Mobile learning facilitates health schools' students' information and learning needs

AlMuhaissen, Suha; Hamad, Faten; Urquhart, Christine; Tarawneh, Ruba Tahsin; Asaad, Muzdalifa; Abu-Ajamieh, Mays

DOI:
10.21203/rs.3.rs-3173697/v1

Publication date:
2023

Citation for published version (APA):
AlMuhaissen, S., Hamad, F., Urquhart, C., Tarawneh, R. T., Asaad, M., & Abu-Ajamieh, M. (2023). Mobile learning facilitates health schools' students' information and learning needs. Research Square. https://doi.org/10.21203/rs.3.rs-3173697/v1

Mobile learning facilitates health schools' students' information and learning needs

Suha AlMuhaissen

s.muhaissen@ju.edu.jo

University of Jordan

Faten Hamad

Sultan Qaboos University

Christine Urquhart

Aberystwyth University

Ruba Tahsin Tarawneh

University of Jordan

Muzdalifa Asaad

University of Jordan

Mays Abu-Ajamieh

University of Jordan

Research Article

Keywords: mobile learning, medical students, health education, students’ attitudes, policy makers, learning practices

Posted Date: August 14th, 2023

DOI: https://doi.org/10.21203/rs.3.rs-3173697/v1

Additional Declarations: No competing interests reported.

Abstract

Purpose;

The aim of this research was to investigate the attitudes towards m-learning among medical students in Jordan, and their perceptions about the advantages and disadvantages of m-learning compared to the status quo (mostly face-to-face learning). It also aimed at exploring how m-learning might support information and learning needs during clinical placements in Jordan.

Methodology;

This research used the quantitative research design. Data were collected using a web-based cross-sectional descriptive questionnaire using Google forms. The questionnaire was administered to 703 students from the five medical schools at the University of Jordan and 690 students completed the questionnaire (response rate of 98.2%).

Findings;

Students confirmed that they use mobile devices to support their learning, mainly using their smartphones. Their use of mobile devices for learning was not well advanced, and most preferred face to face learning. There were some differences among the groups of health students, indicating that m-learning habits vary according to existing teaching methods, the type of content required and the particular benefits that m-learning might offer. Also, medicine students appeared to have more diverse information needs and use mobile devices for a variety of learning related activities. Policymakers and educators need to plan carefully and take an organizational approach to ensure that m-learning complements face-to-face learning, effectively and efficiently. Students and staff should be involved in the design of interactive mobile learning materials and tools.

Originality;

n Jordan, Medical education in the University remains traditional, with lecture-based learning supplemented by labs and simulation tools. Several research studies have used technology acceptance models, including, variously, TAM, UTAUT, and TRA (Theory of Reasoned Action) to investigate the factors affecting intentions to use m-learning among higher education students, however, there was no detailed study of medical students' attitudes exists.

Practical implication;

The results of this research will help policymakers and educators plan infrastructure and curricula for medical education in Jordan, using m-learning to meet the needs of an increased student cohort.

Introduction

Mobile devices are routinely used by university students (Briz-Ponce et al., 2016), as they help individuals to handle many aspects of their daily lives including education and workplace (Wai et al., 2018). Technology became a core facilitator of interaction and collaboration whereby the learning process can continue remotely (Bennet et al., 2020). Using the extended Unified Theory of Acceptance of Technology (UTAUT2) model, Arain et al. (2019) confirm previous research that students believe m-learning is important, easy and habitual to access anywhere at any time, and should be fun to use. Provision of content by educators (Biddix et al., 2016; Joo et al., 2016) may be easier now and there are many potential uses of mobile technology for medical education (Lumsden et al. 2015). From the educator perspective, what are the most effective ways of using m-learning within health professional education – and should educational models change? A protocol for a Campbell Collaboration systematic review on the effects of flipped classrooms to improve learning outcomes in undergraduate health professional education (Naing et al. 2019) discusses turning Bloom's taxonomy on its head – using classroom time to focus on higher level cognition and individual, home-based learning to focus on remembering and understanding. The expected moderators of effects include student related factors such as the amount of out-of-class preparation time, classroom availability and limited high speed internet access for rural and remote students, the quality of interactive tools, and faculty related factors such as faculty members' preference to a more didactic approach. Mobile seamless learning (Wong, 2012) could be designed to fit the flipped classroom, more conventional classroom learning models, or students personal learning spaces (Bennett et al., 2020) using their devices. Research studies on the potential of mobile learning can, according to a main path analysis (citation-based systematic review method) (Hwang et al. 2021) be divided into four main clusters; 1) mobile technologies, and their fit first within information architecture and later, the learning environment; 2) advantages and disadvantages of m-learning for the learners and how educators should respond; 3) moving on from group 2, research on the dynamics of m-learning between educator and learners; and 4) the actual implementation within a particular context – that may be informed by theories such as UTAUT2, or TAM (Technology Acceptance Model).

Professional education, such as medical education may need to focus more on how to integrate technologies into professional education to improve professional digital practices (Smith et al. 2020), by aligning, for example, the affordances of mobile technology on learning outcomes, developing digital competencies that can be authentically applied in educational settings, and matching afforded actions/interactions to digital literacy domains (procedural and technical, sociocultural and cognitive domains). In line with this, many researches have reported the benefits of m-learning as a tool to assist in medical education (Zhang et al., 2021; Kucuk et al., 2020; Chase et al., 2018; Walsh, 2015). For instance, Walsh (2015) stated that because of the numerous advantages to using a mobile device for learning it has been adopted in medical education. High access, low cost, more placed and contextual learning, learner convenience, constant communication and interaction between student and tutor as well as between learner and other learners, and the opportunity to self-assess while learning are some of these benefits.

For educators to manage increased student cohorts effectively, maintaining the benefits of face-to-face learning, but virtually, mobile learning may demand a thorough re-appraisal of the organization of

teaching and learning. This may need examination of resource negotiation (learner negotiation of their learning contracts with teachers), learner co-ordination and collaboration with other learners, monitoring (how does the teacher monitor whether learning is happening and how can remedial action be taken), individualization of learning for students, self-organization for and by students, and ongoing adaptation by teachers, using a model such as the Viable Systems Model (Urquhart et al., 2004; Johnson et al., 2017). Understanding mobile devices usage patterns amongst students to support their learning has captured the attention of many educational experts and library and information service providers, worldwide (Aharony, 2014; Ko et al., 2015; Lau et al., 2020)

Accordingly, it is always important to understand students' needs, practices and attitudes in order to facilitate their needs and provide them with an enjoyable and effective learning environment. Understanding students' readiness to accept m-learning and usage patterns will be useful and advantageous in guiding the design and execution of comprehensive m-learning systems for developers of m-learning applications and educational providers. Although all of the developed countries considered mobile learning as an effective tool for education, it is not properly utilized in Jordan. Moreover, despite the obvious benefits of mobile learning in the clinical setting, there has been little research on the impact of mobile devices in the medical learning environment in Jordan. Therefore, this study will investigate the adoption of, attitudes and perspectives of mobile learning among all medical science students at the University of Jordan: Medicine, Dentistry, Pharmacy, Nursing and Rehabilitation sciences in order to fill this research gap. It also aims at observing the effect of mobile learning on real life situations, memory, psychology and social skills.

The main objective of this research is answer the following research questions:

1. What are the attitudes towards m-learning among medical students in Jordan?
2. What are the perceptions about the advantages and disadvantages of m-learning compared to the status quo (mostly face-to-face learning) in Jordan?
3. How m-learning might support learning during clinical placements in Jordan?
4. How engaged are medical students at The University of Jordan in using mobile devices for educational purposes?
5. Are there any distinctive differences between the three groups of medical students in terms of their mobile learning practices?
6. What are the main intentions behind practicing mobile learning amongst the groups of medical students?

