Sudan Journal of Medical Sciences
Volume 20, Issue no. 1, DOI 10.18502/sjms.v20i1.15462
Production and Hosting by KnE Publishing

KNE Publishing

Check for updates

Research Article

Medical Students' Perceptions of Online Learning During COVID-19 Pandemic in Ibn Sina University

Magdi. A. H. Bayoumi[1], Sibusiso Clifford Ndlangamandla[2], Sahar Osman Bajouri[3], and Nada SidAhmed Eljack[4]*

[1]Faculty of Postgraduate Studies, Scientific Research & Publishing, Ibn Sina University, Khartoum, Sudan
[2]Department of English Studies, College of Human Science, University of South Africa, South Africa
[3]Research Unit in IBRAZ Medical Simulation & Training Centre, Ibn Sina University, Khartoum, Sudan
[4]IBRAZ Medical Simulation & Training Centre, Ibn Sina University, Khartoum, Sudan

Abstract

Background: The COVID-19 lockdown of Sudanese universities in March 2020 affected education at all colleges, notably medical students. Therefore, this study aimed to investigate final-year medical students' perceptions and satisfaction with using mobile phones and Telegram at Ibn Sina University. Fortunately, these students were familiar with using mobile phones and Telegram as technological teaching and learning tools with some lecturers before the spread of COVID-19.

Methods: This evaluation-based design study was conducted from March to June 2020. A diagnostic test and a questionnaire were used to collect data. The diagnostic test consisted of five multiple choice questions (MCQs) on Control Infection Measures. The questionnaire consisted of three sections: (i) demographic characteristics of the students; (ii) students' learning experience; and (iii) mobile learning design. A population of 135 students was targeted and a convenience sample of 40 medical students in their final fifth year voluntarily participated in this study. The questionnaire data were analyzed using SPSS, while the diagnostic test data were analyzed by comparing pass rates per item.

Results: The findings of the diagnostic test revealed that 94% of the students learned about what infections are, where they come from, and how to prevent them; 66% learned about standard precautions; 56% understood how to break the chain of infection; and 53% succeeded in recognizing diseases that are transmitted by infection, thus, they were aware about the epidemic process of an infectious disease. Students enhanced their knowledge of personal hygiene and built personal skills, experiences, and practices for reducing infection. The questionnaire findings revealed that the students showed positive perceptions, strong satisfaction, and positive learning experiences with a percentage score ranging from 67.5% to 95% indicating that they "agree" and "strongly agree," respectively. Moreover, 75% of the students were able to get advice from their instructors whenever they needed and had the opportunity to study, gain knowledge, and interact with their peers successfully. Additionally, 82.5% of the students preferred asynchronous learning and teaching.

Conclusion: Mobile phones and the Telegram App have been accepted well by the students as indicated by the results of the present study and may be used more for academic activities. It is recommended that these tools can broadly be adopted in medical education due to their positive potential during this research.

Keywords: COVID-19, medical students, online learning, perceptions, knowledge

Corresponding Author: Nada SidAhmed Eljack; email: neljack@hotmail.com; nadaeljack@gmail.com

Received: 27 February 2024
Accepted: 13 November 2024
Published: 28 March 2025

Production and Hosting by KnE Publishing

Editor-in-Chief:
Prof. Nazik Elmalaika Obaid Seid Ahmed Husain, MD, M.Sc, MHPE, PhD.

OPEN ACCESS

1. Introduction

The use of technology has increased in the past several years, especially among younger generations. Moreover, the COVID-19 pandemic severely changed how people work, learn, and relate using technology for daily tasks and socialization. Students at different levels of education use technological tools for learning with varying skills and satisfaction levels.

The pandemic severely hampered learning globally. Many countries were not ready for e-learning and had to transition gradually by implementing emergency teaching and learning processes [1]. In most cases, this was not the "formal" e-learning – at best, it could be described as remote, emergency, or, technology-based learning [2].

Authorities in Sudanese universities were looking for alternatives to traditional teaching. Using mobile technologies in learning and teaching can help create a positive environment in higher education [3]. Mobile learning (ML) is a popular substitute or supplementary tool for enhancing teaching and learning processes in Sudanese universities. However, the infrastructural limitations in most of these universities could not provide for an easy transition to e-learning [4]. We predict that sustainable education will be achieved through mobile devices during pandemics, such as the COVID-19 pandemic or any other types of future crises for Africa and the rest of the developing world.

