Exploring the Main Determinants of Mobile Learning Application Usage During Covid-19 Pandemic in Jordanian Universities

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Abstract Recently, higher education sector has been affected by Covid-19 pandemic significantly. Where, several universities have started to adopt online distance learning tools such as mobile learning applications. However, in order to success mobile learning applications during this pandemic, it is important to understand the necessary factors that ensure the actual use among students in post implementation. The findings showed that factors of technology, awareness, training and experience had a significant and positive influence on the actual use of mobile learning applications. While, the results indicated that psychological factors had a negative effect on the actual use. Furthermore, the results also revealed that technological and individual factors play a crucial role in solving the psychological issues among students. The findings of this research will offer useful recommendations for educational institutions in order to encourage the use of mobile learning applications effectively during Covid-19 pandemic.

Keywords Mobile learning applications · Covid-19 pandemic · Actual use · Jordanian universities
1 Introduction

According to a recent report issued by UNESCO, Corona Virus (Covid-19) pandemic has enforced more than 145 countries to close universities and schools, which impacting on 80% of students across the world [1]. In addition, most of universities and colleges have cancelled all teaching and learning activities such as traditional lectures, exams and workshops inside the universities [1]. Covid-19 pandemic has caused many universities to switch from face-to-face to online distance learning. Therefore, several universities across the world have started to resume their lectures and exams through online learning tools such as e-learning and mobile learning applications [2–4].

Mobile learning applications are playing a crucial role during this pandemic because it has several features such as portability, where mobile learning applications can be taken in different locations at home, office and others by using mobile devices [5], instant connectivity, where mobile learning applications can be used to access a variety of information and learning activities anytime and any-where with instant connectivity facility between students and instructors [6], context sensitivity, where mobile devices can be used to find and gather real or simulated data [7], interactivity and mobility [8].

In Jordanian universities, the implementation of mobile learning applications is still in early stages [9], where there are several Jordanian universities that already have been developed mobile learning information systems in their settings such as mobile student information system [6]. In most of mobile learning studies, an improvement in learning is noted because of using mobile learning applications among students, since the mobility of these applications allows for learning any-where and anytime without having to come the university. In this case, the introduction of mobile learning applications will reduce the spread of Covid-19 among students as well as will ensure the continuous of learning in active way with flexible manner and without any constraints.

However, mobile learning in Covid-19 is still a pending topic [1], where some university students and instructors are still reluctant to use mobile learning applications due to several reasons such as lack of technological resources and infrastructure, lack of training and knowledge and psychological aspects [10, 11]. These aspects are paramount in exceptional and emergency situations where the use of mobile learning is not optional, but it is mandatory to maintain student learning with the use of mobile learning applications. Therefore, first, improvement of technological resources and infrastructure is a primary purpose for universities in order to use mobile learning benefits effectively. Second, training of university students and instructors of mobile learning applications is a priority task for universities, which should be compulsory.

Therefore, taking into above critical issues as well as consideration the current situation of Covid-19 and the importance of the use of mobile technologies to conduct the learning remotely, this research addressed the following objectives:
2 Literature Review

As we see now in the world, the global spread of Covid-19 has motivated many universities to adopt online distance learning systems. However, some challenges like technological issues, awareness, literacy and economic aspects might act as a hindrance to the usage of online learning systems, specifically in developing countries like Jordan and Saudi Arabia [12–14]. According to a global survey from the International Association of Universities (IAU) showed that two third of the universities replaced their classroom teaching to online learning [1]. A recent study conducted by Almaiah, Al-Khasawneh and Althunibat [1], showed that Availability of technological infrastructure, access to internet network, competence and pedagogies of online distance learning were the major challenges faced the universities in Jordan and Saudi Arabia.

