



Analysis of the essential factors affecting of intention to use of mobile learning applications: A comparison between universities adopters and non-adopters

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Abstract

Although mobile learning systems offer several benefits for students, academic staff and universities, from easily access and learning anywhere and anytime, the use and acceptance of this new technology in Jordan still very low. However, acceptance of mobile learning by students is crucial to the success of mobile learning. The factors that affect the use and user acceptance of mobile learning are still controversial. Thus, this study mainly proposes an integrated model, with the aim of identifying the most influential factors that may encourage or impede students and universities in Jordan in moving towards acceptance and adoption of mobile learning applications. The proposed model was evaluated empirically with 1200 students from both two groups of universities that already used the mobile learning technology and non-adopters universities in Jordan. The model aims to examine the impact of 11 factors on the adoption of mobile learning applications that were categorised based on four fundamental constructs are: (i) technological factors (security, privacy, compatibility, relative advantage and trust), (ii) organizational factors (resistance to change and technology readiness), (iii) cultural factors and (iv) quality factors (quality of system, quality of content and quality of service). The key findings include: (1) resistance to change, security and privacy concerns still limit mobile learning acceptance and adoption in Jordanian universities; (2) some factors like compatibility, technology readiness, and culture were found to have a negative effect on the intention to use of the mobile learning; (3) five factors (relative advantage, trust, quality of system, quality of content and quality of service) were found to have a positive effect on the intention to use of the mobile learning; and (4) our research also found that the effect of these factors differed in universities that already used the mobile learning and non-adopters. Finally, it is expected that the findings of this research can assist university decision makers, mobile learning application providers and the research community in introducing better strategies for encouraging adoption and acceptance of this technology.

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1 Introduction

Nowadays, with the increased use of recently mobile technologies in higher education, new educational systems was born known as mobile learning applications. These new mobile learning applications are able to change traditional learning and present a new definition about learning, which also show a clear way for learners to learn at home, at work place, at their Journey at any time and any place and removes many limitations and inefficiencies (Joo et al. 2014). The ability to learn at any time and any place, which is one of the characteristics of mobile learning, which has been realized with the development of wireless technologies and mobile technologies. Mobile learning is in fact a new type of e-learning which is implemented through mobile technologies such as smart devices, personal digital assistants (PDA), cell phones, audio players, and etc. Taking advantage of mobile learning applications leads to the learning of learners in the way that fits the current era of knowledge and information as well as satisfies the needs of new generations of adults (Shin 2012). Mobile learning is one of the rich tools for presenting an active learning (Shin 2012; Dobre 2015). It is a critical technological component of higher education in recent years. Mobile learning allows students to learn, collaborate and share their ideas with the help of internet and technology development. Mobile learning creates significant opportunities for learning through the use of mobile devices anywhere and anytime (Almaiah and Man 2016).

Although mobile learning technology provides new opportunities and benefits, the adoption and acceptance of this new promising technology has become a significant problem for both practitioners and academicians (Bere and Rambe 2016; Hsia 2016). The factors that affect the use and user acceptance of mobile learning are still controversial (Joo et al. 2016; Keengwe and Bhargava 2014). Almaiah et al. (2016a, b) stated that the factors that motivates users to accept and use the mobile learning systems are not clear. In most studies, the successful of mobile learning systems are determined based on the user's demand for the use and acceptance (Lai et al. 2016). Hence, it is an important issue to understand which factors contribute to users' intentions to use new mobile learning applications.

However, accepting mobile learning by students and educators is important for mobile learning developers. The adoption of mobile learning is an important factor in determining the students and educators that are prepared to accept or reject it. This paper will help in discovering the adoption of students in using mobile learning at Jordanian universities. Our study shows that this adoption has not yet been adequately discussed in Jordan. This is the main reason for the focus in this area and attempts to identify the gaps that have not been discovered. This paper is among the first studies in the field of mobile learning technology adoption which is done in Jordanian universities, and it can provide useful tips for researchers in order to explore adoption factors of mobile learning applications. To the best of the author's knowledge, this is the first study aims to achieve the following objectives:

- To examine the impact of technological, organisational, cultural and quality factors on the adoption of mobile learning applications in the public universities in Jordan.
- To compare the effect of these factors between universities that had already adopted mobile learning applications and those non-adopters in Jordan.

The paper is organized as follows: The second section presents the literature review of the research. The three section provides the theoretical framework. In the fourth section, the research methodology is explained. In the fifth section, the results and testing theory are provided. In the final section, conclusion, implications and limitations are presented.

1.1 Research motivation

This research was conducted in response to the evidence demonstrating a critical need to investigate the adoption and acceptance of a mobile learning system in Jordanian universities. In particular, previous studies reported that the acceptance problem of a mobile learning system is high in the Jordanian universities (Almaiah and Jalil 2014; Althunibat 2015; Jaradat 2014). Furthermore, it is argued that the determinants of mobile learning acceptance are still unclear (Althunibat 2015), and studies that were conducted to investigate the most appropriate factors for mobile learning acceptance are insufficient (Almaiah and Alismaiel 2018; Su and Cheng 2015; Mohammadi 2015). Hence, this motivated the researcher to investigate the main factors influencing students' acceptance of a mobile learning system in Jordan.

2 Literature review

2.1 Mobile learning

Mobile learning is in fact a new type of e-learning which is implemented through mobile technologies (Almaiah and Almulhem 2018). The most important difference between mobile learning and e-learning can be seen in the ability of mobile learning to present instruction at any place and any time, while the ability to some extent and in fact the use of e-learning is conditioned to set a person behind his/her computer and some places that are forbidden for a computer's use and even portable computers (Behera 2013; Wang et al. 2009). Mobile learning has eliminated place limitation, and an individual is able to use this kind of technology at any place and any time (Ozdamli and Cavus 2011; Sharples et al. 2010). Mobile learning is a suitable solution for those interested in acquiring information and knowledge. By using mobile communication networks and suitable software and hardware, this will produce a surprising change for learning.

Mobile learning expands and improves the ability of learners to communicate and access information through mobile and wireless devices (Martin and Ertzberger 2013). The most popular mobile technology for learning is the mobile devices such as smartphones, tablets etc. Perhaps, the most important reason for this popularity is its multitasking nature; because mobile phones have features like photography, video recording, GPS, Bluetooth, SMS, Multimedia Messaging Service (MMS), and all kinds of educational software, Internet, e-books etc. (Ozturk et al. 2016). It seems that this

definition is the most complete definition for mobile learning that is, mobile learning is the acquisition of knowledge, attitude and skill by taking advantage of mobile technologies at any time and any place that will cause changes in behavior. However, mobile learning services could play an important role in supporting formal education and have important benefits in direct and indirect learning (Hao et al. 2017). The use of mobile learning technology has an important role among learners (Abu-Al-Aish et al. 2013). According to Sarrab et al. (2013) mobile learning has several characteristics and benefits such as learning at any time and any place in order to use an optimum time, students of mobile learning are able to learn from the existed different sources throughout the world, students enjoy from mobile learning are able to have their choice for their time and instruction speed, students of mobile learning are able to keep in touch with their learning activities. Shin et al. (2015) stated that mobile learning is a robust method to attract learners, especially learners in distance learning methods in which face-to-face contacts are very limited.

2.2 Related works

In the context of mobile learning, user's acceptance of mobile learning is considered as one of the main criteria for the success of mobile learning applications (Almaiah et al. 2016a, b; Althunibat 2015). There are several studies in the literature have addressed this issue by investigating the main factors that affect adoption of mobile learning. For instance, Almaiah et al. (2016a, b) proposed a model to examine the effects of quality features on mobile learning applications acceptance in Jordan. The proposed model includes eight quality features including: learning content quality, content design quality, interactivity, functionality, user-interface design, accessibility, personalization, and responsiveness. The authors found that all proposed factors had significant effect except personalization. Sánchez-Prieto et al. (2016) conducted a study to investigate the factors that influence the adoption of m-learning in universities of Spain. The researchers found that five factors play a significant role in adopting mobile learning are: subjective norm, self-efficacy, facilitating conditions, previous experience, and perceived enjoyment. In other study, Althunibat (2015) found in his study that self efficacy, facilitating conditions, and service quality had a significant effect on students' intention to adopt of mobile learning in Jordanian universities. Cheng (2012) in a study addressed the key factors of students acceptance of mobile learning in Taiwan. The authors found that compatibility, convenience, navigation, usefulness, ease of use and enjoyment were the most important factors that affect the adoption of mobile learning and should be taking into consideration. Similarly, Mohammadi (2015), in his study revealed that subjective norm, self-efficacy, personal innovativeness, and perceived image were the essential factors affecting of intention to use of mobile learning in Iran.