Telegram was widely used as a classroom learning tool during the spread of COVID-19 in schools and higher education. In addition, Telegram is a great way to enhance students' talents, abilities, discipline, and self-directed learning by providing them with teaching materials [5]. Moreover, some studies explored the potential benefits and disadvantages of integrating Telegram into undergraduate medical education during the spread of the COVID-19 pandemic. However, online teaching practices and the tools used to deliver content to students in higher education need to be examined, and more research is required to explore the use of mobile phones for educational purposes [6].

This study explores students' perceptions of using mobile phones and Telegram application during the university lockdown. It examines their attitudes, behavior, and interaction among themselves and with the instructor, and reveals the skills students gained from the experience of learning a unit through Telegram. The study sought to fulfil the following objectives:

(i) Examine students' perceptions of ML.

(ii) Describe students' interactions with instructors and with each other when using Telegram.

(iii) Determine which learning outcomes were attained from the tested unit and the related online skills gained during this experience.

To interpret the descriptive study and achieve the aforementioned aim and objectives, the researchers used the FRAME model of ML [7]. This model states that the interaction of mobile technologies, human learning capacities, and the social dimensions of learning drives ML. This model is captured in the intersecting circles below:

The above FRAME model posits that the three aspects: the device, the learner, and the social should interact and correlate maximally for the fulfillment of mobile and blended learning [7, 8]. The model has 26 key elements. However, only three elements significant for this paper are adapted. The three aspects are the device, the learner, and the social aspects, as shown in Figure **1**. First, the device aspect consists of the hardware, efficiency, and usability; second, the learner aspect addresses the students' learning characteristics, mainly the intrinsic ones; and last, the social aspects are the relational, communicational, and interactional attributes.

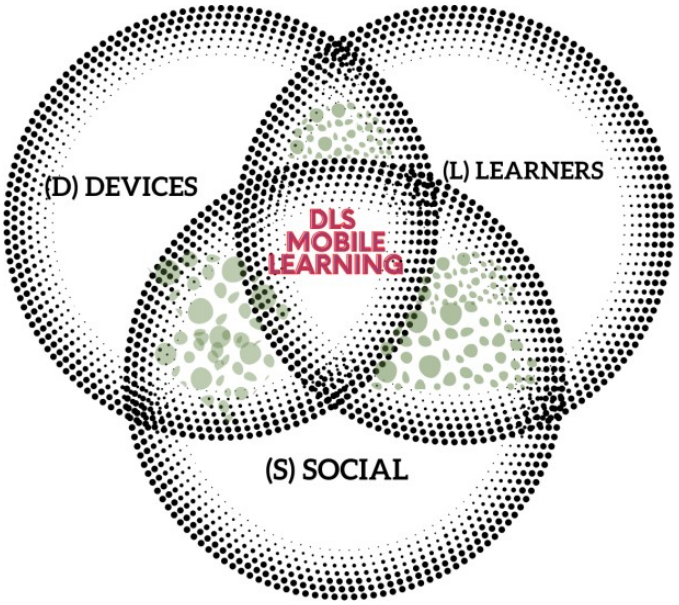

Figure 1: The FRAME model of ML, adapted from Koole [7].

2. Materials and Methods

This is descriptive, experimental, and analytic research. Two types of quantitative data, a questionnaire and a learning unit, were analyzed quantitatively using SPSS.

The study aimed to evaluate the effectiveness of an online education intervention for final-year medical students at Ibn Sina University who used mobile devices to learn during the COVID-19 pandemic in March 2020. The study is within the university's general scope and vision and aims to shift toward digital transformation (DT).

The study was conducted in two phases. The first phase involved a quasi-experimental design with nonequivalent control groups evaluating a learning unit taught through Telegram. Next, a cross-sectional survey assessed the students' perceptions of ML during the COVID-19 lockdown. Figure **2** illustrates how the evaluation-based intervention was conducted in an educational setting.

In this research, we adapted some of the stages of the flow diagram in Figure **2** [9], especially those related to developing goals, teaching students, reporting on the evaluation, and measuring the fulfilment of deliverables.

2.1. Study sample

For the quasi-experiment, due to the limited number of enrolled students, a convenient sample was used to assess all students who attended the live online lecture on Telegram, totaling 135 students.