Another study in UK by Eyles, Gibbons and Montebruno [15], indicated that university students who have less access to the resources like Wi-Fi, internet, smart devices will be the most disadvantaged students from continuous of learning than any other group of students due to sudden closure, and thus, will affect on students’ achievement negatively. In Jordan, public education have been transferred for school students through collaboration of national TV. Similarly, for universities have used several types of online social applications like Microsoft Zoom, Microsoft teams, Youtube, Skype and WhatsApp [1]. In Nigeria, Jegede [16], indicated that online learning is the best alternative tools of classroom teaching and learning in future pandemic occurrence by 89%. A study conducted by Radha et al., [17], during Covid-19 pandemic indicated that majority of students preferred smart phones for conducting the online learning than other devices. They faced number of challenges during online learning due to technical failure like internet connectivity, data limit, device problem and less face to face interaction. Furthermore, more than half of students found online learning as convenience learning in comfortable environment [17].

In fact, Covid-19 pandemic has significantly changed educational system in the world in terms of how to teach, learn and communicate with students. Many countries like Saudi Arabia, Jordan, China and others have started to adopt online virtual classroom to engage the students in teaching learning activities [1]. While, some other countries like Pakistan, India and Bangladesh have completely shut down their universities and schools due to poor access to online learning tools and
applications during Covid-19 lockdown [18]. However, these countries need to identify the essential requirements for ensuring the successful implementation of the online learning systems during Covid-19 pandemic [1]. Therefore, this study mainly aims to propose a conceptual model for exploring the essential factors for mobile learning applications usage during Covid-19 pandemic.

2.1 Online Learning and Covid-19 Pandemic in Jordanian Universities

In Jordan, more than one 100,000 university students from 30 universities have been deprived of education and learning due to the COVID-19 lockdown. Where Ministry of Higher Education of Jordan has allocated budget to start the preparations for online learning in public universities. In fact, many educators have started to use online learning tools such as video conferencing to conduct online classrooms. In addition, they have used pre-recorded online videos were shared to facilitate the teaching and learning process for Engineering, Education, Arts, management and science students of Bachelor and post graduate level.

Before COVID-19, most Jordanian universities looked to online learning as a supplementary way to support the learning process for students [6]. Few of students in these universities may have taken few online classes voluntarily, or professors incorporated online lessons into in-person classes. In fact, before few years Ministry of Higher Education of Jordan closed many online universities in Jordan. Now with Covid-19, the form of education has changes and online learning has become the main rescuer for many universities over the world. In order to help universities to maintain the continuity of learning process for their students during Covid-19 pandemic, there is need to investigate the necessary factors that ensure the actual use of mobile learning applications among students in post implementation [19–21].

Despite many universities already used online learning tools, now Covid-19 made online learning the only feasible way to maintain continuity of education in this pandemic. However, this transition to online learning requires great efforts from universities, teachers, students and governments in order to ensure the successful usage of online learning systems among university students. Unfortunately, there is little research on investigating the success factors of mobile learning adoption during Covid-19, and the past literature on mobile learning research cannot be generalized to the experiences of students during the pandemic. Therefore, this study aims to fill this gap by exploring the main factors of mobile learning system usage among university students during COVID-19.
3 Hypotheses and Research Model

The proposed framework aims to investigate the main determinants of mobile learning adoption during Covid-19 based on examining the impact of technological, individual and psychological factors on mobile learning usage among university students. These factors were adopted from previous studies [22–25].

3.1 Technological Factors

Several previous literature [26–28] have indicated that technological aspects are considered one of the associated factors of mobile learning implementation. Technological aspects in this study include five factors related to internet speed, easy access, availability of technological resources and equipments, availability of necessary applications and software, technical maintenance and other mobile devices and network facilities [29–34]. In fact, lack of technological resources (software, hardware, internet network and technical maintenance) could result to unsuccessful usage of mobile learning applications, and this leading to increase the challenges of both students and university lecturers during Covid-19. This is the main reason of why prior studies focused on the important role of technological aspects on impacting students’ usage of online learning technologies such as e-learning and mobile learning [22]. This result is supported by Aldowah et al., [22], they indicated that there is a positive relationship between technological aspects and students’ usage of e-learning, which leads to successful implementation of e-learning system. Based on these recommendations, this study assumed that investigating the impact of technological aspects on students’ usage of mobile learning could help universities and service providers to provide the necessary technological resources to effectively increase the use of mobile learning applications among university students during Covid-19, and thus, this will ensure the continuity of learning process by using mobile learning applications. Therefore, this study hypothesis the following:

H1: There is a relationship between technological aspects and students’ usage of mobile learning applications during Covid-19.