Additionally, Gan and Balakrishnan (2014) studied study how to adopt and use mobile learning in Malaysia universities. Their findings show that the proposed factors in the research model (social influence, enjoyment, trust, and self efficacy) had positive effect on Malaysian students to adopt mobile learning. Yamakawa et al. (2013) conduct a study to examine the effect of mobility and social influence on adoption of mobile learning in Latin America. The authors found that mobility and social influence were the significant factors. In a study conducted by Iqbal and Qureshi (2012) indicated that three factors (facilitating conditions, perceived playfulness, and social influence) were

observed to achieve better mobile learning benefits. In Greece, Zampou et al. (2012) conduct a study to develop a model to determine the necessary adoption factors of m-learning. They found that trust, innovativeness, relationship drivers, and functionality are the factors that play a significant role in citizens' decision to use of m-learning. In addition, Park et al. (2012) investigated the influential factors that impact the acceptance of mobile learning in universities of Korea. The authors found that self efficacy, system accessibility and subjective norm had positive effect on Korean students to adopt mobile learning. In a recent study conducted by Almaiah, Jalil and Man (2016) proposed a model to examine the effects of three types of quality factors on mobile learning applications acceptance in Jordan. The proposed model includes three quality factors including: content quality, service quality and system quality. The authors found that all proposed factors had significant effect on mobile learning acceptance. This section summarizes outstanding research in the area of adoption/acceptance of mobile learning, Table 1 provides the objectives and main factors used to create the proposed model of each study.

3 The proposed contribution of our research

Based on Table 1, which presents a comprehensive review of different studies and models of mobile learning adoption/acceptance, the researchers found that these models were incomplete and do not cover all factors that could lead to success of mobile learning adoption. These models ignored some factors that could contribute to enhance the system quality, design and content, and thus increase the acceptance. In addition, these studies ignored the effect some important factors like technological, organizational and quality factors on adoption of mobile learning. Therefore, this study proposes a model to examine the impact of 11 factors on the adoption of mobile learning applications that were categorised based on four fundamental constructs:

1. Technological factors (*security, privacy, compatibility, relative advantage and trust*)
2. Organizational factors (*resistance to change and technology readiness*)
3. Cultural factors
4. Quality factors (*quality of system, quality of content and quality of service*)

In addition to the first contribution, this study compares the effect of these factors between universities that had already adopted mobile learning applications and those non-adopters in Jordan.

4 The proposed research model

As shown in Table 1, the number of empirical studies investigating the factors which influence the mobile learning adoption decisions at higher education institutions is small. In addition, these studies were conducted only on a specific number of factors, and neglected other influential factors which could have an impact on the intention to use a mobile learning system, such as quality factors. Therefore, the proposed model of this study combines some factors from Table 1 ([literature review](#)) together with other

Table 1 Related studies on mobile learning adoption/acceptance

Studies	Objective	Sample	Theory used	Country	Factors in the proposed model
Almaiah et al. (2016a, b)	To examine the effects of quality features on mobile learning applications acceptance in Jordan	392 students	Technology acceptance model (TAM)	Jordan	Learning content quality, content design quality, interactivity, functionality, user-interface design, accessibility, personalization, and responsiveness
Sánchez-Prieto et al. (2016)	To investigate the factors that influence the adoption of m-learning in universities of Spain.	–	TAM	Spain	Subjective norm, self-efficacy, facilitating conditions, previous experience, and perceived enjoyment
Althunibat (2015)	To determine the factors that affect on Jordanian students' intention to use of mobile learning.	250 students	TAM and Unified Theory of Acceptance and Use of Technology (UTAUT)	Jordan	Self efficacy, facilitating conditions, and service quality.
Cheng (2012b)	To understand the most significant factors that could lead to increase the acceptance of mobile learning among students in Taiwan.	680 employees	TAM	Taiwan	Compatibility, convenience, navigation, usefulness, ease of use and enjoyment
Mohammadi (2015)	To identify the possible factors that affect the adoption of mobile learning system.	–	–	Iran	Subjective norm, self-efficacy, personal innovativeness, and perceived image
Gan and Balakrishnan (2014)	To study how to adopt and use mobile learning in Malaysia universities	87 students	–	Malaysia	Social influence, enjoyment, trust, and self efficacy
Yamakawa et al. (2013)	To examine the effect of mobility and social influence on adoption of mobile learning	students	TAM	Latin America	Mobility, and social influence
Iqbal and Qureshi (2012)	To investigate the factors that affect the adoption of mobile learning in developing countries	University	–	Developing countries	Facilitating conditions, perceived playfulness, and social influence
Zarpou et al. (2012)	To develop a model to determine the necessary adoption factors of m-learning	Student	TAM and (UTAUT)	Greece	Trust, innovativeness, relationship drivers, and functionality
Park et al. (2012)	To study the influential factors that impact the acceptance of mobile learning in universities of Korea	288 students	–	Korea	Self efficacy, system accessibility and subjective norm
		230 students	TAM	China	

Table 1 (continued)

Studies	Objective	Sample	Theory used	Country	Factors in the proposed model
Liu, Li and Carlsson (2010)	To identify the mobile learning technology adoption drivers in China				Self efficacy, learning autonomy, teacher readiness, student readiness, subjective norm, and behavioral control
Almaiah, Jalil and Man (2016)	Proposed a model to examine the effects of three types of quality factors on mobile learning applications acceptance in Jordan.	293	TAM and with the updated DeLone and McLean's model	Jordan	Content quality, service quality and system quality

factors (quality of system, quality of content and quality of service) that were identified from the interviews presented in a previous work (Almaiah et al. 2016a, b), to examine their effect on students decision to adopt and use the mobile learning system in the universities of Jordan.

In the proposed model of our study, the related factors were extracted, combined, and categorised based on four fundamental constructs are: technological, organisational, cultural and quality factors. The proposed model of this study is shown in Fig. 1.

4.1 Technological factors

This section presents the factors related to the technological characteristics that might have an effect on the students’ decision to adopt and use mobile learning applications. These factors are *security, privacy, compatibility, relative advantage and trust*.