For the second phase, a sample of 40 students voluntarily accepted to participate in completing the questionnaire.

2.1.1. Inclusion criteria

All final-year medical students studying in Ibn Sina University were included to participate in the study.

2.1.2. Exclusion criteria

Those who refused to participate were excluded.

2.2. Intervention

Participants attended the synchronous online course through the Telegram platform, covering some aspects of infection control measures. This unit was available on the Telegram group for

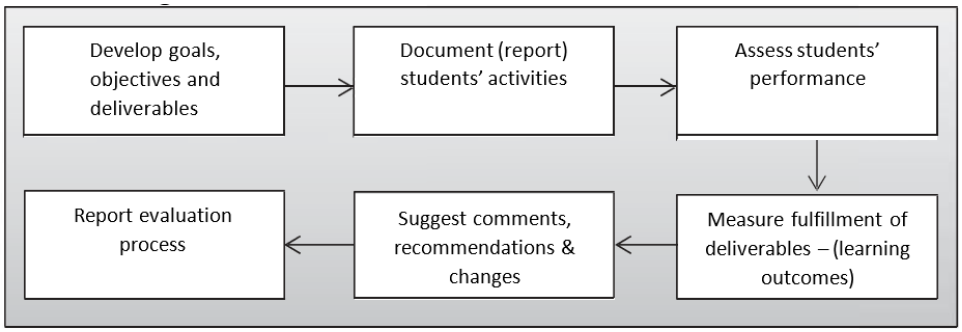

Figure 2: Flow diagram of an effective evaluation process, adopted from Hamadi *et al.* [9].

students to study independently for a week. Participants had a 1-hr live session with two instructors where the lesson was demonstrated and explained. Next, a five-question MCQ quiz was administered to assess students' knowledge about infection control measures. Following that, the students responded voluntarily to the questionnaire. Both the questionnaire and the unit were returned by only 40 students (29%) out of 135.

2.3. Data collection techniques and tools

This study adopted a quantitative approach. Data were collected through a five-option Likert Scale of a structured questionnaire designed to fit the study's purposes and collect information about students' perceptions. The questionnaire was developed after reviewing data from previous studies and adapted to suit the Sudanese educational context. After initial piloting, it was revised, modified, edited, and finalized. Five students outside the sample were chosen randomly to test the questionnaire. Two authors who also served as instructors for medical students collected data.

The questionnaire consisted of three parts. In the first section of the survey, students were asked to provide their demographic details (age, gender, year of study), describe their IT skills, and state whether they had previously participated in any online courses. The second section was a self-reported online learning experience comprising 14 statements. Students were asked to respond on a five-point Likert Scale ranging from "strongly disagree" to "strongly agree" for each statement. The statements included information about learning experiences, achievements, overall satisfaction with the course, recommendations for additional resources, the usefulness of interactions with other students and instructors, and the flexibility and convenience of the online course. The third section was about ML designs. Three questions were addressed to the students: whether they preferred synchronous or asynchronous learning, and if they faced difficulties accessing the unit's contents.

2.4. Data analysis

As mentioned earlier, data analysis was performed using SPSS version 2.0. Descriptive statistics were used to explain the findings. The descriptive statistics were interpreted using the FRAME model of ML, as described earlier [7].

2.5. Validity and reliability of the questionnaire

For the 14 items on the students' perceptions and experiences, a reliability test based on Cronbach alpha was conducted. The test had a significant validity and reliability score of 0.908, as shown in Table **1**.

Table 1: Reliability statistics.

Cronbach's Alpha	*N*
0.908	14

Table 2: Marks obtained from the unit "Infection, Prevention and Control" (*N* = 40).

Questions	Score
1. Which of the following is not part of Standard Precautions?	26 (66%)
2. Epidemic disease _____	21 (53%)
3. The following are components in the chain of infection except _____	22 (56%)
4. Zoonotic diseases (zoonoses) are infectious diseases that humans acquire from _____	38 (94%)
5. Droplet transmission involves the transfer of pathogens via infectious droplets (particles 5 m in diameter or larger). Droplets may be generated by _____	No answer

N, total number of samples

3. Results

The descriptive data analysis had two parts. The first part was the unit's evaluation-based intervention, which was administered and assessed via a short quiz on Telegram. The second part was the questionnaire survey.