H2: There is a relationship between technological aspects and psychological factors for actual use of mobile applications.

3.2 Individual Factors

Individual factors also have been considered as one of the primary determinants of success or failure of mobile learning applications [35]. Chavoshi and Hamidi [35],
found that individual factors are the most effective factors to motivate students’ to accept mobile learning. In fact, understanding individual factors and their impact on mobile learning usage during this pandemic could help in supporting the successful implementation of mobile learning applications in universities. In this study, individual factors focus on three dimensions including knowledge, awareness and training for both students and instructors. A study conducted by Aldowah et al., [22], found that availability of knowledge and necessary skills for both students and instructors have a high impact on e-learning system usage. In addition, Fayyoumi et al., [36], indicated that the primary key to accept new technologies by individuals is continuously offer the required training sessions on how to use new technologies in order to enhance skills of both students and instructors. These results motivated Almaiah and Alyoussef [4], to investigate the main reasons about students’ resistance to accept e-learning system in their learning. The study found that students and instructors’ limited knowledge about new technologies and how to use it minimized their opportunity to use e-learning systems effectively. Based on that, there is strong evidences supporting the impact of individual factors on students’ use of new technologies. Thereby, understanding the impact of individual factors could play an a key role in increasing the use of mobile learning applications among university students and lecturers during Covid-19, and thus, this will ensure the continuity of learning process by using mobile learning applications. Based on that:

H3: There is a relationship between individual factors and students’ usage of mobile learning applications during Covid-19.

H4: There is a relationship between individual factors and psychological factors for actual use of mobile applications.

3.3 Psychological Factors

Psychological factors such as stress, worries about privacy and anxiety can cause failure of using online learning technologies, which may impede the learning [37]. Several studies in the literature have indicated that psychological factors can affect in negative way on students’ technological skills, low participate in online lectures and poor communication with lecturers via online sessions [38]. Taat and Francis [39], found that psychological factors were correlated significantly with students’ actual use of e-learning system in Malaysia during Covid-19 pandemic. In addition, they found that students’ anxiety had negative effect on students’ ability to use online learning tools and their awareness about the benefits of online learning systems. Another studies revealed that students’ stress and anxiety of online learning systems could be reduced by providing the necessary technical infrastructure, high speed of internet and training sessions of how to use new educational technologies such as mobile learning applications. Based on the above discussion, this study investigates the impact of psychological factors on students’ usage of mobile learning applications under Covid-19 pandemic circumstances. Therefore:
There is a relationship between psychological factors and students’ usage of mobile learning applications during Covid-19 (Fig. 1).

**H5:** There is a relationship between psychological factors and students’ usage of mobile learning applications during Covid-19 (Fig. 1).

### 4 Research Method

#### 4.1 Data Collection

In this study, online questionnaire survey was used for data collection due to the Covid-19 pandemic lockdown situation. The researchers of this study had distributed the online questionnaire via email and Google sheet for students at five universities in Jordan. These universities have already developed mobile learning systems in their settings. Using online survey questionnaire, students were invited to participate in this study through online classes, during the summer semester.
2020. All participants in this study were briefed on the academic research purpose and confidentiality of the survey, in which they voluntarily agreed to participate.

### 4.2 Participants

Due to Covid-19 and its prevention, face-to-face data collection was not possible. The questionnaire in the form of Google Sheet has been sent to the students through university lecturers. They were asked to fill the form and submit their responses if they were willing to participate in the research. The participants had not forced to participate in this research and it was clearly mentioned that if they did not like to continue then they were not forced to submit the form. In total, 487 online questionnaires were distributed, with 397 questionnaires being returned, indicating an 81.52% response rate. Most of responses had incomplete or invalid answers and therefore were excluded. Hence, 397 responses were considered valid for further analysis. Among 397 valid responses, 60.7% of respondents were female, while 39.3% were male. Moreover, 52.6% of respondents who responded were undergraduate; 47.4% were postgraduate students.