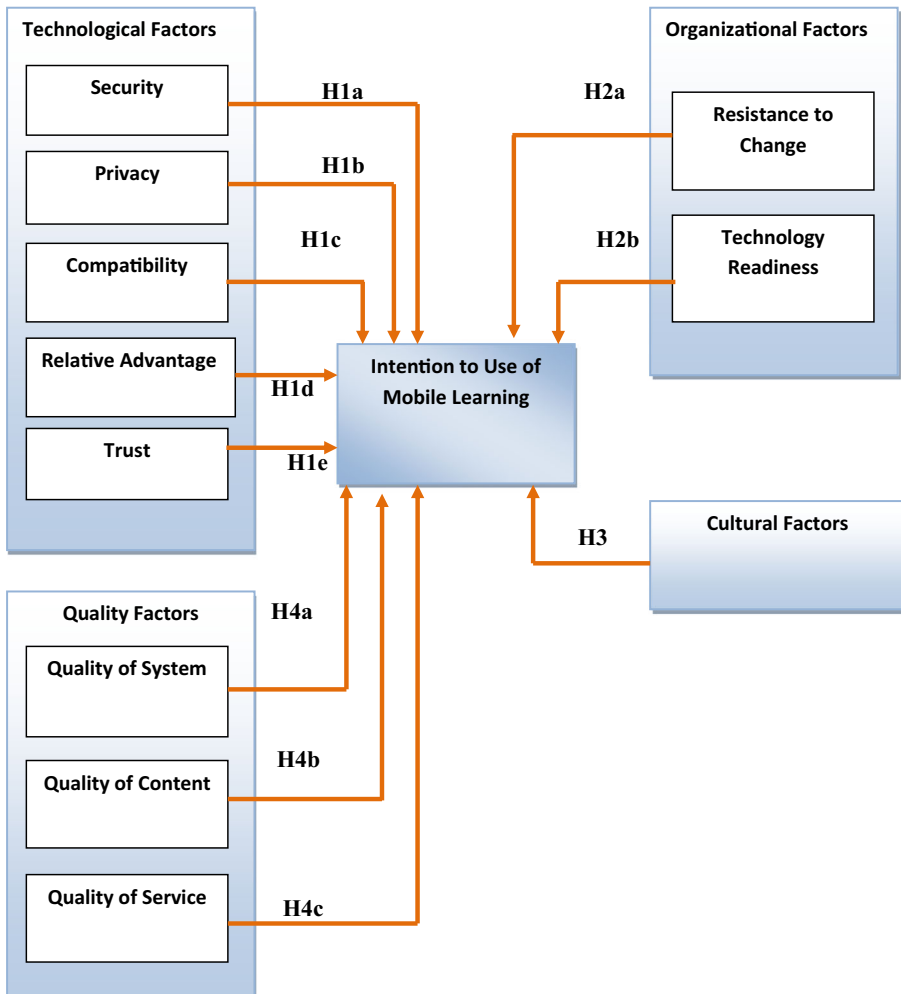


Fig. 1 Proposed model

Security factor is the first dimension of technological factors in the proposed model, which refers to the level of procedures in the mobile learning applications for securing the universities data and users' data (students and educators) from any threats or attacks. Concern about security is one of main reasons for many universities and users that do not intend to employ and use mobile learning system (Lian et al. 2014). The shared environment of resources in the mobile system is one of the security concerns for universities. According to Safa (2016), security and privacy are still considered to be problems and obstructions for the continued use of IS, such as mobile application and other online systems. Therefore, universities need to ensure an efficient level of data privacy and data integrity, along with user authorization, to ensure security for all electronic transactions and online identity authentication (Siponen et al. 2014). Thus, this study proposes:

H1a: Security factor will positively or negatively affect an intention to use mobile learning.

For the *privacy factor*, which is considered one of the main concerns for users that intend to use mobile learning applications (Obiria and Kimwele 2017). In the context of this study, privacy factor is defined as the degree to which universities believe that mobile learning applications are safe and protects their sensitive data. There should be a kind of privacy policy that enforces network not to disclose any learners information, unless their consent has been granted. Thus, the higher the perceived privacy, the more likely mobile learning technology will be trusted, and thus, this will increase the chance of an higher education institutions' adopting mobile learning technology. Therefore, the following hypothesis is proposed:

H1b: Privacy factor will positively or negatively affect an intention to use mobile learning.

Compatibility factor refers to “the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters” (Rogers 1995). It is more likely that students will adopt and use new technologies and systems when it is compatible with their needs, tasks and their learning activities (Park et al. 2017). Compatibility is one of the most important factors that affect the adoption of mobile learning and should be taking into consideration (Cheng 2012). Thus, the following hypothesis is constructed:

H1c: Compatibility factor will positively or negatively affect an intention to use mobile learning.

Relative advantage factor is one of the constructs of Diffusion of Innovation Theory (Rogers 1995). The relative advantage of using the mobile learning system that it will enable students and educators to easily access learning materials, help them to accomplish tasks more quickly, increase productivity, and flexibility of use in terms of place and time (Hao et al. 2017). Hence, students tend to adopt and use new technology, when they perceive significant benefits and value from that new technology such as mobile learning. Thus, this study proposes the following hypothesis:

H1d: Relative advantage factor will positively or negatively affect an intention to use mobile learning.

Trust is another factor of technological factors of mobile learning. This factor is related into two aspects, including the trust of service provider and trust of technology itself. Hence, the problem is not just related to trusting the service provider, but also there is a problem of distrusting the technology itself and its capabilities to provide good service without any interruption or loss of data. Trust refers to the degree of the reliability and trustworthiness of the services offered by mobile learning applications. In this study, this factor measures the confidence of students to use mobile learning to get mobile learning services in a proper response time and accessing appropriate learning content. Also, it measures the willingness of service providers regarding offering their services in the mobile applications. According to Gan and Balakrishnan (2014), the trust factor is the major enabler to let users adopt mobile learning, and it has been defined as a key driver for adoption any new technology. Hence:

H1e: Trust factor will positively or negatively affect an intention to use mobile learning.

4.2 Organizational factors

In this section, the characteristics of organisations which might significantly affect on the students' decision to adopt and use mobile learning applications are identified. In this study, organisations characteristics included two factors are: resistance to change and technology readiness.

Resistance to change factor has been argued to be amongst one of the factors that is impeding the adoption of new technologies (Laumer et al. 2016a, b) and causing the failure of new systems (Dwivedi et al. 2015). Park et al. (2016) suggests that resistance to change is affecting the use of mobile learning system. In addition, several authors indicated that resistance to change is a possible antecedent to IS acceptance (Laumer et al. 2016a, b; Park et al. 2016). In the same token, we argue that acceptance predictors may also impact resistance to change such that the perception of users towards mobile learning applications may affect resistance to change either positively or negatively. If users perceive that mobile learning applications would bring about positive benefits in terms of performance or are very easy to learn and use, then this would reduce resistance to change. In the same respect, users who have negative views about gains in performance or effort expectancy would experience an increase in resistance to change. In the IS literature, resistance to change refers to adverse reaction of users to the proposed change (Hirschheim and Newman 1988). In this research, resistance to change is conceptualised as the user's opposition to adopting the new mobile learning applications. Hence, users offering some resistance to mobile learning will have an inverse effect on their intention to use such a system. Therefore, we posit that:

H2a: Resistance to change factor will positively or negatively affect an intention to use mobile learning.

For the *technology readiness* factor, existence of the IT infrastructure and the technical resources makes it easier for universities to implement mobile learning technology. The access to mobile learning application depends on internet connectivity. Therefore, a good internet connection, high bandwidth and internet speed play an important role in an users decision to adopt and use mobile learning applications. Prior studies have concluded that universities that have a robust technical infrastructure and necessary technical skills are more likely to adopt and employ a new technology (Song and Kong 2017). Hence:

H2b: Technology readiness factor will positively or negatively affect an intention to use mobile learning.

4.3 Cultural factors

Culture factor is defined as the “habits, beliefs, values, norms and behavioural patterns of a group of people in a particular country” (Leung et al. 2005). In this study it is expected that the culture of Jordanian people may have an effect on intention to adopt and use. Thus, this factor is an important aspect that should be taken into consideration. This factor also emerged from the studies carried out previously with IT experts in the literature (Hao et al. 2017). This study measures the effect of the culture on the acceptance and adoption of mobile learning applications through student’s beliefs towards using new mobile applications in their universities. Based on this discussion, the hypothesis is proposed as the following:

H3: Culture factor will positively or negatively affect an intention to use mobile learning.

4.4 Quality factors

In this section, the suggested factors from interviews conducted previously with IT experts and students who they are used mobile learning system are presented (Almaiah et al. 2016a, b). These factors included three types of quality aspects, namely quality of system, quality of content and quality of service.

Quality of system factor refers to the desirable characteristics of the system and application. Quality of system is one of the critical factor for the success of the information systems (DeLone and McLean 2003). Quality of system can be measured by a set of dimensions which includes ease-of-use, functionality, interface design and reliability (Almaiah & Alamri, 2018, Chung et al, 2015). In general, quality of system depends on users’ perceptions; thereby, offering elevated levels of system quality can generate a perception among learners that the system will be easy to use, with easy access to the learning materials that the information system provides and high level of utility where the learners can efficiently identify the desirable characteristics of the information system. Mohammadi (2015) found that quality of system is the main predictor of intention to use of e-learning. In addition, Almaiah, Jalil and Man (2016)

found that system quality had significant effect on mobile learning acceptance. Based on this discussion, we propose the following:

H3a: Quality of system factor will positively or negatively affect an intention to use mobile learning.

Quality of content factor implies the quality, format, and accuracy of information provided by the system and application. Quality of content is measured by a set of characteristics such as relevance, scope, accuracy, timeliness, completeness, and efficiency of content (Almarashdeh et al. 2010; Cheng 2012). Practically, mobile learning has great benefits to students because of the richness of learning content provided by the mobile learning application. Mohammadi (2015) indicated that information quality is one of the most crucial factors, playing a vital role in determining the success of educational technology systems. Almaiah, Jalil and Man (2016) revealed that content quality had significant effect on acceptance of a mobile learning system. Hence:

H3b: Quality of content factor will positively or negatively affect an intention to use mobile learning.