3.1. Short quiz

The first part of the data consisted of the scores obtained by the students in a short quiz designed to evaluate their understanding of the unit. The unit was titled "Infection, Prevention, and Control," and it dealt with the transmission of diseases and precautionary measures in medicine. Table **2** presents the number of students who obtained the correct answers according to the memo designed by the course instructor.

Only item four showed an excellent result, with 94% of the students obtaining the correct answer. This was followed by item one, where 66% obtained the correct answer. Items two and three showed an accurate result of 53% and 56%, respectively, which were not high scores. Item five received no responses, perhaps due to a technical problem on Telegram during the quiz.

3.2. The survey questionnaire

The students then completed a questionnaire on their perceptions of technology-based learning.

The following describes the results obtained from the questionnaire administered through Telegram during COVID-19, when students were unavailable for face-to-face classes.

3.2.1. Demographic characteristics

Part one of the questionnaire required demographic information from the participants – 57.5% were males. The overall nationality of the students in the registered program was about 80% Sudanese and 20% foreign nationals. In addition, in the population sample for this research, 47.5% of Sudanese students responded, compared to 52.5% of non-Sudanese students. Furthermore, students were required to state where they resided. Most of the students (87.5%) lived in Khartoum state, the capital city of Sudan.

3.2.2. Students' perceptions of ML

Part two of the survey questionnaire examined the participant's perceptions of ML. Table **3** indicates their responses.

Table 3: Students' perceptions of ML.

Questions	*N*	Frequency	Scale–Rate
The internet connection around areas of residence	40	4 (10.0%)	Poor
		17 (42.5%)	Good
		19 (47.5%)	Excellent
Experience with online courses	40	26 (65.0%)	Yes
		14 (35.0%)	No
Difficulties faced while accessing and studying the course content	40	6 (15.0%)	Yes
		34 (85.0%)	No
Rating the learning experience	40	8 (20.0%)	Poor
		14 (35.0%)	Good
		18 (45.0%)	Excellent

3.2.3. Students' perceptions and experiences

Table **4** presents the Likert scale rating information, with five options ranging from "strongly disagree" to "disagree," "neutral," "agree," and "strongly agree." This rating scale was used to evaluate participants' perceptions and experiences, engagement, interactions, and sense of satisfaction during the actual learning process.

Table 4: Students' perceptions and experiences.

Items	*N*	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Students' responses
2.1 I feel satisfied with this blended learning experience.	40	1 (2.5%)	2 (5%)	10 (25%)	5 (12.5%)	22 (55%)	Strongly agree
2.2 The course and the learning material were clear and well structured.	40		1 (2.5%)	4 (10%)	15 (37.5%)	20 (50%)	Strongly agree
2.3 I was able to understand the course material.	40			3 (7.5%)	12 (30%)	25 (62.5)	Strongly agree
2.4 I was able to answer the questions satisfactorily.	40			8 (20%)	9 (22.5%)	23 57.5%	Strongly agree
2.5 This online course will be more valuable if supplemented with other technologies like videos and podcasts.	40	2 (5%)			9 (22.5%)	29 (72.5%)	Strongly agree
2.6 I was able to get advice from my instructor whenever I needed help.	40	1 (2.5%)	3 (7.5%)	6 (15%)	10 (25%)	20 (50%)	Strongly agree
2.7 This online course can be more valuable if there is direct interaction with the instructor.	40	2 (5%)	1 (2.5%)	4 (10%)	7 (17.5%)	26 (65%)	Strongly agree
2.8 I had an opportunity to study and discuss with my colleagues.	40		3 (7.5%)	7 (17.5%)	9 (22.5%)	21 (52.5%)	Strongly agree
2.9 I did not encounter any difficulties in responding to the discussion.	40	1 (2.5%)	2 (5%)	2 (5%)	15 (37.5%)	20 (50%)	Strongly agree

Table 4: Continued.

