PE4	M-learning is capable of increasing student productivity in online settings	
EE1	Using m-learning is easy for you	3
EE2	Interacting with mobile settings for m-learning is easy for you	
EE3	Operating with m-learning for your educational tasks and requirement is easy for you	
SF1	People influencing my behavior believe I should use m-learning	3
SF2	People that are important to me believe I should use m-learning	
SF3	Faculty members and instructors in our university have been supportive towards the use of m-learning	
FC1	My university has supported the use of m-learning	4
FC2	The resources needed to use m-learning are available for me	
FC3	I have the needed knowledge to use m-learning	
FC4	In cases of any difficulties, I have the needed assistance for me in my use of m-learning	
AT1	The use of m-learning has been good for me	3
AT2	I like using m-learning	
AT3	Using m-learning is interesting to me	
BI1	I intend to use m-learning for my studies	3
BI2	I predict I will use m-learning for my studies	
BI3	I am planning to use m-learning for my studies	

V. DATA ANALYSIS AND RESEARCH RESULTS

SPSS V24.0 was used to analyze the data gathered from respondents and to perform the analytical tasks required for this research study. The following subsections present the

results and analysis from the 683 participating students.

A. Analyzing Validity and Reliability

SPSS was used to investigate internal consistency, reliability, and construct validity for the questions used in this research study, through computing the principal component analysis using varimax rotations and Cronbach’s alpha coefficients. The results were positive for the questions that ranged from 0.75 and 0.93, as shown in Table III. With regard to question reliability, a greater Cronbach’s alpha level value indicates internal consistency; all questions used in this research study had Cronbach’s alpha coefficients higher than 0.70 (considered the minimum acceptable level) [30].

TABLE III: RESULTS OF ROTATED FACTOR LOADING AND CRONBACH’S ALPHA COEFFICIENTS

	Components					
	1	2	3	4	5	6
PE1	0.783					
PE2	0.736					
PE3	0.754					
PE4	0.692					
EE1		0.772				
EE2		0.784				
EE3		0.736				
SF1			0.877			
SF2			0.869			
SF3			0.596			
FC1				0.695		
FC2				0.861		
FC3				0.842		
FC4				0.714		
AT1					0.705	
AT2					0.792	
AT3					0.583	
BI1						0.815
BI2						0.844
BI3						0.793
Cronbach’s α Value	0.752	0.933	0.841	0.837	0.761	0.767

B. Students Demographic and Mobile Device Usage Analysis Results

Table IV shows the demographic and mobile device usage characteristics of participants. The table shows the frequencies, percentages, and cumulative percentages for each category. It can be seen that most participants were male (72.9%), and 85.9% were from public universities. In terms of educational level, the results shows that most participants are in their second and third years, with percentages of 49.6% and 41.6%, respectively. The major age cohorts for participants were 18-20 years (54.3%), and 21-23 years (41.4%). The results show that the majority of students have been using m-learning (97.7%). In addition, the results showed that the most commonly used mobile device for m-learning was smart phones (Android) (40.6%). In terms of use of m-learning prior to the COVID-19 pandemic, the results showed that the majority (83.3%) had used some form

of m-learning. The most influencing person for student intention to use m-learning was “instructor/ faculty member” (85.5%).

TABLE IV: DEMOGRAPHIC AND USAGE RESULTS

Items	N = 683		
	Frequency	%	Cumulative
1. Gender			
Male	498	72.9%	72.9%
Female	185	27.1%	100%
2. University type			
Public	587	85.9%	85.9%
Private	96	14.1%	100%
3. Educational level			
First year	23	3.4%	3.4%
Second year	339	49.6%	53.0%
Third year	284	41.6%	94.6%
Fourth year	37	5.4%	100.0%
4. Age			
18 – 20	371	54.3%	54.3%
21- 23	283	41.4%	95.8%
> 23	29	4.2%	100.0%
5. Use of mobile device for learning			
Yes	667	97.7%	97.7%
No	-16	2.3%	100.0%
6. Types of mobile devices you mostly use for m-learning			
Laptop (Windows/Mac)	189	27.7%	27.7%
Tablet	13	1.9%	29.6%
Smart phone (Android)	277	40.6%	70.1%
Smart phone (Apple)	197	28.8%	99.0%
Smart phone (Windows)	7	1.0%	100.0%
7. I have been using m-learning prior to the COVID-19 pandemic			
Yes	569	83.3%	83.3%
No	114	16.7%	100.0%
8. The person most influencing my intention to use m-learning			
Instructor/ faculty member	584	85.5%	85.5%
Peers	27	4.0%	89.5%
Family	19	2.8%	92.2%
No one	53	7.8%	100.0%