Quality of service factor refers to the expected and received service quality from the system and application as well as the system provider. Quality of service may contribute to the success of system adoption among potential users. Rehman et al. (2012) suggested that the level of quality of service to end users has a significant impact on the use of online services. Mobile learning applications provide services to end users via the Internet at any time and everywhere. Therefore, ensuring a high quality of service to users will increase the chance of students adopting and using new mobile learning applications. Almaiah (2018) indicated that service quality is one of the most important factors that affect the adoption of mobile learning and should be taking into consideration. Hence, the following hypothesis is proposed:

H3c: Quality of service factor will positively or negatively affect an intention to use mobile learning.

5 Research methodology

This research was conducted in two phases involving qualitative and quantitative data in the form of: questionnaires for students (Phase 1: quantitative data); and a semi-structure interviews with an policy makers, IT/IS specialists and students from both universities adopters and non-adopters (Phase 2: qualitative data).

The study investigates the factors influence adoption of mobile learning apps from two aspects (i.e. university level and student level), and thus data must be obtained from these two sources, which requires to use more than one method to achieve data saturation in this study. Moreover, the research would have limitations if only one side was interviewed from the student level, and thus it was necessary to consider more than one method. For this reason, this study employed a mixed approach (quantitative and qualitative methods). In the next sub-sections we will describe each method in details.

5.1 Phase one: Quantitative method

5.1.1 Research method and measurement

In this research the questionnaire method was considered as a suitable technique for in-depth investigation of relationships between variables and to test the proposed hypotheses. Overall, the 11 factors in the research model along with intention to use the mobile learning system were measured using 45 closed-ended questions. The statements of questionnaire were adapted from former studies and some items were modified to fit with this study and the Jordanian context, as shown in Table 2. In this study, the closed-ended questions were designed using a five-point Likert scale ranging from 5 “strongly agree” to 1 “strongly disagree”. The questionnaire items were designed in English and then were translated into Arabic, since Arabic is the original language in Jordan and this will make easy to understand from the participants. In order to ensure that the instrument included all the appropriate items for measuring each construct a review of the instrument was conducted. Three experts who had experience in questionnaire design were asked to review the instrument of this study. The experts who participated in this study were researchers at Jordanian universities, all of them were speakers of both Arabic and English, in order to validate the translated version of questionnaire. Therefore, in order to ensure content validity, the researchers were asked individually to provide feedback and suggestions on the instrument. Through their review a few changes were made to some unclear questions and statements.

5.1.2 Data collection

The main participants of this research were students from 4 public universities that had already adopted the mobile learning system and from 6 public universities non-adopted the system in Jordan. The respondents were from the Faculty of Information Technology; this limitation was to ensure that they had an understanding of both the current situation of their universities and new information technology. The questionnaire was distributed on paper, where researcher visited all of the available classes during the semester with permission of their instructors. This method was selected in this study because this technique was quicker and easier to manage in the time compared to the other techniques that required more technical resources and time, such as probability sampling techniques.

The number of participants used in this research was 1200 students studying in ten public universities in Jordan. According to Saunders et al. (2009), when using a large sample size, the error rate in generalising the results will be low. In addition, the typical sample size should be about 200, as it is agreed that 200 cases and above can be considered adequate for performing a reliable and robust analysis as suggested by Kline (2011). Thus, the sample size in this study was enough and acceptable.

5.1.3 Respondents profile

All the respondents in this study were students from ten public universities in Jordan. As shown in Table 3, which presents the characteristics of participants and universities participating in this study, the largest group of students were from the universities that

Table 2 Instrument constructs and their sources

Factors	Items	Questions	Literature
Security	SE1	Security concerns affect our decision to use mobile learning application.	Shin (2015)
	SE2	I could use the system if I confident that the private information in mobile learning application is secure	
	SE3	I could use the system if nobody can view my information or data stored in mobile learning application without my agreement	
	SE4	I could use the system if my information or data in mobile learning application will not be manipulated by inappropriate parties	
Privacy	PV1	Privacy concerns affect our decision to use mobile learning application.	Shin (2015)
	PV2	My personal information in the mobile learning application may be exposed to other parties without my knowledge.	
	PV3	I would use mobile learning application if the privacy of my information was guaranteed.	
Compatibility	CM1	I would use mobile learning applications if they were consistent with our needs.	Hsu et al. (2007)
	CM2	Using mobile learning applications fit our learning style.	
	CM3	The compatibility of mobile learning applications with aspects of learning would encourage us to use it.	
	CM4	Mobile learning applications are Not fit our learning style.	
Relative advantage	RA1	The use of mobile learning applications in our university will help us to accomplish tasks more quickly.	
	RA2	Using mobile learning applications increases our productivity.	
	RA3	Using mobile learning applications can increase flexibility.	
	RA4	Using mobile learning applications increases the quality of university services.	
	RA5	By using the mobile learning applications I am able to obtain learning services easily.	
Trust	T1	I could use the mobile learning application if the service provider is widely acknowledge (the university)	Gao et al. (2010)
	T2	I could use the mobile learning application if I feel confident that the data returned by the application is reliable.	
	T3	I could use the mobile learning application if I have a clear conception of the functionality of the application	
Resistance to change	RC1	I would not change of using the current learning way to mobile learning applications.	Nov and Ye (2009)
	RC2	I would not substitute using e-learning with mobile learning applications.	
	RC3	Overall, I don't want the mobile learning applications to change the way I currently learning.	

Table 2 (continued)

Factors	Items	Questions	Literature
Technology readiness	TR1	Having a robust technical infrastructure (e.g., high bandwidth) would enable us to use mobile learning applications.	Cheon et al. (2012)
	TR2	Having a fast Internet connection would encourage us to adopt mobile learning applications.	
	TR3	Having the necessary technical skills would enable us to use mobile learning applications	
	TR4	My university still has limited technical knowledge about mobile learning technology.	
	TR5	We still lack in technical skills of using mobile learning applications in our university.	
Culture	CU1	Expert opinions affect our decision to use mobile learning applications.	Venkatesh et al. (2003)
	CU2	Students whose opinions I value would prefer me to use mobile learning applications.	
	CU3	In general, we like to try new technology that facilitates our learning.	
Quality of system	QS1	Mobile learning application provides interactive features between users and system	DeLone and McLean (2003); Ozkan and Koseler (2009)
	QS2	Mobile learning application has attractive features	
	QS3	Mobile learning application is user friendly	
	QS4	Mobile learning application optimizes response time	
Quality of content	QC1	Mobile learning application provides complete content.	Gu et al. (2009); Cheng (2012)
	QC2	Mobile learning application provides sufficient content.	
	QC3	Mobile learning application provides accurate content.	
	QC4	Mobile learning application provides up to date content and information	
Quality of service	QOS1	Mobile learning application allows us to access services any time.	DeLone and McLean (2003); Cheng (2012)
	QOS2	Mobile learning application allows us to access services from anywhere.	
	QOS3	Having a high quality of service would encourage us to use mobile learning application.	
	QOS4	Providing good compensation for downtime or failure to provide expected service would encourage us to use mobile learning application.	
	QOS5	Ensuring a good backup service would encourage us to use mobile learning application.	
Intention to use	IU1	I tend to use mobile learning application	Lin (2011)
	IU2	I am likely to use mobile learning application in the near future	

had not adopted mobile learning technology (64.6%), while 35.4% of the students were from universities that already used mobile learning. Based on the results in Table 3, the majority of participants 58.5% were female and 41.5% were male. Most of participants were youngsters that 74.3% of them were between the ages of 18 and 24. In addition,

Table 3 Profile characteristics of participants and universities

Characteristics	Frequency (<i>N</i> = 1200)	Percentage	Adopters (<i>N</i> = 425)	Percentage	Non-adopters (<i>N</i> = 775)	Percentage
Gender						
Male	498	41.5	198	46.5	300	38.7
Female	702	58.5	227	53.4	475	61.3
Age						
18–24	892	74.3	310	72.9	582	75.0
Over 24	308	25.7	115	27.1	193	25.0
Education level						
Undergraduate	877	73.0	367	86.3	510	65.8
Master	276	23.0	37	8.7	239	30.8
PhD	47	4.0	21	5.0	26	3.4
Do you have a smart phone?						
Yes	1200	100	425	100	775	100
No	0	0.0	0	0.0	0	0.0
Which kind of operating system does your smart phone have?						
Android	766	63.8	397	93.4	369	47.6
Apple IOS	432	36.0	28	6.6	404	52.2
Other	2	0.2	0	0.0	2	0.2
Internet usage						
Computer-desktop	13	1.1	4	0.9	9	1.1
Laptop	362	30.1	72	16.9	290	37.4
Smart phone	825	68.8	349	82.2	476	61.5

73.0% of participants were undergraduate students and 27.0% of them were postgraduate students. It is interesting to note that all students from universities adopters and non-adopters they have mobile smart phone. This means that the availability of mobile phones among students in Jordanian universities very high. Thus, mobile devices availability factor is not challenge for adoption mobile learning in Jordan. The results also indicated that Android was the most popular type of mobile platforms used, reported by 63.8% of students, followed by Apple IOS 36.0%. Furthermore, it was found that a high proportion of participants (68.8%) prefer to use the internet through their mobile phones more than laptop and computer desktop.