Items	*N*	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Students' responses
2.10 The blended learning allowed me to manage my time more effectively.	40	1 (2.5%)	2 (5%)	5 (12.5%)	12 (30%)	20 (50%)	Strongly agree
2.11 I acquired skills in the self-regulation of learning.	40		2 (5%)	5 (12.5%)	12 (30%)	21 (52.5%)	Strongly agree
2.12 I acquired skills in using the internet for study purposes.	40		1 (2.5%)	8 (20%)	10 (25%)	21 (52.5%)	Strongly agree
2.13 The various blended learning practices and activities influence our learning positively.	40		4 (10%)	7 (17.5%)	6 (15%)	23 (57.5%)	Strongly agree
2.14 I may find difficulty in learning a complete/full course through blended learning.	40	15 (37.5%)	6 (15%)	6 (15%)	6 (15%)	7 (17.5%)	Strongly disagree
Total	40	1 (4%)	2 (5%)	5 (14%)	10 (23%)	22 (54%)	Strongly agree

Table 5: ML designs.

Section 3: ML designs	*N*	Percentage	Students' responses
Do you prefer to study online courses in real-time/live with your instructor and colleagues?	40	25 (62.5%)	Yes
Do you prefer to study recorded online courses and to watch/listen to them later at any time you prefer?	40	33 (82.5%)	Yes
Did you find any problem while opening/accessing the course contents?	40	37 (92.5)	No

3.2.4. ML designs

Table **5** shows questions that required students to express their preferences for the type of ML designs.

4. Discussion

The results of evaluating the current medical students' perceptions and experiences using mobile devices and Telegram showed that international students at the university responded more positively to the research than Sudanese students. This may have been because international students tend to have scholarships that fund their internet and mobile phone costs. They resided within the capital city, Khartoum, and had access to network coverage.

Internet connectivity was a key indicator for both the device and social aspects in the FRAME model of ML used in this study. Most students stated that their internet connection was either good or excellent. Although Sudan may not have a reliable internet connection throughout the country, residents in urban areas such as Khartoum generally have access to the internet.

Moreover, the other two elements of the ML model – the learner and social situations – affect students' access and competence with mobile phones in this study. Medical students' perceptions of ML showed that students' experience of frequently using online courses was high. They confirmed they encountered no difficulties while accessing and studying the online courses. A computer skills course was compulsory for all students at the university and was usually taught in the first

and second years. Ibn Sina's students continued to have online computer skill courses during the university lockdown. In 2022, a new unit on e-learning was established at the university. This was to support and enhance the university's gradual transformation toward digitalization in teaching and learning in the future. These results aligned with a 2022 study on undergraduate medical students in Egypt. The study revealed that the majority of the students had positive perceptions on the use of ML. Results demonstrated the online values of learning and assessment during the COVID-19 pandemic. Students showed satisfaction with the e-learning sessions. Based on these findings, blended learning will be the preferred learning method in the future [10]. On the other hand, students preferred the asynchronous method of learning.

Furthermore, medical students conducted self-assessments and confirmed high satisfaction with their online learning experience. They highly preferred Telegram over other applications as a learning method during this experience. The aforementioned study, investigating undergraduate medical students' perceptions of online learning in forensic medicine and a toxicology course during the COVID-19 pandemic, confirmed these results. Students perceived Telegram to be user-friendly [10].

In the current study, mobile phones were considered an essential device that helped medical students perceive its usefulness and ease of use. Similarly, in 2022, a university-level research study was conducted in Jordan using the Technology Acceptance Model (TAM) developed by Davis in 1989, with components to analyze students' use of mobile phones and WhatsApp. The study ensured that the perceived ease of usefulness (PEU) and perceived usefulness (PU) were significant predictors of the behavioral intention to accept mobile learning in education. Examples of the factors evaluated in the study were students' experiences, engagement, interactions, sense of satisfaction, quality of internet connection, frequency of using online courses, quality of online classes, difficulties they encountered while studying online, the device that they prefer to study online which was WhatsApp, and their readiness to study online in the future [11]. These factors were also revealed in the results of the current study. They ensured students' perceptions and satisfactions of using a mobile phone for online learning, but with their preference toward the Telegram App.

Furthermore, students expressed their preferences and perceptions of the type of ML design. They revealed that they favored listening to recorded courses later at a time they might choose for convenience. Therefore, asynchronous learning is the type they preferred. On the other hand, another study, which was conducted in Saudi Arabia in 2023, revealed that medical students perceive both synchronous and asynchronous learning as positive learning methods, each with its advantages and disadvantages. Synchronous learning encouraged student interaction during the live lectures, while asynchronous learning helped them manage their time better [12].