C. Analyzing Results for UTAUT Construct

Table V displays the results – mean and standard deviation (SD) for the level of acceptance for m-learning. It can be seen that there was a positive impact on the acceptance of m-learning in Saudi higher education associated with the COVID-19 lockdown. The results showed that Saudi students have confidence in that m-learning is useful for their education, with a mean value of PE (3.72). Moreover, students agreed that they have the needed knowledge and skills for interacting with m-learning; the mean result for EE was 3.66. In terms of social factors influencing their opinion

towards using m-learning, the mean results for SFs was 3.28, and the results from Table IV show that the main influencers were instructors and faculty members. In terms of facilitating conditions, the mean result for FCs was 3.24, which is considered a moderate level, and it can be understood as the COVID-19 lockdown causing many students to rely on personal efforts more than the provided resources provided by their universities, and universities must put more efforts on providing the needed support. AT had the mean of 3.55, which is considered high, showing that students did not have many challenges towards using m-learning. In addition, the BI mean value of 3.42 indicates a positive attitude towards the use of m-learning.

TABLE V: LEVEL OF ACCEPTANCE FOR M-LEARNING

N	Construct	Mean	SD	Level
1	Performance Expectancy (PE)	3.72	0.60	High
2	Effort Expectancy (EE)	3.66	0.70	High
3	Social Factors (SFs)	3.28	0.79	Moderate
4	Facilitating Conditions (FCs)	3.24	0.79	Moderate
5	Attitude Towards Behavior (AT)	3.55	0.69	High
6	Behavioral Intention (BI)	3.42	0.80	High

D. Regression Analysis for UTAUT Construct

This research used regression analysis [31] in order to evaluate the relationship between the main five constructs found in UTAUT model and the BI towards using m-learning. Fig. 4 shows the β -value for the used constructs.

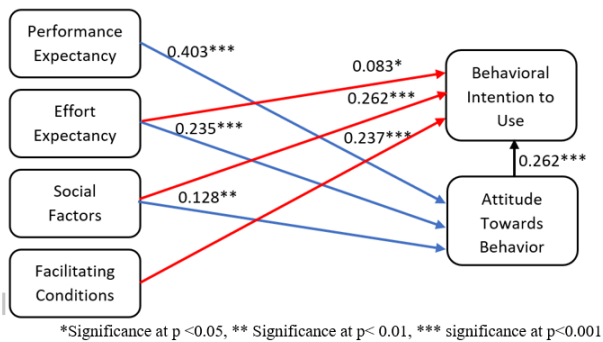


Fig. 4. Graphical representations of β -value.

VI. HYPOTHESES TESTING RESULTS

A. Hypotheses Results Conclusions

Table VI shows the results of testing the study hypotheses. The results show positive correlations for most of the constructs, with p-values of less than 0.001. The supported hypotheses were: H1, H2, H3, H6, H7, H8, and H9. The results show that there is positive effect between AT and the three constructs PE, EE, and SFs. Moreover, there are positive effects between BI and EE, SFs, and FCs. In addition, the results show that there is no positive effect of FCs on AT, but they have an obvious effect on BI, while PE has no obvious effect on BI. From the results we can conclude that while FCs do not have an obvious effect on BI, but they do

have an effect on AT, it can be considered to be a significant mediator into BI.

TABLE VI: HYPOTHESES TESTING RESULTS

Hypothesis	Result	Conclusion
H1: (PE) significantly affects (AT)	Significant (β -value=0.403, $p < 0.001$)	Supported
H2: (EE) significantly affects (AT)	Significant (β -value= 0.235, $p < 0.001$)	Supported
H3: (SFs) significantly affect (AT)	Significant (β -value=0.128, $p < 0.001$)	Supported
H4: (FCs) significantly affect (AT)	Not Significant	Not Supported
H5: (PE) significantly affects (BI)	Not Significant	Not Supported
H6: (EE) significantly affects (BI)	Significant (β -value=0.083, $p < 0.001$)	Supported
H7: (SFs) significantly affect (BI)	Significant (β -value=0.262, $p < 0.001$)	Supported
H8: (FCs) significantly affect (BI)	Significant (β -value=0.237, $p < 0.001$)	Supported
H9: (AT) significantly affects (BI)	Significant (β -value=0.262, $p < 0.001$)	Supported

B. Hypothesis Testing (T-test)

This section will present and discuss the results of remaining hypothesis from 10 to 17 with respect to the results shown in Table VII.