Literature Review

Mobile learning

Researchers have tried to define m-learning throughout the literature (Al-Adwan et al., 2018). For instance, m-learning is defined as e-learning that takes advantage of mobile devices and wireless transmission

(Suanpang, 2012). Hidayat and Utomo (2014) defined m-learning as a service that gives general information electronically to the learner. Viberg (2015) defined it as the gain of any knowledge and skill by using mobile technology, regardless time or place. M-learning is also defined as the use of mobile devices to support the teaching–learning process (Díez, 2017).

M- learning offer many features and functions to students. For instance, students can: download books and study materials (Nassuora, 2012), make phone calls, respond to e-mails instantly, capture pictures, and connect freely with lecturers and colleagues off campus (Handal et al., 2013; Mubuke et al., 2017) in addition to obtaining immediate feedback (Crawford, 2007). Mobile learning provides multiple educational services for students at a relatively low cost which in turn provides benefits to universities (Almaiah et al.,2019; Pynoo et al., 2011). It also provides a competitive advantage for any educational institute and soon the use of these services in educational institutions will be undeniable, especially in universities (Criollo-C et al., 2018). Furthermore, mobile learning differs from other methods and platforms in that it allows for learning regardless of time or place. Once learners have identified their learning requirements, they can instantly use their mobile devices to search for the necessary information they need. Thus, the most essential feature of mobile learning is its ability to meet spontaneous information needs (Ozdamli and Cavus, 2011).

M-learning technology is a tool that may create more meaningful means to teach and learn at distance. However, there are a number of challenges associated with mobile learning. The first is associated to technology acceptance. Regardless users' willingness to use technology, they still have to learn how to exploit the new technology and hence this might cause them to refuse or have doubt because they do not know how to use it or may consider that they do not need it (Setirek & Tanrikulu, 2015). It is necessary to determine prejudice and attitude and convince the learner about the practical aspects and advantages of the new technology (Sönmez et al, 2018). The second challenge is related to applications design process that require professional skills and strategies (Sönmez, 2018). Proper design of a system for m-learning requires a numbers of issues that should be considered. Such as: cost, system usability, roles, choice of technology, support for teachers, security issues and others (Viberg, 2015). The third is technology knowledge among teachers and students. In this regard Setirek and colleagues argued that "Requirement of fluency in the authoring tools for mobile learning systems" has the ultimate importance (Setirek & Tanrikulu, 2015). Unfortunately, technology literacy is a challenge for teachers and learners (Brown & Mbati, 2015).

Mobile Learning in Higher Education

Research into mobile learning among the young "millennial" generation is growing due to the high prevalence of mobile devices among them and their general acceptance to mobile learning as a learning method (Zhang et al., 2021). Traxler and Vosloo stated, as the number of people using mobile devices increases, interest in mobile learning will also increase. This will lead to more mobile learning initiatives, including higher education (Traxler & Vosloo, 2014). Students' mobile learning behaviors are mainly determined by their mobile learning intentions, information needs, attitudes toward mobile learning, and willingness to repeat mobile learning behaviors (Pinto et al., 2020; Wai et al., 2018). Understanding the

learning requirements of students is critical for improving learning efficiency and delivering an effective mobile learning design.

Alksasbeh (2012), mentions that the success of mobile learning system in higher education relies upon the students' acceptance of the technology (Alksasbeh, 2012). It is a necessity to investigate into the elements that influence the acceptance of students, such as factors of acceptance, constraints and needs (Al Zoubi et al., 2019). This should be a main concern for the management of a university when considering applying of a mobile learning system (Alksasbeh, 2012). When factors related to acceptance of mobile learning are realized, the universities carrying out this learning method can enhance on the delivery services to the students (Al Zoubi et al., 2019). The service quality factor has an essential role for students' attitude towards using m-learning (Liu & Han, 2010; Abu-Al-Aish, 2013). Klimova and Poulova (2016) affirmed that mobile learning is likely to enhance learning efficiency among students given that this learning is carefully planned, observed, checked and constantly adjusted by all stakeholders. They added that since the university is well equipped with mobile devices they will have the ability to study individually on place, time and authority. Delcker et al (2018) pointed out how institutions aim to benefit-from the fact that students possess mobile devices-for academic purposes.

A study by Briz Ponce et al (2016) at the University of Salamanca compared the use of an anatomic app for learning and the traditional face to face method managed by a teacher. The results revealed a statistical better performance of learners using mobile apps than those using the traditional method. They add that mobile devices should be considered as an additional tool to supplement the teachers' explanation. Moreover, Jairak et al (2009) and Ahmad (2020) studied students' attitudes, views and opinions about using of mobile phones in an academic environment in a higher education institution in Jamaica. The results were used to better understand and to assist education policy-making authorities in adopting most sufficient approaches to incorporating mobile technology in learning. The results showed an overall positive student attitude toward cell phones usage as a learning means and blending cell phones into learning activities. Faimau et al (2022) point out that the use of smartphones for educational purposes is in part determined by the degree that students understand the different contexts that shape their learning setting.

Furthermore, Alksasbeh et al (2011) investigated group factors that affected mobile learning acceptance in Jordan. Factors under investigation were: gender, mobile device ownership, and prior experience in Internet use and prior mobile learning use. The results showed that a previous experience have a positive influence on behavioral intention towards mobile learning. In addition, it was found that male students have higher levels of behavioral intention and hence higher acceptance of mobile learning. Furthermore, the researchers found significant differences regarding behavioral intention to use mobile learning between mobile phone owners and those who do not own mobile phones (Alksasbeh et al, 2011). In line with this, students' perception toward the use of mobile phones in education in Jordan was investigated (Qudah et al., 2013). The results revealed positive attitudes towards the usage of mobile phone use in university education.

However, Lee and Lee (2022) results pointed out that the increased use of mobile device had negative effect on GPA. Accordingly, they proposed some improvements for the future digital learning policy. Furthermore, Al-Salman et al (2022), studied the effect of prolonged online learning that university student had to undergo during Covid-19 strict regulatory measures. The findings revealed that anxiety, change in sleeping habits, distraction and a stress-building environment, -maybe leading to depression- have resulted due to the use of digital tools in the learning process. They add that this effect was incensed due to social distancing, the lockdowns, health risks and the decreasing household income. This has led to increase in the number of psychological diseases and a decline in students' academic achievements.

Use of m-learning in medical education

The use of m-learning in medical education varies internationally as might be expected given differences in Internet infrastructures and educational models. Yunusa et al. (2018) conclude that, despite the rapid uptake of mobile technologies in sub-Saharan Africa, m-learning for medical education still faces many technical and budgetary problems. A survey in Turkey (Kucuk et al., 2020) used the Theory of Planned Behaviour to explain how medical students believed they might use mobile devices in their coursework, and found that students perceived m-learning as useful, and that they felt ready for m-learning. In a pilot project using iPad mini devices during clinical placements in the UK, students perceived that the devices made their work more efficient, but the devices were used mostly between clinical sessions and at home (Chase et al. 2018).