5.1.4 Data analysis technique

In this study, a Structural Equation Modeling analysis (SEM) was applied to examine the proposed model and our eleven factors within their casual relationships structure, as can be seen in Fig. 1. Structural equation modeling is the most appropriate tool used to reveal linear relationships and effects among observed and latent variables (MacCallum and Austin 2000). In this research, the analysis of data included three main steps. First, respondents profile that includes information demographic has been analysed. Second, reliability and validity tests were conducted in order to test the consistency of the

measurements. Finally, for testing the research hypotheses SEM analysis method was performed. The results of the data analysis are presented in the next section.

5.2 Phase two: Qualitative method

In the case of qualitative method, we conducted in-depth one-on-one interviews to explore adoption factors of mobile learning applications. The first stage of the interview data analysis was reading the transcripts, labeling relevant pieces, deciding which codes are the most important, and creating categories by bringing several codes together. Vital information about interviewees' experiences, perceptions, and attitudes toward adoption factors of mobile learning applications were retrieved through coding. During the second stage, data obtained were formulated for the experimental settings' description and interpretation. According to Rubin and Rubin (2011), the worth of a study is established through identified themes and their correlation with the research questions. The identified themes are summarized in the [qualitative results](#) section below.

The interviews were conducted with policy makers from six Jordanian universities, those who decide the universities policies, along with IT/IS specialists and students from both universities adopters and non-adopters. This approach was used to get more details to answer any research questions could not be answered through the quantitative research in phase one.

6 Quantitative results

In this section, we present the results of analysing the proposed model using two level of analysis, measurement model level and structural model level. In the measurement level, presents the results of reliability and validity tests. While, the structural level presents the evaluation results of the model fit, the results of assessing the relationships among construct variables in the research model and the results of comparison between universities that had already adopted the mobile learning system and those which were non-adopters.

6.1 Results of measurement model level

Before conducting the main statistical analysis, it is important to verify the reliability of the instrument and ensure the quality of the measures. Therefore, in the following subsections present the results of reliability and validity analysis.

6.1.1 Reliability analysis

In this step, the consistency of the measurements and items in the same was assessed. The composite reliability was utilised to verify the consistency of the measurements and items in the same construct. According to Hair et al. (2010), if the value of composite reliability above 0.7 it is considered to be highly reliable and between 0.6 and 0.7 is acceptable. Based on the results of Table 4 show that the values of composite reliability for all constructs were higher than 0.7, which means they exceeded the minimum threshold. Thus, all the constructs were reliable.

Table 4 Results of reliability and validity analysis

Factors	Composite Reliability (CR)	Average Variance Extracted (AVE)
Security (SE)	0.89	0.540
Privacy (PV)	0.78	0.555
Compatibility (CM)	0.83	0.552
Relative Advantage (RA)	0.88	0.549
Trust (T)	0.93	0.602
Resistance to Change (RC)	0.82	0.526
Technology Readiness (TR)	0.84	0.502
Culture (CU)	0.90	0.608
Quality of System (QS)	0.79	0.524
Quality of Content (QC)	0.90	0.559
Quality of Service (QOS)	0.92	0.586
Intention to Use (IU)	0.87	0.594

6.1.2 Validity analysis

In this study, the construct was also evaluated using two types of validity analysis are: convergent validity and discriminant validity. For evaluating the convergent validity, Average Variance Extracted (AVE) was used. The acceptable value of AVE is 0.5 or higher (Hair et al. 2013), and it is clear from the results that the AVE values for the constructs are 0.5 or higher, as shown on Table 4.

The discriminant validity was assessed in this study through comparing the square root of AVE with correlations between the constructs. To demonstrate discriminant validity, the value of the square root of AVE for each latent construct should be greater than the value of correlations estimated between the constructs (Fornell and Larcker 1981). It is clear from the results that the value of the square root of AVE for all constructs, as shown in Table 5, was higher than the correlation between these constructs. On the whole, the results showed adequate evidence of the discriminant validity of the constructs.

6.2 Results of structural model level

After confirming from the reliability and validity in the previous level, the research model and hypotheses were assessed in this level. The results of structural model analysis was divided into three sections. The first section presents the evaluation of the model fit. The second section provides the results of assessing the relationships among construct variables of the research model. The final section presents the results of comparison between universities that had already adopted the mobile learning system and those which were non-adopters.

6.2.1 Assessment of model fit

In this study, Goodness of Fit (GoF) analysis was used to assess how well the proposed model fits with the collected data using Confirmatory factor analysis (CFA). CFA was

Table 5 Results of discriminant validity

Constructs	SE	PV	CM	RA	T	RC	TR	CU	QS	QC	QOS	IU
SE	0.88											
PV	.480	0.89										
CM	.471	.433	0.85									
RA	.461	.528	.441	0.74								
T	.367	.513	.401	.386	0.89							
RC	.564	.463	.513	.584	.301	0.84						
TR	.469	.429	.291	.338	.345	.421	0.80					
CU	.513	.401	.386	.564	.463	.513	.584	0.82				
QS	.367	.513	.401	.386	.471	.433	.291	.338	0.77			
QC	.469	.429	.291	.338	.345	.421	.338	.345	.421	0.81		
QOS	.386	.564	.463	.513	.584	.513	.401	.386	.564	.463	0.80	
IU	.338	.345	.421	.338	.345	.421	.564	.463	.513	.584	.301	0.75

The diagonal numbers in bold indicate the square root of the Average Variance Extracted (AVE)

conducted to examine the following model-fit indices of the measurement model: Chi-square/degree of freedom ($\chi^2/d.f.$), Goodness-of-Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean square Residual (SRMR), Normed Fit Index (NFI), Non-Normed Fit Index (NNFI), (Comparative Fit Index (CFI), and Incremental Fit Index (IFI). As described in Table 6, the values of all model fit indices were satisfactory.

6.2.2 Assessment of research model hypotheses

In this research, the relations among variables were assessed through standardised path for full sample ($N = 1200$), which includes two group of students from universities that adopted mobile learning system and non-adopters. Whereas, in the next section we will

Table 6 Results of model fit indices of the structural model

Fit index	Research model	Acceptable values	Source
$\chi^2/d.f.$	3.55	<5.00	Kline (2005)
GFI	0.919	>0.90	Bagozzi and Yi (1988)
AGFI	0.882	>0.80	Fornell and Lacker (1981)
RMSEA	0.049	<0.06	Hair et al. (2013)
SRMR	0.066	<0.08	Bagozzi and Yi (1988)
NFI	0.920	>0.90	Hair et al. (2013)
NNFI	0.925	>0.90	Bentler and Bonnet (1980)
CFI	0.939	>0.90	Fornell and Lacker (1981)
IFI	0.911	>0.90	Widaman and Thompson (2003)

Table 7 Results of structural model analysis

Hypotheses	Full sample (N = 1200)				Adopters (N = 425)				Non-adopters (N = 775)							
	Direct	OR	Indirect	(β)	T-value	Positive (+)	OR	Negative (-)	(β)	T-value	Positive (+)	OR	Negative (-)			
H1a	Direct			-0.512	-5.512*	-			-0.210	-1.934*	-			-0.432	-5.512*	-
H1b	Direct			-0.241	-2.122*	-			-0.171	-1.075*	-			-0.265	-3.512*	-
H1c	Direct			-0.376	-2.493*	-			-0.266	-1.327*	-			-0.277	-4.530*	-
H1d	Direct			0.469	4.225*	+			0.439	2.527*	+			-0.523	-5.986*	-
H1e	Direct			0.523	5.569*	+			0.482	2.176*	+			0.598	5.650*	+
H2a	Direct			-0.441	-4.501*	-			0.302	1.873*	+			-0.324	-5.101*	-
H2b	Direct			-0.340	-2.457*	-			-0.128	-1.901*	-			-0.213	-1.901*	-
H3	Direct			-0.320	-3.005*	-			-0.314	-1.457*	-			-0.398	-3.457*	-
H4a	Direct			0.189	4.457*	+			0.138	2.457*	+			0.210	4.101*	+
H4b	Direct			0.267	4.890*	+			0.199	2.901*	+			0.211	4.057*	+
H4c	Direct			0.278	4.625*	+			0.201	3.132*	+			0.250	4.117*	+

* P < 0.001

present the comparison between adopters and non-adopters. Table 7 presents the results of hypotheses for technological factors. The results show that the paths for hypotheses (H1a, H1b, H1c, H1d, H1e) had a significant and negative effect on students' intention to use mobile learning applications. Overall, this means the hypotheses for technological factors: security, privacy, compatibility, relative advantage and trust are supported.