Hypothesis (H10: Students in public and private Saudi universities have different levels of m-learning acceptance). The results indicate that the significance level (2-tailed) is 0.001, and the p-value is less than 0.01, thus we accept the hypotheses that there is a significant difference in m-learning acceptance between public and private university students in Saudi universities, with a confidence and significance level of 0.01.

Hypothesis (H11: Students are affected by different influencers towards m-learning acceptance.). The results indicate that the significance level (2-tailed) is 0.585, and the p-value is larger than 0.01, thus we reject the hypotheses that there is a significant difference in m-learning acceptance between Students in Saudi university with respect to the defined influencers in this research study, with a confidence and significance level of 0.01.

Hypothesis (H12: Students prior use of m-learning have effects on different levels of m-learning acceptance). The results indicate that the significance level (2-tailed) is 0.001, and the p-value is less than 0.01, thus we accept the hypotheses that there is a significant difference in m-learning acceptance between students that have prior knowledge of using m-learning compared with students that had not, with a confidence and significance level of 0.01.

Hypothesis (H13: Students used devices for m-learning have different effects towards m-learning acceptance.). The results indicate that the significance level (2-tailed) is 0.603, and the p-value is larger than 0.01, thus we reject the hypotheses that there is a significant difference in m-learning acceptance due to the usage of different devices between students in Saudi universities, with a confidence and

significance level of 0.01.

Hypothesis (H14: Students prior use of mobile devices have different effects towards m-learning acceptance). The results indicate that the significance level (2-tailed) is 0.594, and the p-value is larger than 0.01, thus we reject the hypotheses that there is a significant difference in m-learning acceptance due to the prior usage of mobile devices between students in Saudi universities, with a confidence and significance level of 0.01.

Hypothesis (H15: Students' age has different effect towards m-learning acceptance.). The results indicate that the significance level (2-tailed) is 0.001, and the p-value is less than 0.01, thus we accept the hypotheses that there is a significant difference in m-learning acceptance between students with respect to age in Saudi universities, with a confidence and significance level of 0.01.

Hypothesis (H16: Students' educational level has different effects towards m-learning acceptance). The results indicate that the significance level (2-tailed) is 0.001, and the p-value is less than 0.01, thus we accept the hypotheses that there is a significant difference in m-learning acceptance between students with respect to their educational level as defined in this research for students in Saudi universities, with a confidence and significance level of 0.01.

Hypothesis (H17: Students' gender has different effect towards m-learning acceptance.). The results indicate that the significance level (2-tailed) is 0.001, and the p-value is less than 0.01, thus we accept the hypotheses that there is a significant difference in m-learning acceptance between students with respect to their gender in Saudi universities, with a confidence and significance level of 0.01.

TABLE VII: TESTING HYPOTHESIS H10-H17

Analysis Factor	df	t	Sig. (2-tailed)	Result
University Type	683	3.45	0.001	Supported
Personal influencer	683	1.08	0.585	Not Supported
Prior Use of M-Learning	683	3.08	0.001	Supported
Types of Devices	683	0.947	0.603	Not Supported
Mobile Device	683	1.22	0.594	Not Supported
Age	683	3.89	0.001	Supported
Educational Level	683	3.35	0.001	Supported
Gender	683	4.05	0.001	Supported

VII. CONCLUSION

This research study investigated different aspects related to m-learning acceptance and adoption with respect to the UTAUT model. The results of this research study showed that there is a positive attitude from Saudi public and private university students towards m-learning adoption during the COVID-19 lockdown with respect to the main factors found in the UTAUT model. The results of this investigation showed positive impacts when examining constructs according to the UTAUT model on behavioral intention to use m-learning. The results of performance expectancy, perceived usefulness, effort expectancy, and perceived ease of use were all found to score highly when analyzing the questionnaire results. In addition, seven out of nine

hypotheses were supported by this research results. T-test results gave us another perspective on the effect of different factors towards m-learning usage. It showed that personal influencers, types of used devices and mobile usage have no effect on students' attitude towards m-learning. On the other hand, it showed that there are differences in relation to university type, prior usage of e-learning, age, educational level, and gender.

In general, the results show that the current policies and implementations of m-learning by Saudi universities guided by the Ministry of Higher Education are leading to positive effects and adoption of m-learning.

There are some limitations of this research study due to number of participations. However, a future research study is being planned and guided by the results found in this research to include more universities and wider participation of male and female students. The results of this research study are vital for further investigation of social and economical factors that are to be included as mediators with respect to the UTAUT model.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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