Zhang et al. (2021) examined attitudes towards m-learning among medical and nursing students in Hong Kong, using a questionnaire based on a modified TAM (Technology Acceptance Model). Like many earlier studies, Zhang et al. (2021) found that students used their mobile devices for quick fact checking, accessing health care information and downloading some course related material, but less often for formal academic reading, or participating in online discussions. A review of 21 studies suggested that medical students welcome m-learning, and concluded there were potential benefits for improving clinical competence (Koohestani et al., 2018). However, as Smith (2020) indicates, the question to be resolved is less the positive attitude of medical students (Masik et al., 2015; Attall et al., 2020; Baghcheghi and Koohestani, 2021) but whether m-learning truly contributes to professional digital practices. There is review evidence that m-learning is effective for acquiring new skills and knowledge (Klímová, 2018) and that mobile devices can be used as learning tools for procedural, reflection and collaborative purposes (Sophonhiranrak et al., 2021). Findings by Chang et al. (2022) indicate that mobile technologies can offer interactive learning tools to enhance nursing students' learning engagement and performance. Furthermore, Sophonhiranrak's (2021) review indicated that mobile devices can be used as learning tools for various tasks such as submitting homework, reflecting on immediate learning experiences, and sharing ideas. Other researches has pointed out the capabilities of mobile devices in facilitating personalized learning where learners are able to set their learning goals and milestones, assess their progress, select their own learning channels, and gain access to desired content (Bai, 2019).

M-learning in Jordan

In Jordan, several research studies have used technology acceptance models, including, variously, TAM, UTAUT, and TRA (Theory of Reasoned Action) to investigate the factors affecting intentions to use m-learning among higher education students (Althunibat; 2015); Almasri, 2018; Al-Adwan et al., 2018; Al Zoubi et al., 2019; Al-Zoubi & Ali, 2019) but no detailed study of medical students' attitudes exists.

Blended learning has been used in some disciplines at the University of Jordan since 2016, with the aim of increasing efficiency but at the same time encouraging a shift to effective student-centered learning. Medical education in the University remains traditional, with lecture-based learning supplemented by labs and simulation tools.

The main aim of this research was to help policymakers, educators and information services providers plan infrastructure and curricula for medical education in Jordan, using m-learning to meet the needs of an increased student cohort.

Method

This study aimed at investigating attitudes and perspectives of m-learning among all medical science students at five medical science schools at the University of Jordan: Medicine, Dentistry, Pharmacy, Nursing and Rehabilitation sciences. M-learning in the study included use of a variety of mobile devices (laptops, tablets, iPads, smartphones). This research adopted the quantitative research design to collect actionable insights from complex numerical data and analysis to support effective decisions making about the m-learning in the future.

Data Collection Method

Data for the current study were collected using a web-based cross-sectional descriptive questionnaire using Google forms. The data collection tool was constructed by the authors, based on the most appropriate existing validated questionnaire (Zhang et al., 2021), with additional questions that concerned the medical learning environment and technical infrastructure in Jordan.

The questionnaire, with seven sections, aimed to evaluate the prevalence of use and preferences of medical students towards m-learning. The first section collected demographics of study participants including age, sex, nationality, residence, academic levels and their particular medical school. The second section concerned the participants' current practice with regard to m-learning including type of internet connection, devices used, reasons for their selection of certain internet connections and websites of interest. The third section investigated study participants' experience with m-learning, level of motivation, psychological impact, cost and accessibility. In the fourth section questions about the effect of m-learning on the participants were covered, for example knowledge retention and distraction (scale and type). Challenges of m-learning were explored in the fifth section of the questionnaire. The sixth and seventh sections discussed participant preferences toward m-learning and participants' evaluation of their experience with m-learning. A brief description of the study and its aims was added at the beginning

of the questionnaire followed by a statement of informed consent to participate in the study that had to be signed before filling in the questionnaire.

Study Participants

The questionnaire was first administered to participants electronically using Google forms and was distributed via email or social media (WhatsApp, Facebook, Telegram, etc.). After a short period, to increase the number of responses, the research team visited classrooms of medical schools in person and guide all students to the questionnaire link and prompted them to complete it. The data collection tool was thus distributed to all 703 students from the five medical schools at UJ and N=690 students completed the questionnaire response rate of 98.2% (See Table 1). Data collection took place between November 2021 and March 2022. There were no exclusion criteria. To minimize social desirability bias, assurance was given to participants that their responses would be anonymized. Collected data was stored with the corresponding author and further analysis was anonymized.

Table 1

Questionnaire Validity

The data collection tool was evaluated at different steps. **Face validity** was assessed by a pilot study to test the questionnaire items with 20 randomly selected students and minor changes agreed after discussion. It was also reviewed by an expert in the field of information sciences. Further statistical confirmation of the tool validity and reliability was obtained by calculating Cronbach's Alpha values which ranged between 0.651 and 0.844 (indicating adequate consistency).

Moreover, sample adequacy was confirmed by Principal Component Analysis (PCA) showing Kaiser-Meyer-Olkin (KMO) values range of 0.660 – 0.845 and a significant Bartlett's Test (p=0.000). (Table 2).

Table 2

Statistical Evaluation

The sample size was calculated using Raosoft™ sample size calculator with 95% Confidence level, which showed a sample size of at least 385 respondents was required to ensure reliable sample size to describe the m-learning characteristics in medical schools at UJ.

The responses to all questions were encoded, entered, and analyzed using SPSS® 23.0 (IBM, Armonk, NY). Responses were then presented as frequencies and percentages for categorical variables, and as means and standard deviations (or medians and interquartile ranges) for continuous variables. Comparisons between groups were performed using chi-square test. A p-value of < 0.05 was considered significant.

The study was approved by the Institutional Review Board (IRB) at the Deanship of Academic Research—The University of Jordan (IRB Ref. 119-2021). All methods conformed to the national guidelines and the ethical standards of the Declaration of Helsinki. The questionnaire ensured the confidentiality and anonymity of study participants.

Results

Characteristics of used Devices, Internet connection Type, and Educational Websites

The majority of students (N=638, 92.6%) are using smartphones as the most frequent used device for mobile learning followed by laptops (N=550, 79.7%). Majority of students relay on Wi-Fi connection (N=446, 64.6%). They indicated the speed of the connection as a main criterion. Notably, almost all (N=982, 98.8%) the respondents use YouTube as the main website for learning (Table 3).

Table 3

Usage of Mobile Devices for Learning Purposes

Table 4 summarizes the activities that student conduct using their mobile device. The activities include looking up medical facts and unfamiliar medical term, transferring files and related material and sending and receiving e-mails. As expected, students indicate that they use their mobile devices to watch medical videos, explaining the high usage rate of YouTube (See Table 3). The results indicate a significant statistical difference (in terms of rating score indicated by mean values) among the five medical disciplines. For instance, Medicine students generally agreed that they mainly use mobile devices to look up quick facts and unfamiliar medical terms and transfer files, photos, or other data (M=4.71) and (M=4.60) respectively. Conversely, nursing students generally agreed with these items at the weakest level amongst the five groups of students (Table 4). However, accessing the university library website was found to be the lowest activity that the students perform on their mobile devices.

Table 4

Attitudes Toward Mobile Learning

Students were also asked to indicate their feelings of and experience with mobile learning compared to traditional face-to-face (F2F) learning. The majority of respondents (N=481, 69.7%) indicated feeling isolated from their colleagues during mobile learning compared to traditional F2F learning (N=25, 3.6%) (Table 5). Most of the positive feelings and experience (e.g. interaction, motivation) were associated with the traditional F2F learning environment.