The relationship between organisational factors: (H2a) resistance to change and (H2b) technology readiness and intention to use mobile learning were significant and negative effect, shown in Table 7. This means that also these hypotheses are also confirmed.

In addition, the P value for the path estimated for hypothesis of cultural factor (H3) was $B = -0.132$. This means that the effect of cultural factor on students' intention to use of mobile learning application was negative.

Furthermore, the results clearly show that the paths of hypotheses for quality factors (H4a, H4b and H4c) were supported. This result indicates that the effects of quality of system, quality of content and quality of service on students' intention to use the mobile learning applications were positive and statistically significant.

The variance in intention to use of mobile learning was ($R^2 = 71.3$). This indicates that 71.3% of the variance in intention to use of mobile learning as dependent variable is significantly explained by these independent variables. These findings show that the proposed model is statistically significant in explaining mobile learning application adoption and usage at users level. Final path test of the research model with β -values and R^2 -values shown in Fig. 2.

6.2.3 Results of comparison between adopters and non-adopters

In this section, an further analysis was conducted in order to investigate the differences between universities that had already adopted mobile learning applications and those non-adopters. In this research, most of the students (64.6%) from universities that had not already adopted mobile learning system, whereas 35.4% of students from universities that already utilised the mobile learning system. The results are presented in Table 7.

It is clear from the results that the effect of some technological factors (security, privacy and compatibility) were negative and other factors (relative advantage and trust) were positive and statistically significant for both groups (adopters and non-adopters). These factors (security, privacy, compatibility, relative advantage and trust) have a stronger effect on students' intention to use of mobile learning in universities that had utilized mobile learning system than in non-adopters. The interesting results also show that the effect of resistance to change and technology readiness were negative in non-adopter universities and positive effect in adopter universities, the standardised regression weight for non-adopters $\beta = -0.324$, and $\beta = 0.302$ for universities that were adopters. This means these factors could be impeding them from utilizing mobile learning applications.

Moreover, the impact of cultural factor on students' intention to use the mobile learning was negative in both adopters and non-adopters universities. Moreover, for both groups, the analysis shows that the effects of quality of system, quality of

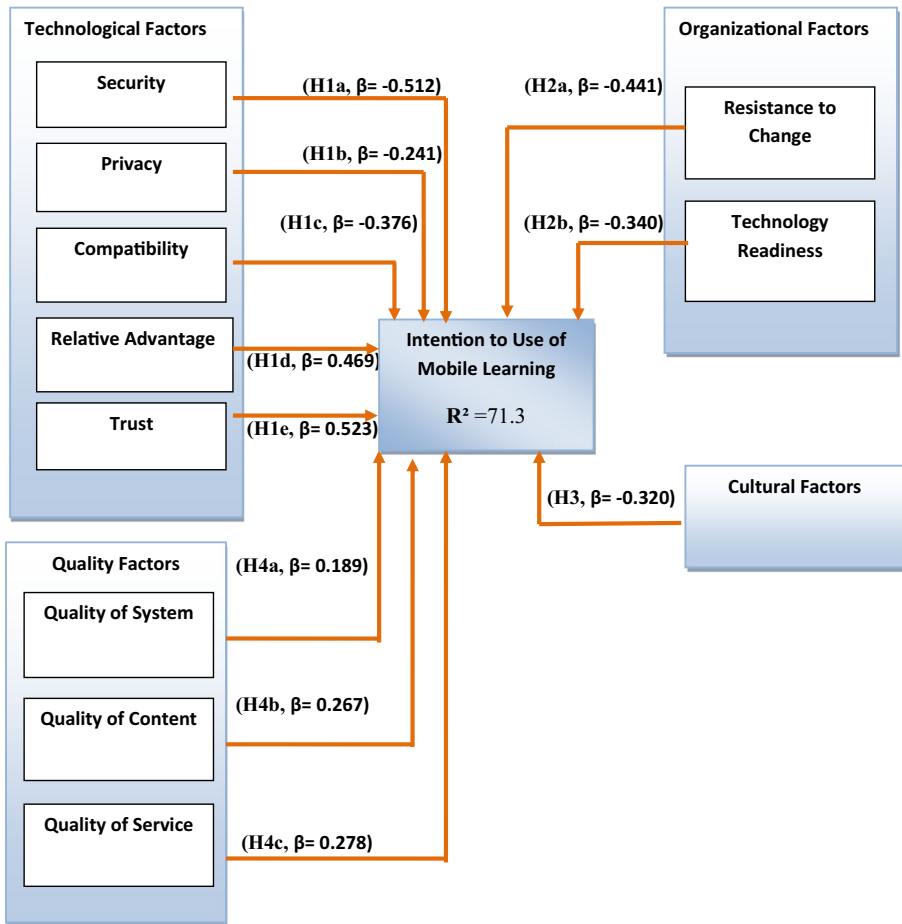


Fig. 2 Final path test of the research model with β -values and R^2 -values

content and quality of service were positive and statistically significant, and these factors had a stronger effect in adopter universities as compared with non-adopters.

7 Qualitative results

This section presents the results of the interview data collected as part of the qualitative research for this study to investigate the differences between universities that had already adopted mobile learning applications and those non-adopters. The results are associated with the aim of identifying the most influential factors that may encourage or impede universities in Jordan towards adoption of mobile learning applications. The interviews were conducted with policy makers from six Jordanian universities, those who decide the universities policies, along with IT/IS specialists and students from both universities adopters and non-adopters.

7.1 The qualitative results of the factors affecting of intention to use of mobile learning from universities adopters

The analysis of the qualitative interviews showed new factors were discovered that affect of intention to use of mobile learning through the interviews with policy makers of universities, IT specialists and students. These factors are:

(1) *Perceived value*

As mentioned by interviewees, perceived value of mobile learning applications is an important factor that influences users toward mobile learning adoption. The interviewees pointed out that:

"Mobile apps for university activities, It is relevant and useful since that allows students to use one application through their mobile devices for accessing learning activities anywhere and anytime" [Policy Maker].

Some interviewees also added that the *"Mobile learning apps, It's very useful since it allows me to access all electronic materials related to different courses" [Student].*

"It allows me to access a rich and diversified content of useful information" [Student].

Mobile learning apps allow students to communicate with instructors and universities *"New version of Mobile learning apps allow students to communicate with instructors and university supervisors and get the latest learning contents and learning activities" [IT Specialist].*

Also they added:

"New version of Mobile learning apps also allow students to perform new services such as courses registration (registering for academic courses), online payment (paying fees using mobile student account) anywhere and anytime, so they don't have to go to the university offices and lose their time" [IT Specialist].

(2) *Awareness*

Based on the interview results, awareness is the second driver towards mobile learning applications adoption as mentioned by the participants. The interviewees confirmed that

"Low familiarity with mobile learning apps negatively and significantly influence its adoption of, and low level of mobile learning apps awareness by users is an obstacle toward adoption" [Policy Maker].

The interviewees stated that *"Despite some universities in Jordan provides mobile learning apps, and these apps are full of important learning content and services, but it still not famous and well-known, and there are many students who do not know about them because of the lack of advertisement" [Policy Maker].*

Also they added “*Many students do not know the existence of the mobile learning apps due to the lack of publicity*” [Policy Maker].

"Mobile learning system is a new tool for learning, and it is still unfamiliar for students like e-learning system" [Policy Maker].

One of the interviewees suggested that “*universities should advertise about these new apps through social network sites to increase the awareness among students*” [Policy Maker].

Some of participants stated “*We have not heard of the mobile learning apps before*”. [Student].

Another participants added “*Several students don't have awareness about the mobile learning apps*” [Student].