### 4.3 Research Instrument

The items and measurements for testing the constructs in the proposed model were adopted from existing previous research. The online questionnaire included four constructs (technological factors, individual factors, psychological factors and actual use) and included demographic information (e.g., gender and age). The items for measuring technological factors and individual factors were developed from the measurements used by Almaiah and Al Mulhem [2]. The measurement items for psychological factors was derived from Taat and Francis [39]. Actual use were adapted from Delone and McLean [40]. In this study, a 5 point scale similar to Likert model was utilized for measuring every item, ranging from “strongly disagree = 1” to “strongly agree = 5”. In order to examine the appropriateness and clarify of the questionnaire, we invited five university professors, each of them holding significant expertise in the mobile learning field. After that, pre-tested was carried out with 25 post-graduate students from University of Jordan, with the results indicating that the instructions and questions were completely understood.

### 4.4 Data Analysis Methods

In this study, we have applied two main techniques in order to analyze the data as well as evaluate the proposed hypotheses in the research model. The first method is
the confirmatory factor analysis (CFA) in order to evaluate the measurement model in terms of reliability, convergent validity, and discriminant validity. In the second method, structural equation modelling (SEM) method was applied to test the hypotheses in the proposed model.

5 Results

5.1 Results of Cronbach’s Alpha

The Cronbach’s alpha analysis was employed to evaluate the reliability of items for each construct in the proposed research model. As the results summarized in Table 1, the value of this coefficient ranged between 0.773 and 0.894, exceeding the critical value of 0.7 as suggested by Kannan and Tan [41], and indicating satisfactory reliability for all variables in the proposed research model.

5.2 Results of Convergent and Discriminant Validity

In this study, all variables in the proposed model were evaluated using two types of validity analysis: convergent and discriminant validity. For convergent validity analysis, Table 1 shows that the average variance extracted (AVE) was above (0.5). According to Hair et al. [42], specify that a variance greater than 0.5 is acceptable. Therefore, the convergent validity values for the research constructs are acceptable. Concerning the discriminant validity analysis, the square root of AVE was obtained to correlate the latent constructs. Table 2 highlights that the square root of the AVE for each construct is greater than the pairwise correlations. This result means that the psychometric characteristics of the instrument are also deemed acceptable in terms of their discriminant validity [43].

Table 1 Results of Cronbach’s Alpha and AVE

| Variables             | Cronbach’s alpha | Average Variance Extracted (AVE > 0.5) |
|-----------------------|------------------|----------------------------------------|
| Technological Factors | 0.894            | 0.773                                  |
| Individual Factors    | 0.773            | 0.741                                  |
| Psychological Factors | 0.887            | 0.796                                  |
| Actual Use            | 0.865            | 0.801                                  |
5.3 Results of the Structural Equation Modelling (SEM)

The proposed model was examined using SEM method. The findings of hypotheses testing, presented in Table 3, indicated that all hypotheses were supported. Based on the results, technological factors had significant and positive effects on students for motivating them towards using mobile learning application effectively during Covid-19 pandemic. This result supports hypothesis H1, (H1: $\beta$-value = 0.527, $p < 0.001$). In addition, the results indicated that there is significant positive relationship between individual factors and students’ actual use of mobile learning applications, which supported hypothesis H3 (H3: $\beta$-value = 0.498, $p < 0.001$). This implies that individual factors had significant and positive effect on students for motivating them towards using mobile learning application effectively during Covid-19 pandemic. The results also indicated that psychological factors had significant negative effect on actual use of mobile learning applications among university students, which supported hypothesis H5 (H5: $\beta$-value = −0.532, $p < 0.001$). This implies that psychological factors could prevent students to use mobile learning applications effectively during this pandemic, and thus, this will cause failure of mobile learning applications usage. In addition, the results showed that psychological factors influenced positively by both of technological and individual factors (H2: $\beta$-value = 0.570, $p < 0.001$) and (H4: $\beta$-value = 0.502, $p < 0.001$). Based on these results, hypotheses H2 and H4 were supported.