Table 6 elaborates more on the students' expectations of m-learning. For instance, the students indicated their preference of F2F learning (N=219; 31.7%) when compared to m-learning (N=38; 5.5%). They pointed out m-learning as learning mode should complement F2F learning and not be used as an alternative. This may be associated with their moderate rating to their readiness to use m-learning (N= 339; 49.1%). Only

(17%) of respondents indicated a high readiness rate to use m-learning. Furthermore, the students indicated some features that they wish to be available to enhance their experience with m-learning. This includes the availability of mobile learning applications offline, adapting exam platforms to be compatible with mobile devices, and the development of mobile learning application that is free of distraction source such advertisements (Table 6).

Table 5

Table 6

Advantages of Mobile Learning

The study also aimed at exploring the perceived advantages of m-learning from medical students' perspectives. The results indicated that the students believe that m-learning increased the students' ability to learn by themselves (M=3.98, SD=1.00) and hence it enhanced their learning skills (M=3.95, SD=0.9). Being able to instant access to information was also given a high average rating score (3.94) by all five student groups. Meanwhile, "Mobile learning has improved my online-searching skills" (3.87) also received relatively high average rating scores (Table 7). The results indicate a significant statistical difference (in terms of rating score indicated by mean values) among the five medical disciplines for some (but not all) of the attitudes. For instance, medicine students generally rated their perception of the advantages higher than the other disciplines. There were no significant differences of opinion among the groups over m-learning's contribution to enhancement of learning or online searching skills (Table 7).

Table 7

Effects and Challenges of Mobile Learning

Students' perception of m-learning effect on their memory is negative (N=360, 52.2%) (Table 8). This might be explained by the different types of distractions that students are exposed to during m-learning, e.g. social media (N=646, 93.6%), noise from the surrounding environment (N=568, 82.9%). The high rating of distraction sources is presumably associated with the appearance of personalized advertising based on the user's search history.

Table 8

The respondents considered the continuous need for internet connection as the main barrier to m-learning (M=4.46, SD=0.9) (Table 9). Applications and programmes are dependent on the Internet and thus this will disturb the learning process in case of internet cut or electrical power cut. Other disadvantages include 'technical issues" and 'short battery life'. Infrastructure challenges may explain some of the earlier attitudes noted in Tables 5 and 6.

The results also show significant statistical differences among the students from different medical majors toward the use of mobile devices. Nursing students generally agreed that the "Continuous Internet

need", "Technical issues", "Short battery life", "Small screen" and "limited storage capacity" all are key barriers to m-learning. Conversely, Medicine students generally agreed with these items at the weakest level amongst the five groups of students (Table 9).

Table 9

Discussion

The findings confirmed that health students in Jordan, across all groups (medical, dental, pharmacy, nursing and rehabilitation) use mobile devices to support their learning. Nearly all students used smartphones. Like Zhang (2021), there were some differences among the groups of health students, indicating that m-learning habits vary according to existing teaching methods, the type of content required and the particular benefits that m-learning might offer. For example, nursing students are less likely to transfer files, photos and other data, but are more likely than other groups to engage with lectures. Medical, dental and pharmacy students are more likely to watch videos than the other groups. Health students valued the ability to check facts quickly using a mobile device, and pharmacy students were reliant on their devices for many purposes. The library website appeared to be more difficult to access on mobile devices for these students in Jordan. Mobile learning is not only about enabling students to learn anywhere and at any time, but also about providing student with an interactive and effective learning experience through active exploration and interaction with a variety of online material for mobile learning. This is dependent on the quantity, variety, and usefulness of the tools, resources, and services made available online by the university library. To this end, Hamad et al (2018) found that mobile services has not yet been fully exploited in these environments in Jordan for various reasons i.e. incompatible IT infrastructure and a lack of training. Similarly, whether a university library provides learners with access to relevant and adequate content could be one of the critical factors determining students' degree of engagement in mobile learning (Fan et al., 2020). Along the same lines, libraries need to design more innovative mobile information services (Wójcik, 2019) and promote their mobile services (Chen, 2019), the benefits of mobile learning and the information literacy required (Aharony et al., 2020; Allard et al., 2020; Rantala et al., 2019).

To that end, whether a student is actively engaged in mobile learning is highly dependent on the amount, variety and relevance of the tools, resources and services made available by the university library in an online format. As highlighted by Walsh (2015), despite the convenience of such mobile technology, students are interested in mobile library services only when they can actually see the need, the benefits are apparent to them, or the digital content is relevant to their study and practice. Along the same lines, whether a university library is providing access to relevant and adequate content for learners could be one of the critical factors determining students' level of activeness in mobile learning (Fan et al., 2020).

The popularity of YouTube among the sites accessed indicates that many of the videos accessed are from YouTube, or from other clinical specialist sites (Mayo Clinic, for example). Videos may offer 3-D visualization to assist in learning anatomy (as noted by Mustafa et al. 2020 in a study of Jordanian

medical students) or examining drug-receptor mechanisms for pharmacy students. Giuliano et al. (2016) describe how a drug literature evaluation course was flipped, with the previous homework was transformed into in-class activities and the previous lectures were transformed into multiple short YouTube videos. This result could perhaps highlight the needs for collaboration between information specialist and educators to design and publish educational videos and make available using a library YouTube channel established to complement the library information services.

A systematic review of experimental studies using m-learning (Koohestani et al. 2018) found most studies focused on modification of knowledge or skills, with several studies focusing on manual techniques (e.g. tube insertion). No studies examined changes in the system or organizational practice. It is important therefore to consider how students view the fit of m-learning into their learning experience. The students surveyed in Jordan expressed their preference for face-to-face learning over using their mobile devices for learning, with most of the opinion that m-learning complements traditional face-to-face learning. The majority feel isolated from their colleagues in the m-learning environment, and feel more motivated to learn in the face to face environment with more direct communication with their instructors. A systematic review (Sophonhiranrak et al. 2021) of m-learning studies in higher education suggests that collaborative learning tools may be used to support a collaborative learning strategy that would support and perhaps enhance the face to face experience. Also, the design of an interactive learning environment should help students to relate new information to existing knowledge (Chang et al., 2022).

Students were neutral about the increase in level of medical knowledge gained through m-learning, and finding alternative continuing professional development opportunities, indicating that their experience in using social networks online for personal purposes were not being translated to professional online networking possibilities. Medical and dental students were more likely to attribute increased independent learning to use of m-learning than the other groups, but all groups rated the enhancement of learning skills through m-learning about the same. Most students (apart from the rehabilitation group) rated provision of instant access to information valuable. The differences among the groups suggest that some groups may be more aware of useful resources, or that there are more resources available for some groups – or a mixture of the two factors.

The major factors that discouraged the respondents from engaging in m-learning included: different source of distractions such as social media, noise from the surrounding environment, and devices and connection issues such as dependency on the internet, technical issues, short battery life, small screen and limited storage capacity, findings are in line with earlier studies (Dukic et al., 2015; Ko et al., 2015). Jordanian health students perceived that face-to-face learning might be more efficient, but it seems that the environment in which they use m-learning has distractions, unlike other studies that indicate the efficiency of m-learning (Al-Adwan et al., 2018; Lin et al., 2019; Zhou & Li, 2019). The finding that m-learning does not seem to improve their memorization may be attributed to the distraction problems, and perhaps some problems with the fit of m-learning within their learning experience. Lee and Lee (2022) pointed out that the increased use of a mobile device had a negative effect on GPA among their sample.

The Jordanian students' wish list for m-learning characteristics indicates some concerns about being dependent on mobile applications only. Being able to work offline at times is desirable, and applications need to be suited to the smaller screen of a mobile device (particularly smartphones).