In the current study, students had no difficulties accessing the course materials. These results resemble a study conducted at the university level in Ukraine in 2020 [13]. Both studies revealed positive attitudes and perceptions among university students and their readiness for mobile-assisted learning. Furthermore, this study's results were also supported by a survey conducted in 2023 [14], which revealed that mobile phones were the most available technological tools in colleges. It confirmed that ML has a significant role in assisting learning and clinical practice. The study recommended the integration of ML into the curriculum and training students to help them develop a positive perception of ML in the teaching and learning process. However, in a different study conducted in China in 2023 with medical students, the results revealed no significant differences between two groups of

students' academic performances – one group studied online while the other face-to-face [15]. This suggests the need for more research in this area, and more focus is needed on the criteria of designing online medical courses and to ensure their validity and reliability to enhance students' academic achievements.

In another instance, a study conducted in a geography class showed that students had strong positive perceptions of ML. A moderately positive correlation was observed between students' perceptions and posttest scores, suggesting a correlation between positive perceptions and improved learning achievement [16]. Along the same line, when rating the whole learning experience of the current study—including learning the unit, evaluating the unit, and completing the questionnaire survey—most students rated the experience as a positive one.

A possible limitation in this study is that it did not confirm significant improved learning achievements based on the learning unit because of the absence of a control group. This might be due to the small sample size of the participants, the limited number of questions based on five MCQ, and facing some technical problems with Telegram. This may lead to the results of this study not being generalizable, except if the sample size is increased and mitigation of any potential technical challenges during the study is incorporated.

5. Conclusion

The study began by establishing three objectives centered on assessing the perceptions, sense of satisfaction, and actual experiences of fifth-year medical students who used mobile phones for learning during the COVID-19 pandemic. The research documented the activities undertaken while administering the learning unit, such as the scores obtained, the use of Telegram, and the survey results. Our findings from the learning unit showed some degree of success, although not satisfactory, because students did not perform very well in the posttest. However, the survey results suggested positive perceptions and experiences during the ML experience. This finding confirmed that mobile phones and Telegram can be used as alternatives for online learning in higher education institutions in Sudan and other African countries during emergencies, such as the COVID-19 pandemic.

It is recommended that access to the internet be improved in the country and that policymakers, departments, and individual academics introduce ML. ML is more flexible than other computer-based teaching and learning devices. Many students possess mobile devices and continue using them even during a crisis, a pandemic, or when required by universities to find quick solutions to learning during emergencies. Therefore, the study has accomplished its mission, which is confirmed by the literature review wherein similar interventions and strategies of teaching and learning were implemented. We believe that for Africa and the rest of the developing world, education sustainability will be achieved through mobile devices during crises like the COVID-19 pandemic.

The study's implications include adopting the FRAME model of ML when implementing ML or online learning. This initiative can also be applied in similar contexts, such as pandemics or the current political situation in Sudan.

Declarations

Acknowledgments

The researchers would like to acknowledge the students, staff, and management of Ibn Sina University who participated in and/or supported the study.

Ethical Considerations

Ethical approval was obtained from the Ibn Sina University Ethical Committee. The study was conducted at the Medical Training Centre in 2020. After demonstrating the study's purposes and entirely voluntary enrollment, all participants were informed that they had the right to leave at any stage. Before participating, all participants gave verbal informed consent. Confidentiality and privacy were maintained throughout the study.

Competing Interests

None declared.

Availability of Data and Material

All materials of this study are available from the corresponding author upon request.

Funding

This study has not received any external funding.

Abbreviations and Symbols

MCQ: Multiple choice questions
SPSS: Statistical Package for Social Sciences
ML: Mobile learning
DT: Digital transformation
M-learning: Mobile learning
E-learning: Electronic learning
TAM: Technology acceptance model
PEU: Perceived ease of usefulness
PU: Perceived usefulness
Telegram App: Telegram application

References

[1] Gacs, A., Goertler, S., & Spasova, S. (2020). Planned online language education versus crisis- prompted online language teaching: Lessons for the future. *Foreign Language Annals, 53*(2), 380–392. https://doi.org/10.1111/flan.12460

[2] Sara, R., & Oifaa, T. (2020). Emergency remote learning in higher education during COVID-19 era: Students and professors' experiences. *Linguistic Forum, 2*(4), 13–19. https://doi.org/10.53057/linfo/2020.2.4.2