6 Discussions

In fact, the global spread of Covid-19 has motivated many universities to adopt mobile learning applications in order to ensure the continuous of learning among students. But, some issues related to technological challenges, individual characteristics and psychological problems may act as hindrances to the usage of these applications among university students. Therefore, there is need to investigate the main determinants that could affect on students’ acceptance or rejection of mobile learning applications during Covid-19 pandemic. In order to success mobile learning during this pandemic, it very is important to understand the necessary factors that ensure the actual use among students in post implementation. Based on that, this study proposed a model to examine the effect of technological, individual
Table 3  Results of SEM analysis

| Hypotheses                                                                 | Standardized coefficient (β) | SE (P) | T-value | Supported   |
|---------------------------------------------------------------------------|-----------------------------|--------|---------|-------------|
| **H1**: There is relationship between technological aspects and students’ usage of mobile learning applications during Covid-19 | 0.527*                      | 0.008  | 4.542   | Positive Effect |
| **H2**: There is a relationship between technological aspects and psychological factors for actual use of mobile applications | 0.570*                      | 0.008  | 4.921   | Positive Effect |
| **H3**: There is relationship between individual factors and students’ usage of mobile learning applications during Covid-19 | 0.498*                      | 0.005  | 4.130   | Positive Effect |
| **H4**: There is a relationship between individual factors and psychological factors for actual use of mobile applications | 0.502*                      | 0.005  | 4.443   | Positive Effect |
| **H5**: There is a relationship between psychological factors and students’ usage of mobile learning applications during Covid-19 | −0.532*                     | 0.010  | 4.712   | Negative Effect |

and psychological factors on actual use of mobile learning applications among university students during Covid-19 pandemic. The proposed model was examined using structural equation modelling (SEM). The findings of this study will offer useful recommendations for educational institutions to ensure the success of mobile learning applications usage during Covid-19 pandemic. The findings of this study will be discussed in details below.

First, the findings of this study found that actual use of mobile learning applications during Covid-19 influenced significantly by technological factors in terms of internet speed, easy access, availability of technological resources, availability of software and applications and technical maintenance. These results imply that availability of technological resources such as of laptops and mobile devices with high speed of internet network are considered the most prerequisite requirements for both university lecturers and students to participate in online teaching and learning through mobile learning applications. On the other hand, challenges increase when technical support is not consistently available or there is not a plan to periodically maintenance of technical challenges. In some developing countries, many students have not been able to complete their learning due to poor internet access, poor data service, or even lack of laptop or mobile devices. Therefore, it is important that universities should introduce and implement mobile learning applications to ease the online teaching and learning activities during the Covid-19 lockdown for both lecturers and students.
Second, the study findings found that individual factors (knowledge, awareness and training) had significant and positive effect on students for motivating them towards using mobile learning applications effectively during Covid-19 pandemic. This implies that there is significant positive relationship between individual factors and students’ actual use of mobile learning applications. The findings indicates that successful online learning through using mobile learning applications during Covid-19 is feasible only when university students and instructors have the adequate skills, knowledge and awareness on how to exploit the advantages of mobile learning applications. Although the many advantages of mobile learning applications, which making teaching and learning accessible to students regardless of geography or culture, it requires awareness, training, and knowledge of these applications. Universities should not assume that all students and instructors have the same knowledge, awareness and willingness to engage in online learning technologies like mobile learning applications. On the other hand, inadequate technical skills of students and instructors will cause stress about them and thus, the result is failure of mobile learning applications usage. Therefore, the findings of this study recommends that university administration and decision makers need to provide adequate online training sessions for their students and instructors on how to employ mobile learning applications in learning and teaching process to make online learning successful during this pandemic.

Third, the findings indicated that psychological factors affected on actual use of mobile learning applications in a negative way. In addition, the results showed that psychological factors influenced positively by both of technological and individual factors. This means that psychological issues such as stress, phobia of working independently, worries about privacy, and anxiety could impede the learning and teaching via mobile learning applications. Therefore, universities should enhance students’ comfort through easily access to mobile learning classes, enhance their ability to enjoy through using mobile learning applications and increase their awareness about the benefits of mobile learning applications.