A systematic review of m-learning in higher education generally (Sophonhiranrak et al. 2021) acknowledges many of the technical and infrastructure difficulties, but also suggests that instructors should be aware of their learners' learning styles, learning environments and consider how to organize the content for a consistent and acceptable learning experience. The differences among the particular health student groups in usage and perceptions around mobile devices suggest that solutions for a blended learning approach will vary according to the different curricular needs of each group, and their expected digital competencies as professionals (Smith et al., 2020). Synthesising the findings across Tables 5 and 6, what students need from m-learning are clinically relevant and realistic learning materials, with short and engaging activities (to deal with the distraction problems), with frequent, short online tests to self-check progress (to help preparation for examinations). Urquhart et al. (2004) explained how virtual learning environments could be evaluated, noting that students liked the possible individualization of their learning with interactive exercises. Careful design of such online activities means that instructors can effectively engage with students individually (but virtually) and students can monitor their own learning. By using mobile interactive learning environments such as AI application-Chatbots, students can organize, re-examine their acquired knowledge and deeply think about different situations by exploring relevant information (Chang et al., 2022).

Research Limitations

The survey findings are based only on a questionnaire based data collection tool. Although high response indicates confidence that opinions are representative, it is difficult to assess the reasons for differences – why, for example, should rehabilitation students be keener on interactive educational games than the other groups. Further work required to assess what students find particularly useful and why, and how instructors might use m-learning to complement their teaching, whether they favor the traditional approach or not.

Conclusion

The aim of this research was to help policymakers, educators and information services providers plan infrastructure and curricula for medical education in Jordan, using m-learning to meet the needs of an increased student cohort. Students confirmed that they use mobile devices to support their learning, mainly using their smartphones. Their use of mobile devices for learning was not well advanced, and most preferred face to face learning. There were some differences among the groups of health students, indicating that m-learning habits vary according to existing teaching methods, the type of content required and the particular benefits that m-learning might offer. Policymakers and educators need to plan carefully and taken an organizational approach to ensure that m-learning complements face-to-face learning, effectively and efficiently. Also, libraries and information services providers need to advance its

mobile services and be more innovative in their services to meet students' information and learning needs and provide an attractive learning environment.

Declarations

Ethics approval and consent to participate

Consent was given in writing at the beginning of the interview.

The study was approved by the Institutional Review Board (IRB) at the Deanship of Academic Research—The University of Jordan (IRB Ref. 119-2021). All methods conformed to the national guidelines and the ethical standards of the Declaration of Helsinki. The questionnaire ensured the confidentiality and anonymity of study participants.

Consent for publications

Not applicable

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of interest

The authors declare that they have no conflict of interests.

Funding

Not Applicable

Authors' contributions

FH participated in designing the study, revised the data collection tool and participated in the writing of the manuscript. MA and MAA developed the data collection tool, participated in the data collection and data entry. CU contributed to write the discussion. RT revised the data analysis and participated in writing the manuscript. SA participated in designing the study, revised the data collection tool, carried out the data analysis, and participated in the writing of the manuscript. All authors have read and approved the manuscript. In addition, all authors are aware of this submission and agree with it.

Acknowledgment

The authors would like to thank all study participants for their input and time. tool.

References

1. Abu-Al-Aish, A. & Love, S. (2013). *Factors influencing students' acceptance of m-learning: An investigation in higher education. The International Review of Research in Open and Distributed Learning, 14(5), –.* doi:10.19173/irrodl.v14i5.1631
2. Aharony, N. (2014). Library and information science students' perceptions of m-learning. *Journal of librarianship and information science*, *46*(1), 48-61.
3. Aharony, N., Julien, H., & Nadel-Kritz, N. (2020). Survey of information literacy instructional practices in academic libraries. *Journal of Librarianship and Information Science*, *52*(4), 964-971.
4. Ahmad, T. (2020). Student perceptions on using cell phones as learning tools: Implications for mobile technology usage in Caribbean higher education institutions. *PSU Research Review*, 4(1), 25-43. DOI: 10.1108/PRR-03-2018-0007
5. Al-Adwan, A. S., Al-Madadha, A., & Zvirzdinaite, Z. (2018). Modeling students' readiness to adopt mobile learning in higher education: An empirical study. *International Review of Research in Open and Distributed Learning*, *19*(1).https://doi.org/10.19173/irrodl.v19i1.3256
6. Alksasbeh, M., Sheik Osman, W.R. & Ibrahim, H.H. (2011). Differences in Mobile Learning Acceptance for Higher Education Students in Jordan. 2nd WORLD CONFERENCE on INFORMATION TECHNOLOGY - WCIT-2011
7. Allard, B., Lo, P., Liu, Q., Ho, K. K., Chiu, D. K., Chen, J. C., ... & Jiang, T. (2020). LIS pre-professionals' perspectives towards library user education: A comparative study between three universities in Greater China. *Journal of Librarianship and Information Science*, *52*(3), 832-852.
8. Almaiah, M. A., Alamri, M. M., & Al-Rahmi, W. M. (2019). Analysis the effect of different factors on the development of Mobile learning applications at different stages of usage. *IEEE Access*, *8*, 16139-16154. doi:10.1109/ACCESS.2019.2963333.
9. Al-Salman, S., Haider, A.S. and Saed, H. (2022).The psychological impact of COVID-19's e-learning digital tools on Jordanian university students' well-being. *The Journal of Mental Health Training, Education and Practice*. https://doi.org/10.1108/JMHTEP-09-2021-0106
10. Al-Zoubi, A.I., Al-Zoubi, A.I. & Al-Zoubi. M. (2019). Factor That Influence To Acceptance M-Learning among Jordanian Students. *Computer and Information Science*, 12(1); 2019.
11. Al-Zoubi, S. I., & Ali, M. (2019). E-mobile acceptance using unified theory of acceptance and use of technology (UTAUT): Research on universities in Jordan. *Annals of Emerging Technologies in Computing (AETiC), Print ISSN*, 3(4), 28-36. DOI: 10.33166/AETiC.2019.04.003.
12. Arain AA, Hussain Z, Rizvi WH, Saleem M (2019) Extending UTAUT2 toward acceptance of learning in the context of higher education. Univers Access Inf Soc 18:659–673. https://doi.org/10.1007/s10209-019-00685-8
13. Baghcheghi, N., & Koohestani, H. R. (2021). The relationship between the willingness to mobile learning and educational achievements in health-care professional students. *Journal of Education and Health Promotion*, *10, 1-6*.
14. Bai, H. (2019). Preparing teacher education students to integrate mobile learning into elementary education. *TechTrends*, *63*(6), 723-733.