[3] Salhab, R., & Daher, W. (2023). University students' engagement in mobile learning. *European Journal of Investigation in Health, Psychology and Education, 13*(1), 202–216. https://pubmed.ncbi.nlm.nih.gov/36661766/. https://doi.org/10.3390/ejihpe13010016

[4] Ibnouf, M. A. M. (2021). Editorial-university staff and student protection from COVID-19: Strategic measures for teaching and learning in resource-limited setting. *Sudan Journal of Medical Sciences, 16*(1), 1–4. https://doi.org/10.18502/sjms.v16i1.8932

[5] Gyane, S. O. J. (2021). Perceptions of students on the use of Telegram during the COVID-19 pandemic [AIM]. *Acta Informatica Malaysia, 5*(1), 21–24. https://doi.org/10.26480/aim.01.2021.21.24

[6] Kite, J., Schlub, T., Zhang, Y., Choi, S., Craske, S., & Dickson, M. (2020). Exploring lecturer and student perceptions and use of a learning management system in a postgraduate public health environment. *E-Learning and Digital Media, 17*(3), 183–198. https://doi.org/10.1177/2042753020909217

[7] Koole, M. (2009). A model for framing Mobile learning. In M. Ally (Ed.), *Mobile learning: Transforming the delivery of education and training* (Chapter 2, pp. 25–47). AU Press. https://www.researchgate.net/publication/252714629

[8] Koole, M., Buck, R., Anderson, K., & Laj, D. (2018). A comparison of the uptake of two research models in mobile learning: The FRAME model and the 3-level evaluation framework. *Education Sciences, 8*(3), 114. https://doi.org/10.3390/educsci8030114

[9] Hamadi, M., El-Den, J., Sriratanaviriyakul, N., & Azam, S. (2021). A social media adoption framework

as pedagogical instruments in higher education classrooms. *E-Learning and Digital Media, 18*(1), 55–85. https://doi.org/10.1177/2042753020950869

[10] Abdelrahman, K., Nasser, A., Atwa, H., Mostafa, A., Eman, G., & Metwally, E. (2022). Undergraduate medical students' perception of online learning and assessment during the COVID-19 pandemic: An Egyptian experience. *Egyptian Society of Clinical Toxicology Journal*, *10*(2), 90-103. https://doi.org/10.21608/esctj.2022.176291.1018

[11] Habes, M., Elareshi, M., Salloum, S. A., Ali, S., Alfaisal, R., Ziani, A., & Alsridi, H. (2022). Students' perceptions of mobile learning technology acceptance during Covid-19: WhatsApp in focus. *Educational Media International, 59*(4), 288–306. https://doi.org/10.1080/09523987.2022.2153990

[12] Alzahrani, H. A., Shati, A. A., Bawahab, M. A., Alamri, A. A., Hassan, B., Patel, A. A., Ahmad, M. T., El Maksoud, W. A., & Alsaleem, M. A. (2023). Students' perception of asynchronous versus synchronous distance learning during COVID-19 pandemic in a medical college, southwestern region of Saudi Arabia. *BMC Medical Education, 23*(1), 53. https://doi.org/10.1186/s12909-023-04034-5

[13] Krasulia, A., & Saks K. (2020). Students' perceptions towards mobile learning in an English as a foreign language class. *IEEE 20th International Conference on Advanced Learning Technologies (ICALT)* (pp. 238–240). https://essuir.sumdu.edu.ua/handle/123456789/82637

[14] Yesuf, K. A. (2023). College student perception toward use of mobile learning during coronavirus disease 2019 (COVID-19) era in 2021. *HT Health Technology*, *7*(June). https://ht.amegroups.org/article/view/8065/html

[15] Mao, S., Guo, L., Li, P., Shen, K., Jiang, M., & Liu, Y. (2023). New era of medical education: Asynchronous and synchronous online teaching during and after COVID-19. *Advances in Physiology Education, 47*(2), 272–281. https://doi.org/10.1152/advan.00144.2021

[16] Rigdel, K. S., Zangmo, T., Zangmo, M., & Zangmo, T. (2024). Students' perceptions towards mobile learning and its influence on students' learning achievement, *i-manager's Journal of Educational Technology*, *20*(4), 31–43. https://doi.org/10.26634/jet.20.4.20242