Finally, the model proposed in this research determined the main determinants of mobile learning applications actual use that could be beneficial for Jordanian universities to ensure the effective usage of mobile learning applications during Covid-19. In addition, this study added to the current literature by investigating the effect of technological, individual and psychological factors on mobile learning usage among university students. Therefore, the results of this study will serve as an important reference for university policy makers, managers and IT technicians regarding the effective factors that contribute in enhancing the usage of mobile learning applications among students during Covid-19, and thus, ensure the continuous of learning process during this pandemic.
7 Research Implications

The findings of this study will serve as an important reference for university policy makers, managers and IT technicians regarding the effective factors that contribute in enhancing the usage of mobile learning applications among students during Covid-19. The findings suggest that technological infrastructure and resources play a vital role in increasing the use of mobile learning applications effectively during Covid-19. Therefore, in order to success the use of mobile learning in universities, technical department in universities should provide the necessary technological resources such as fast, affordable or free Internet access, providing laptops, iPads, or tablets and providing periodically maintenance of technical problems and solve it. This study also recommends for university decision makers that students’ stress and anxiety of mobile learning applications can be reduced by providing the necessary technical infrastructure, high speed of internet and training sessions of how to use mobile learning applications.

This study also provides a useful recommendation for university decisions makers on a deeper understanding on the importance of individual factors in accepting and using mobile learning applications effectively, through preparing university students and instructors and equipping them with the necessary technical skills, knowledge and awareness of the several advantages of mobile learning applications are vital to increase the use of mobile learning applications effectively and thus, this will reduce the bad consequences and challenges of online learning. Therefore, universities should not ignore like these factors that could contribute in enhancing the use of mobile learning applications during Covid-19.

In fact, technological resources such as laptop and mobile devices with high speed of internet network are considered the most prerequisite requirements for both university lecturers and students to participate in online teaching and learning process. In many developing countries, many students have not been able to complete their learning due to poor internet access, poor data service, or even lack of laptop or mobile devices. Therefore, it is important that universities should introduce and implement mobile learning applications to ease the online teaching and learning activities during the COVID-19 lockdown for both lecturers and students.

8 Conclusions

The use of mobile learning applications to continuous the learning process during Covid-19 pandemic became very useful. Critical situations such as Covid-19 pandemic shed light on the importance of mobile learning applications and their benefits for both university students and instructors. Faced with this exceptional situation, mobile learning applications are useful tools to ensure the continuous of learning in an active way with flexible manner and without any constraints. In order
to success these applications during this pandemic, it very is important to understand the necessary factors that ensure the actual use among students in post implementation.

Therefore, in this paper we responded to these objectives, we empirically investigated the factors that could influence on the actual use of mobile learning applications during Covid-19 pandemic in Jordanian universities. Where, we identified some important aspects that lead to success implementation of mobile learning applications and the main factors that motivate to use mobile learning among students. In addition, the technological, individual and psychological factors that influenced on the actual use of mobile learning applications were verified, with highlighting eleven aspects: technological resources (internet speed, easy access, availability of technological resources and equipments, availability of necessary applications and software, technical maintenance), individual factors (knowledge, awareness and training) and psychological factors (stress, worries about privacy and anxiety).

The findings found that availability of technological resources, awareness among students and lecturers, training on the use of mobile learning apps and experience of mobile learning before the pandemic were positively influence on the actual use of mobile learning applications among university students. While, the effect of psychological factors was negative the actual use of mobile learning applications. Furthermore, the results showed that psychological factors influenced positively by both of technological and individual factors.

Although this research has several contributions, it does have some limitations. In the first place, the data were collected from a limited set of universities. Thus, further studies in more universities or in more countries are required to improve the generalizability of the findings. Secondly, besides technological, individual and psychological factors, there may be other important factors that could affect on mobile learning actual use, such as organizational, culture, quality, and others. Future work could examine their effects.

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