15. Bennett, D., Knight, E., & Rowley, J. (2020). The role of hybrid learning spaces in enhancing higher education students' employability. *British Journal of Educational Technology*, *51*(4), 1188-1202.
16. Briz-Ponce, L., J. A. Juanes-Méndez, F. J. García-Peñalvo, and A. Pereira. 2016. "Effects of Mobile Learning in Medical Education: A Counterfactual Evaluation." *J Med Syst* 40 (6): 136. https://doi.org/10.1007/s10916-016-0487-4. https://www.ncbi.nlm.nih.gov/pubmed/27098779.
17. Brown,T. H., Mbati, L. S. (2015). Mobile learning: Moving past the myths and embracing the opportunities. International Review of Research in Open and Distributed Learning, 16(2),115-135.
18. Chan, A. & Lee, M.J. (2007) Pervasive, lifestyle integrated mobile learning for distance mobile learners. The Journal of Open and Distance Learning, 22(3), 201-218.
19. Chang, C. Y., Hwang, G. J., & Gau, M. L. (2022). Promoting students' learning achievement and self-efficacy: A mobile chatbot approach for nursing training. *British Journal of Educational Technology*, *53*(1), 171-188.
20. Chase, T. J., Julius, A., Chandan, J. S., Powell, E., Hall, C. S., Phillips, B. L., ... & Fernando, B. (2018). Mobile learning in medicine: an evaluation of attitudes and behaviours of medical students. *BMC medical education*, *18*(1), 1-8.
21. Chen, S. C. (2019). Undergraduate students use of mobile apps to search library catalogs. *Library Hi Tech*, 37(4), 721-734.
22. Crawford, V. M. (2007). Creating a powerful learning environment with networked mobile learning devices. Educational Technology Magazine: The Magazine for Managers of Change in Education, 47(3), 47-50.
23. Criollo-C, S., Luján-Mora, S., & Jaramillo-Alcázar, A. (2018, March). Advantages and disadvantages of M-learning in current education. In *2018 IEEE world engineering education conference (EDUNINE)* (pp. 1-6). IEEE. DOI: 10.1109/EDUNINE.2018.8450979.
24. Delcker, J., Honal, A., & Ifenthaler, D. (2018). Mobile device usage in higher education. In *Digital technologies: Sustainable innovations for improving teaching and learning* (pp. 45-56). Springer, Cham.
25. Faimau, G., Tlhowe, K., & Tlhaolang, O. (2022). Smartphone Use, Experience of Learning Environment, and Academic Performance among University Students: A Descriptive Appraisal. *Advances in Human-Computer Interaction*, *2022*. Article ID 2617596, 11 pages https://doi.org/10.1155/2022/2617596
26. Fan, K. Y. K., Lo, P., Ho, K. K., So, S., Chiu, D. K., & Ko, E. H. (2020). Exploring the mobile learning needs amongst performing arts students. *Information Discovery and Delivery*, *48*(2), 103-112.
27. Gharaibeh, M. K., & Gharaibeh, N. K. (2020). An empirical study on factors influencing the intention to use mobile learning. *Advances in Science, Technology and Engineering Systems Journal*, *5*(5), 1261-1265.
28. Hamad, F., Farajat, S., & Hamarsha, A. (2018). Awareness and adoption of mobile technologies in the delivery of services in academic libraries in Jordan: a library staff perspective. *Global Knowledge, Memory and Communication*, *67*(6/7), 438-457.

29. Handal, B., MacNish, J., & Petocz, P. (2013). Adopting mobile learning in tertiary environments: Instructional, curricular and organizational matters. *Education Sciences*, *3*(4), 359-374.
30. Hidayat, A. & Utomo, G. (2014). Open source based m-learning application for supporting distance learning. TELKOMNIKA, 12 (3), 657-664
31. Hwang, B. L., Chou, T. C., & Huang, C. H. (2021). Actualizing the Affordance of Mobile Technology for Mobile Learning. *Educational Technology & Society*, *24*(4), 67-80.
32. Johnson, M. W., Prescott, D., Lyon, S. (2017). Learning in online continuing professional development: an institutionalist view on the personal learning environment. *Journal of New Approaches in Educational Research, 6*(1), 20-27. doi: 10.7821/naer.2017.1.189
33. Kaliisa, R., & Picard, M. (2017). A systematic review on mobile learning in higher education: The African perspective. *TOJET: The Turkish Online Journal of Educational Technology*, *16*(1).
34. Klímová, B. (2018). Mobile learning in medical education. *Journal of medical systems*, *42*(10), 1-6.
35. Klimova, B., & Poulova, P. (2016). Mobile learning in higher education. *advanced science letters*, *22*(5-6), 1111-1114.
36. Ko, E. H., Chiu, D. K., Lo, P., & Ho, K. K. (2015). Comparative study on m-learning usage among LIS students from Hong Kong, Japan and Taiwan. *The Journal of Academic Librarianship*, *41*(5), 567-577.
37. Koohestani, H. R., Arabshahi, S. K. S., Fata, L., & Ahmadi, F. (2018). The educational effects of mobile learning on students of medical sciences: A systematic review in experimental studies. *Journal of Advances in Medical Education & Professionalism*, *6*(2), 58.
38. Kucuk, S., Baydas Onlu, O., & Kapakin, S. (2020). A model for medical students' behavioral intention to use mobile learning. *Journal of Medical Education and Curricular Development*, *7*, 1-7.
39. Lau, K. S., Lo, P., Chiu, D. K., Ho, K. K., Jiang, T., Zhou, Q., ... & Allard, B. (2020). Library and learning experiences turned mobile: A comparative study between LIS and non-LIS students. *The Journal of Academic Librarianship*, *46*(2), 102103.
40. Lee, P.S. & Lee, C.M. (2022): Are South Korean College Students Benefitting from Digital Learning?, International Journal of Human–Computer Interaction, DOI:10.1080/10447318.2022.2047319
41. Lin, X. F., Deng, C., Hu, Q., & Tsai, C. C. (2019). Chinese undergraduate students' perceptions of mobile learning: Conceptions, learning profiles, and approaches. *Journal of Computer Assisted Learning*, *35*(3), 317-333.
42. Liu, Y., & Han, S. (2010). Understanding the Factors Driving M-learning Adoption: a Literature Review. Campus-Wide Information Systems, 27(4), 210-226. https://doi.org/10.1108/10650741011073761
43. Lumsden, C. J., Byrne-Davis, L. M. T., Mooney, J. S., & Sandars, J. (2015). Using mobile devices for teaching and learning in clinical medicine. *Archives of Disease in Childhood-Education and Practice*, *100*(5), 244-251. https://doi.org/10.1136/archdischild-2014-306620
44. Masika, M. M., Omondi, G. B., Natembeya, D. S., Mugane, E. M., Bosire, K. O., & Kibwage, I. O. (2015). Use of mobile learning technology among final year medical students in Kenya. *Pan African Medical*

Journal, *21*(1).