(3) *Availability of learning contents and activities*

All interviewees mentioned that the availability of learning contents and activities is the critical aspect of the adoption of mobile learning apps. Their comments were as following

"The mobile learning apps should contain the learning materials such as PPT slides", "The mobile learning apps should support the access and download course items like e-learning system" [Policy Maker].

A lot of the students who used the mobile learning apps before confirmed that

"The availability of learning contents is the primary factor to encourage students for accepting this new system". They also noted that *"There is a lack of availability learning contents and activities by the mobile learning system"* [Student].

Majority of students expressed according to their comments that “*Mobile learning system provides limited services*”. Students indicated that “*They used the mobile learning system only for some administrative services such as courses schedule, dates of registration, university announcements, and calendar*”.

(4) *Interface design quality*

The findings reveal that interface design quality play an important role in the continuous use of mobile learning apps. This result is new in the mobile learning field since no study has investigated it before. The interviewees said:

"If users are satisfied with the content design and interface design of mobile learning apps, they will perceive utility value, which translated into more intention to reuse" [IT Specialist].

Some interviewees stated “*The designers of mobile learning apps should develop attractive and appealing interfaces*” [IT Specialist].

They also added that there are some critical factors that should be considered to design high quality interfaces for mobile learning apps:

"The first one is related to its user-friendliness, the interface design of mobile learning apps should be user-friendly and simple". "The second one is related to the ease of navigation" [IT Specialist].

Other interviewees reported that there are some problems related to interface design. These are the problems they faced:

Poor of design: *"The pages are not designed for small screens of mobile devices and thus difficult to use"* [student]. *"The design of the app is bad"* [student].

Problem of design compatibility: *"I had major problems accessing the app with my iPhone so I had to use my friend android phone to access the app"* [student].

Problem of design navigation: *"For example, when I click on e-services and I want to go back there, it doesn't take me. It, however, redirects me to the main page, which it bothers me"* [student].

"When I used the app, I found it to be poorly designed, hard to navigate and less data-rich" [Student].

(5) **Technical Issues**

Some interviewees stated that there are several technical problems in the current mobile learning apps, which affect on the continuous use of mobile learning apps. They said:

Problems with internet connectivity issues and poor network reception to download and upload files:

"Slow internet connectivity makes it hard to access mobile learning apps" [Student]

Incompatibility of mobile learning apps to operating systems other than Android:

"I find it difficult to download the application from google play store" [Student],
"I had to uninstall and reinstall severally" [Student].

7.2 The qualitative results of the factors affecting of intention to use of mobile learning from universities non-adopters

The analysis of the qualitative interviews showed new factors were discovered that affect of intention to use of mobile learning through the interviews with policy makers of universities. These factors are:

(1) **Location and Economic Status**

The interviewees from universities that had not adopted mobile learning system justified the reasons of non-adoption as following:

First one, the location of university is one the critical issues that should be considered in the adoption of new technology because these universities are located in rural locations:

“Universities that are located in the rural and village communities do not have the same services similar to those who locate in cities” [Policy Maker].

“The mobile learning app is a new concept in the rural and village communities”
[Policy Maker]

Another interviewees mentioned *“This issue is critical because it is part of the change process which needs to convince rural students to accept the new mobile learning apps”* [Policy Maker].

Second one is related to economic status, the interviewees mentioned:

“Students in these universities are not as wealthy as other students in the capital and other major cities, and are considered less technology oriented. The same impression exists about other technologies, not only mobile applications” [Policy Maker].

(2) **ICT literacy**

ICT literacy is another important factor towards mobile learning applications adoption as mentioned by the interviewees:

“The majority of students in these universities are living in villages and some of them have low ICT literacy. Thus, implementing the entire application of mobile learning is a challenging chore” [Policy Maker].

They also added:

“One of the factors that should be considered to increase the chance of mobile learning apps adoption is to improve ICT skills of students” [Policy Maker].

They outlined in this regard:

“If the universities can't alleviate the ICT literacy level, then it would become a barrier to achieving the strategic goals with respect to implementing mobile learning apps” [Policy Maker].

(3) **Financial Support**

All interviewees confirmed that financial support is one of the obstacles that faces the mobile learning adoption projects. The interviewees pointed out that:

“In case of financial troubles such as the current state of budget deficit, many projects could be detained because the government is the sole source of our financial prospects” [Policy Maker].

8 Discussion

8.1 Technological factors

This study discusses the effect of factors related to the technological characteristics on intention to use of mobile learning applications. These factors are *security*, *privacy*, *compatibility*, *relative advantage* and *trust*.

The results of this study reveal that the '*security factor*' has a negative and significant impact on intention to use of mobile learning applications. Despite security concerns were found to be among the barriers that inhibit users from adopting mobile learning, security solutions and techniques have been enhanced to ensure that the mobile learning system is a secure environment (Park and Kim 2014). This result is in agreement with previous studies such as (Park and Kim 2014), which found that concern about security is one of the main reasons that prevent users from using mobile applications. Furthermore, the issue of security still has a negative influence in adopter universities. This implies the adopters also still feel that this technology is not fully secure. It can be concluded that security is one of the obstacles to mobile learning adoption in Jordan.

Also, '*privacy factor*' was found to have a significant negative impact on intention to use of mobile learning applications in Jordanian universities. In this study, students have concerns about personal data and their information in the mobile applications could be exposed to other parties without their consent. Furthermore, the results indicate that the concern about privacy does not just affect the students from non-adopter universities to adopt mobile learning. In this study, the students from universities that already used mobile learning applications also still have fears about the privacy issues. This result means that concern about privacy is one of the barriers against the adoption of mobile learning applications in Jordanian universities. The result of this study is in line with a study conducted by (Liew et al. 2017), which found that privacy concerns affected the users' intention to use e-commerce websites in Malaysia.

Based on the results of this study, '*trust factor*' was found to be a significant factor which had a positive influence on students' intention to use mobile learning applications. The results also indicate that the effect of trust across adopter and non-adopter universities, it was found that there was no difference between the universities that were already adopting mobile learning systems and non-adopters. This result implies that the trust is among the factors that drive Jordanian students to adopt and use mobile learning applications. The findings of this study are consistent with a former study (Liew et al. 2017), which confirmed that trust has a significant effect on adoption of mobile wireless technology, as well as being one of the critical factors for using online services (Buchanan et al. 2013).

The results of this study revealed that the '*relative advantage*' has a positive relationship with intention to use of the mobile learning applications. This result agrees with results of former studies (Chen and Zhang 2016), which have found that relative advantage drives to employ the mobile health services. One possible explanation of this result is that students in Jordanian universities realise the benefits of using mobile learning applications. It was also found that the effect of this factor was significant and negative effect on non-adopter universities. Thus, the result of this study suggests that these universities did not yet realise the benefits of implementing mobile learning applications. Moreover, there may be lack of understanding and awareness of the advantages of this technology or that the benefits are not obvious to the universities. Therefore, in order to

increase implementation of this technology, the level of benefit that universities receive from the mobile technology should be made clear to them.

8.2 Organizational factors

In this research two organisational factors were investigated, namely: *resistance to change and technology readiness*.

Although '*resistance to change*' has been argued to be amongst one of the factors that is impeding the adoption of new systems and technologies (Dwivedi et al. 2015), this is essential and considered an important element in the acceptance and adoption of mobile internet services (Zhou 2014). In this study, resistance to change was found to have a negative effect on intention to use of mobile learning applications. This means experiencing high resistance to change would lead to a reduction in the intention to use mobile learning applications. This result is in line with previous studies in mobile health services (Guo et al. 2013), which found that resistance to change had negative impact towards acceptance of mobile health service in China. Also, the result indicated that resistance to change has a positive effect on adopter and negative effect on non-adopter universities. This means that some universities still suffer from resistance by students and faculty members for adoption of new technology. Thus, it is require more effort from universities to overcome users negative cognitive responses to such technology because if users perceived that using mobile learning applications would improve their performance, this would lead to a reduction in resistance to change and an increase in the intention to use mobile learning applications.

In this study '*technology readiness*' factor has a negative influence on intention to use of mobile learning applications. Previous studies indicated that technology readiness plays a critical role in adoption of mobile learning (Hyman et al. 2014). In addition, the results showed that technology readiness had a negative significant effect in adopter and non-adopter universities. This result means that the issues related to technology readiness such as Internet infrastructure and technical resources still impeded the universities in Jordan from employing and adopting mobile learning applications. A possible explanation for this finding is that the technical infrastructure in Jordan is still at the development stage. Another explanation is that the universities still have limited technical skills in the development of mobile learning applications. Overall, this factor plays an important role in adopting and using mobile learning applications. Thus, to increase adoption of mobile learning applications in Jordan further effort should be made to address Internet infrastructure (i.e., bandwidth and speed). In addition, having the necessary technical skills in the universities would encourage adoption of this new technology.