45. Mubuke, F., Ogenmungu, C., Masaba, A. K., & Andrew, W. (2017). The predictability of perceived enjoyment and its impact on the intention to use mobile learning systems. *Asian Journal of Computer Science And Information Technology*, *1*(1), 7. doi.org/10.15520/ajcsit.v6i851.
46. Mustafa AG, Taha NR, Alshboul OA, Alsalem M, Malki MI. (2020). Using YouTube to learn anatomy: perspectives of Jordanian medical students. *Biomed Research International*, paper 6861416. doi: 10.1155/2020/6861416.
47. Naing, C., Chellappan, D. K., Shew Fung, W., Riegelman, A., & Whittaker, M. A. (2019). PROTOCOL: The effects of flipped classrooms to improve learning outcomes in undergraduate health professional education: A systematic review. *Campbell Systematic Reviews*, *15*.
48. Nassuora, A. B. (2012). Students acceptance of mobile learning for higher education in Saudi Arabia. *American Academic & Scholarly Research Journal*, *4*(2), 24-30.
49. Osman, M., El-Hussein, M., & Cronje, J. (2010). Defining mobile learning in the higher education landscape. Educational Technology & Society, 13(3), 12-21.
50. Ozdamli, F., & Cavus, N. (2011). Basic elements and characteristics of mobile learning. *Procedia-Social and Behavioral Sciences*, *28*, 937-942.
51. Pew Research Center. (2021). Mobile Fact Sheet.https://www.pewresearch.org/internet/fact-sheet/mobile/
52. Pinto, M., Caballero, D., Sales, D., & Fernández-Pascual, R. (2020). MOBILE-APPS questionnaire: Developing and validating a scale to measure the attitudes and perceptions of undergraduate students on mobile information literacy. *Journal of librarianship and information science*, *52*(4), 1063-1072.
53. Pynoo, B., Devolder, P., Tondeur, J., Van Braak, J., Duyck, W., & Duyck, P. (2011). Predicting secondary school teachers' acceptance and use of a digital learning environment: A cross-sectional study. *Computers in Human behavior*, *27*(1), 568-575. DOI: 10.1016/j.chb.2010.10.0
54. Qudah, K. Y., Hussain, J. A., & Al Matari, R. (2013). Students' Attitudes in Colleges of Education at the Jordanian Universities towards Mobile Phone Usage in University Education. *International Journal of Interactive Mobile Technologies (iJIM)*, *7*(2), pp. 19–28. https://doi.org/10.3991/ijim.v7i2.2286
55. Rantala, A., Enwald, H., & Zinn, S. (2019). Web-based health information seeking: a small-scale comparative study between Finnish and South African university students. *Library Hi Tech, 37(4), 933-944.*
56. Setirek, A. C., & Tanrikulu, Z. (2015). Significant developmental factors that can affect the sustainability of mobile learning. *Procedia-Social and Behavioral Sciences*, *191*, 2089-2096.
57. Smith, E. E., Kahlke, R., & Judd, T. (2020). Not just digital natives: Integrating technologies in professional education contexts. *Australasian Journal of Educational Technology*, *36*(3), 1-14.
58. Sönmez, A., Göçmez, L., Uygun, D., & Ataizi, M. (2018). A review of current studies of mobile learning. *Journal of Educational Technology and Online Learning*, *1*(1), 12-27.

59. Sophonhiranrak, S. (2021). Features, barriers, and influencing factors of mobile learning in higher education: A systematic review. *Heliyon*, *7*(4), e06696.
60. Suanpang, P. (2012). The integration of m-learning and social nework for suporting knowledge sharing. *Creative Education*, *3*, 39.
61. Traxler, J., & Vosloo, S. (2014). Introduction: The prospects for mobile learning. *Prospects*, *44*(1), 13-28.
62. UNESCO. (2013). Policy guidelines for mobile learning. France: UNESCO.
63. Urquhart, C., Spink, S., Thomas, R., Yeoman, A., Turner, J., Durbin, J., ... & Armstrong, C. (2004, September). Evaluating the development of virtual learning environments in higher and further education. In *Blue skies and pragmatism: learning technologies for the next decade. Research proceedings of the 11th Association for Learning Technology conference (ALT-C 2004). Held* (pp. 14-16). https://core.ac.uk/download/pdf/185297279.pdf
64. Viberg, O. (2015). Design and use of mobile technology in distance language education: Matching learning practices with technologies-in-practice. Repro: Örebro University.
65. Wai, I. S. H., Ng, S. S. Y., Chiu, D. K., Ho, K. K., & Lo, P. (2018). Exploring undergraduate students' usage pattern of mobile apps for education. *Journal of Librarianship and Information Science*, *50*(1), 34-47.
66. Walsh, K. (2015). Mobile learning in medical education. *Ethiopian journal of health sciences*, *25*(4), 363-366.
67. Wójcik M (2019) How to design innovative information services at the library? Library Hi Tech 37(2): 138–154.
68. Wong, L. H. (2012). A learner-centric view of mobile seamless learning. *British Journal of Educational Technology*, *43*(1), E19-E23.
69. Zhang, X., Lo, P., So, S., Chiu, D. K., Leung, T. N., Ho, K. K., & Stark, A. (2021). Medical students' attitudes and perceptions towards the effectiveness of mobile learning: A comparative information-need perspective. *Journal of Librarianship and Information Science*, *53*(1), 116-129.
70. Zhou, M., & Li, Z. (2019). Blended mobile learning in theatre arts classrooms in higher education. *Innovations in Education and Teaching International*, *56*(3), 307-317.

Tables

Table 1: Participants Characteristics

	All	Medicine	Dentistry	Pharmacy	Nursing	Rehabilitation
	N (%)	188 (27.2)	121 (17.5)	179 (28.6)	86 (12.5)	98 (14.2)
Sex (*p<0.05*)						
Female	489 (70.9)	88	88	175	64	74
Male	201 (29.1)	100	33	22	22	24
Nationality (*p<0.05*)						
Jordanian	639 (92.6)	166	109	183	85	96
Others	51 (7.4)	22	12	14	1	2
GPA[@] (*p<0.05*)						
mean±SD	3.33±0.44	3.45±0.43	3.27±0.48	3.44±0.44	3.13±0.47	3.12±0.42
Median (IQR)	3.4 (3 – 3.8)	3.58 (3.1–3.8)	3.58 (3–3.6)	3.5 (3.3–3.7)	3.15 (2.9–3.5)	3.1 (2.9–3.1)
Excellent	174 (25.2)	71	21	60	11	11
Very Good	356 (51.6)	77	74	111	39	55
Good	94 (13.6)	19	18	15	16	26
Fair	2 (0.3)	0	1	0	1	0
Age (*p<0.05*)						
mean±SD	20.5±1.3	20.2±1.3	20.4±1.4	20.5±1.3	19.9±1.6	20.1±1.6
Median (IQR)	20 (20 – 21)	20 (19 – 21)	20 (19 – 21)	20 (20 – 21)	20 (19 – 21)	20 (20 – 21)
Year of Study (*p<0.05*)						
First-year student	73 (10.6)	21	8	5	29	10
Second-year student	189 (27.4)	68	47	35	18	21
Third-year student	237 (34.3)	63	32	93	18	31
Fourth-year student	120 (17.4)	19	16	30	20	35

Fifth-year student	54 (7.8)	5	17	31	0	1
Sixth-year student	17 (2.5)	12	1	3	1	0
Format Preferred (*p<0.05*)						
Hard Copies	257 (37.2)	40	20	97	46	54
Electronic Format	433 (62.8)	148	101	100	40	44
Number of hours spend on studying using m-devices (*p<0.05*)						
mean±SD	5.7 (2.5)	6.2 (2.7)	6.2 (2.2)	5.6 (2.4)	5.4 (2.5)	4.7 (2.2)
Median (IQR)	5 (4 – 7)	6 (4.5 – 7)	6 (4.5 – 8)	5 (4 – 7)	5 (4 – 7)	4 (3 – 6)
Less than 2 hours	50 (7.2)	9	3	16	10	12
2 – 4 hours	174 (25.2)	35	25	51	25	38
4 – 7 hours	320 (46.4)	98	57	92	33	40
More than 7 hours	146 (21.2)	46	36	38	18	8

SD: Standard Deviation

IQR: Interquartile Range

[@]Don't sum up to 100% because first year-first semester students don't have a GPA yet

Table 2: Statistical Evaluation of the data collection tool.

Section	Cronbach's Alpha	Kaiser-Meyer-Olkin (KMO)	Bartlett's Test	*p-value*
Practice items	0.777	0.795	4433.2	0.000
Experience items	0.660	0.754	1310.6	0.000
Effect of ML items	0.651	0.660	239.8	0.000
ML Challenges items	0.824	0.845	1202.7	0.000
Preferences items	0.730	0.833	2746.1	0.000
Evaluation items	0.844	0.828	2032.5	0.000

Table 3: Characteristics of used Devices, Internet connection Type and Educational Websites

Factor	Items	N (%)
Device@	Smartphone	639 (92.6)
	Laptop	550 (79.7)
	iPad	201 (29.1)
	Tablet	120 (17.4)
	PDA	12 (1.7)
Internet Connection	Wi-Fi Connection	446 (64.6)
	4G & 5G	244 (35.4)
Criteria to choose Internet Connections	Speed	387 (56.1)
	Affordability	235 (34.1)
	Accessibility & Availability	191 (27.7)
	Capacity & Strength	72 (10.4)
	Safety	8 (1.2)
Websites for Medical Information	YouTube channels	682 (98.8)
	PubMed	314 (45.5)
	Mayo-clinic	288 (41.7)
	JFDA (Jordan Food & Drug Administration)	200 (29)
	UpToDate	197 (28.6)
	CDC (Centers for Disease Control and Prevention)	183 (26.5)
	Healthline	161 (23.3)
	Amboss	101 (14.6)

	Oxford Handbook of Clinical Medicine (OHCM)	89 (12.9)
	Lexicomp	86 (12.5)
	British National Formulary (BNF)	65 (9.4)

[@]Don’t sum up to 100%

Table 4: Usage of Mobile Devices for Learning Purposes

	Medicine	Dentistry	Pharmacy	Nursing	Rehabilitation	All mean	SD
Looking up quick facts and unfamiliar medical terms (*p>0.05*)	4.71	4.64	4.65	4.47	4.58	4.63	0.7
Transferring files, photos, or other data (*p<0.05*)	4.60	4.50	4.57	4.41	4.56	4.54	0.7
Sending and receiving e-mails (*p<0.05*)	4.36	4.39	4.62	4.50	4.41	4.46	0.8
Watching video related to educational subjects (*p<0.05*)	4.46	4.48	4.47	4.26	4.20	4.40	0.8
Engaging with lectures (*p<0.05*)	3.87	3.90	4.31	4.38	4.19	4.11	1.1
Reaching academic material (*p>0.05*)	3.82	3.85	4.24	3.98	4.12	4.01	1.2
Download and listen to audio books and lectures (*p<0.05*)	3.57	3.64	4.25	3.64	4.04	3.85	1.2
Accessing health-care information (*p<0.05*)	3.53	3.56	3.89	3.85	3.59	3.69	1.2
Playing interactive educational games (*p<0.05*)	2.64	2.56	2.94	2.73	3.10	2.79	1.4
Accessing the university library website (*p<0.05*)	2.63	2.35	3.03	2.83	2.74	2.74	1.4

Numerical values are assigned as: 1 = Never; 2 = Rarely; 3 = Sometimes; 4 = Often; 5 = Always.

Table 5: Experience of M-learning Compared to Face to Face Learning

	Mobile learning,	Traditional method of learning (F2F)	Both are the same	None
I feel more isolated from my colleagues	481 (69.7)	25 (3.6)	92 (13.3)	92 (13.3)
I feel more interactive in lectures	77 (11.2)	441 (63.9)	86 (12.5)	86 (12.5)
I prefer to communicate with instructors	99 (14.3)	453 (65.7)	105 (15.2)	33 (4.7)
I feel more motivated to study	80 (11.6)	504 (73)	79 (11.4)	27 (3.9)
I can use acquired knowledge in real-life situations	42 (6.1)	464 (67.2)	163 (23.6)	21 (3)
I feel more distracted	488 (70.7)	98 (14.2)	64 (9.3)	40 (5.8)
Better regarding cost	448 (64.9)	125 (18.1)	67 (9.7)	50 (7.2)
More Time consuming	182 (26.4)	438 (63.5)	56 (8.1)	14 (2)
Easy accessibility to educational material	430 (62.3)	165 (23.9)	83 (12)	12 (1.7)
Information sticks to my mind for a longer time	74 (10.7)	528 (76.5)	80 (11.6)	8 (1.2)
More efficient learning style	90 (13)	494 (71.6)	99 (14.3)	7 (1)
I have experienced this psychological issue more with				
· Anxiety	215 (31.2)	70 (10.1)	306 (44.3)	99 (14.3)
· Aggressive Attitude	124 (18)	35 (5.1)	71 (10.3)	460 (66.7)
· Depression	279 (40.4)	46 (6.7)	190 (27.5)	175 (25.4)

Table 6: M-learning Preference and Features.

		N (%)
Preferred method of learning:		
1. To use mobile learning as an additional tool along with traditional way (blended learning)		433 (62.8)
2. To use traditional way only		219 (31.7)
3. To use mobile learning only		38 (5.5)
How much do you rate your readiness for mobile learning?		
	Moderate	339 (49.1)
	Low	232 (33.6)
	High	119 (17.2)
Characteristics, I, look for in mobile learning[@]		
1. Develop the applications with offline accessibility		448 (64.9)
2. Adapt exam platforms to be compatible with all mobile devices		430 (62.3)
3. Develop less distractive applications (turning off advertisements and distractive notifications)		391 (56.7)
4. Extend features available in web application into mobile application		317 (45.9)
5. Others		13 (1.9)

[@]Don't sum up to 100%

Table 7: Advantages of using mobile devices for learning.

	Medicine	Dentistry	Pharmacy	Nursing	Rehabilitation	All mean	SD
Mobile learning has improved my ability to learn by myself (Self-Learner) (*p<0.05*)	4.12	3.99	4.03	3.92	3.67	3.98	1.0
Mobile learning has enhanced my learning skills (*p>0.05*)	3.97	3.93	3.97	4.06	3.82	3.95	0.9
Provide instant access to information (*p<0.05*)	4.10	4.08	3.90	3.78	3.68	3.94	1.0
Mobile learning has improved my online-searching skills (*p>0.05*)	3.88	3.84	3.88	4.07	3.69	3.87	1.0
Mobile learning provides me with up-to-date knowledge (*p<0.05*)	3.56	3.18	3.27	3.38	3.08	3.32	1.1
Mobile learning has provided the chance to participate in activities other than studying (like volunteering, part-time job... etc.) (*p<0.05*)	3.06	3.21	3.18	3.60	2.97	3.18	1.3
Mobile learning has increased my level of medical knowledge (*p<0.05*)	3.23	2.97	2.91	2.93	2.78	2.99	1.1

Numerical values are assigned as: 1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree.

Table 8: Effect of M-learning on Learning Process

		N (%)
ML effect on memory status	Positively affected (I remember things easier)	84 (12.2)
	Negatively affected (I fail to remember things)	360 (52.2)
	Neutral (nothing has changed)	246 (35.7)
During ML, I feel distracted by	Social Media	646 (93.6)
	Noise around me (street and neighborhood noises, family circumstances, etc.)	568 (82.3)
	Calls	483 (70)
	Electronics Games	374 (54.2)
	Others	96 (13.9)

Table 9: Disadvantages of using mobile devices for learning.

	Medicine	Dentistry	Pharmacy	Nursing	Rehabilitation	All	
						mean	SD
Continuous Internet need (*p<0.05*)	4.21	4.24	4.69	4.76	4.46	4.46	0.9
Technical issues (*p<0.05*)	3.30	3.72	3.78	4.00	3.92	3.68	1.1
Short battery life (*p<0.05*)	3.19	3.56	3.82	3.90	3.84	3.61	1.3
Small screen (*p<0.05*)	2.88	3.06	3.55	3.80	3.47	3.30	1.3
Limited storage capacity (*p<0.05*)	2.56	2.98	3.53	3.69	3.65	3.21	1.4

Numerical values are assigned as: 1 = Never; 2 = Rarely; 3 = Sometimes; 4 = Often; 5 = Always.