8.3 Cultural factor

In this section, the effect of '*culture factor*' on adoption of mobile learning applications was examined. The results of this study found that the relationship between culture factor and intention to use of mobile learning applications was negative. This result was supported by a former study (Thomas et al. 2013), which found that the effect of culture factor on adoption of mobile learning in Guyana was negative. In addition, Althunibat (2015) found that culture is one of the major challenges facing adoption of mobile

learning in Jordan. The results also show that the impact of culture factor was negative on both adopter and non-adopter. One potential explanation of this result is that there is lack of awareness and knowledge of the mobile learning applications and how it works. Thus, increasing awareness among students to use the mobile applications may encourage them to adoption of new mobile learning applications.

8.4 Quality factors

In this study, three types of quality factors were investigated, which had not been studied in existing mobile learning acceptance researches. As we mentioned above, these factors were explored from interviews conducted with a number of experts in exploratory study conducted by (Almaiah et al. 2016a, b). The experts mentioned that these factors should be investigated empirically and studied their effects on acceptance and adoption of mobile learning. The results of these factors are presented below.

This study showed that ‘*quality of system*’ has a positive and significant effect on intention to use of mobile learning applications. This result is consistent with previous studies in e-learning acceptance (Cheng 2012; Mohammadi 2015) which revealed that the effect of quality of system on e-learning adoption was significant. The results also showed that the influence of quality of system on universities that have already adopted the mobile learning applications was stronger than non-adopters. This result means that the quality of system is one of the factors that drive students to adopt and use mobile learning applications. One potential explanation of this result is that when mobile learning applications offer the elevated levels of system quality can generate a perception among students that the system will be easy to use, with easy access to the learning materials that the information system provides and high level of utility where the learners can efficiently identify the desirable characteristics of the system. Thus, ensuring high quality of system functionalities and characteristics is an important step to increase the acceptance and adoption of mobile learning applications.

The results of this study revealed that ‘*quality of content*’ has a positive relationship with intention to use of mobile learning applications. This result is in agreement with past studies (Cheng 2012; Mohammadi 2015), which found that quality of content is one of the main critical factors that lead to increase the acceptance and adoption of e-learning system among learners. The results also indicated that the effect of this factor on both universities adopter and non-adopter was positive. However, the effect was greater in universities adopter compared to non-adopters. A possible explanation of this finding is that mobile learning has great benefits to students because of the richness of learning content provided by the mobile learning application. This makes learning contents on the mobile learning application are more useful for learning, and thus, this will lead to increase the chance of accepting and adopting this system.

Finally, the results showed that the ‘*quality of service*’ has a positive and significant impact on the students’ decision to adopt and use of mobile learning applications. This finding is consistent with a former study (Mohammadi 2015). Furthermore, it was found that the quality of service is one of the factors that drive universities to utilise mobile learning, as the effect of this factor on the universities that had already adopted mobile learning application was slightly stronger than that for non-adopters. Overall,

the results of this study imply that ensuring quality of service from service providers is an critical step to increase the use and acceptance of mobile learning applications.

9 Research implications

This study contributes to the research in the fields of both mobile learning and adoption of new IT innovations by studying adoption and acceptance of mobile learning technology in Jordanian universities. The proposed model of mobile learning adoption in this study has included as variables the critical factors identified from the literature review, together with other factors that have not been examined in previous studies, to determine their impact on students' intention to use of mobile learning application. It is different from former studies, in that no study exists combining all these factors together, as shown in Fig. 1, to examine their effects on the adoption and acceptance decision. Furthermore, to the best of the author's knowledge, no previous study has investigated the impact of these factors on the students' intention to use of mobile learning application in the public universities of Jordan. Although the acceptance and adoption rate of mobile learning applications in Jordanian universities is still at the initial stage, this research has investigated and shown the differences between universities that were already using mobile learning technology and non-adopters. Overall, this research does not merely fill this research gap, but also provides a comprehensive evaluation of the technological, organisational, cultural and quality factors affecting mobile learning adoption. This study has increased understanding of the current situation and concerns regarding mobile learning adoption, especially in Jordan.

In addition, the effect of quality factors on mobile learning acceptance and adoption have not been studied in previous studies (Please see Table 1). Thus, the inclusion of these factors in this study is a further contribution to the body of knowledge on this topic. This study is one of first studies to investigate the effect of the quality factors on students' intention to use mobile learning applications.

The other main contribution of this research is the proposed model. The model in this research was constructed from the literature review, and included additional factors which had not been investigated in existing studies, and then the related factors were also explored through the interviews presented in a previous work (Almaiah et al. 2016a, b) (Alkhater 2014). Finally, the mobile learning adoption model was evaluated quantitatively, using a large sample ($n = 1200$), in order to assess the relationships between the factors and the students' intention to use mobile learning; in other words, to explore the factors that encourage or impede mobile learning adoption in the Jordanian universities. The results confirmed that the proposed model fitted well with the data. Thus, the developed model is considered to be valid and capable of making a valuable contribution in explaining the adoption of the mobile learning at adopters and non-adopters universities level. Thus, the integrated model can be used in any future studies concerning the adoption of new technologies. It is considered that this research provides a valuable information resource for future researchers in the mobile learning adoption area, as well as in the area of new technologies adoption generally.

10 Limitations and future work

The present study opens the door for further research in future. This study focused on investigations into the factors that impact on mobile learning acceptance and adoption in the public universities in Jordan. The research was conducted only in the public universities in Jordan, which means the study only reflects the situation of that country. Future study could investigate mobile learning adoption in the private universities and compare the private and public universities in Jordan. Overall, the research model could be applied in other countries and universities, not just in Jordan. Moreover, the model can be used in future for studying adoption of a new IT innovation.

This research studied the relationships among construct factors that had been identified in the model. Although this study includes the key factors that might impact on mobile learning adoption, future studies could extend the developed model by adding other factors, for example, social factors. The role of quality factors in developing mobile learning applications also needs more investigation in future research.

Further, the sample of this study was limited to students. Future research should take into account the view of academic staff and IT staff; this will help in understanding issues related to adoption more deeply.

Finally, future studies may consider theories of IT acceptance such as the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh et al. (2003), Technology Acceptance Model (TAM) (Davis 1989), Theory of Reasoned Action (TRA) (Fishbein and Ajzen 1975) and the Theory of planned behavior (TPB) (Ajzen 1991) to study the acceptance and adoption of mobile learning in universities.

11 Conclusion

Although mobile learning systems offer several benefits for students, academic staff and universities, from easily access and learning anywhere and anytime, the use and acceptance of this new technology in Jordan still very low. Thus, an integrated model has been proposed, with the aim of identifying the most influential factors that may encourage or impede students and universities in Jordan in moving towards acceptance and adoption of mobile learning applications. The proposed model was evaluated empirically with 1200 students from both two groups of universities that already used the mobile learning technology and non-adopters universities in Jordan. The model aims to examine the impact of 11 factors on the adoption of mobile learning applications that were categorised based on four fundamental constructs are: (i) technological factors (security, privacy, compatibility, relative advantage and trust), (ii) organizational factors (resistance to change and technology readiness), (iii) cultural factors and (iv) quality factors (quality of system, quality of content and quality of service). However, resistance to change, security and privacy concerns still limit mobile learning acceptance and adoption in Jordanian universities. In addition, some factors were found to have a negative effect on the intention to use of the mobile learning. These factors are compatibility, technology readiness, and culture. Furthermore, five factors (relative advantage, trust, quality of

system, quality of content and quality of service) were found to have a positive effect on the intention to use of the mobile learning. Our research also found that the effect of these factors differed in universities that already used the mobile learning and non-adopters. Finally, it can be concluded that the proposed model is valuable in explaining the adoption and acceptance of the mobile learning applications at adopter and non-adopter universities level. It is expected that the findings of this research can assist university decision makers, mobile learning application providers and the research community in introducing better strategies for encouraging adoption and acceptance of this technology. The findings of this study can also add to their awareness and understanding of why some universities are utilising the mobile learning technology while others are not.

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