

Type of the Paper (Article.)

From text to e-text: Perceptions of Medical, Dental and Allied students about e-learning

Ayesha Fahim ^{1,*}, Sadia Rana ², Saira Atif ³, Sakeenabi Basha ⁴, Irsam Haider ¹, Mohammad Khursheed Alam ^{5,*}, and Anil Kumar Nagarajappa ⁶

¹ University College of Dentistry, University of Lahore, Lahore, Pakistan; ayeshafahim.af@gmail.com; i002haider@gmail.com

² Sharif Medical & Dental College, Lahore, Pakistan; dr.sadiarana2@gmail.com

³ Institute of Dentistry, CMH Medical College, Lahore, Pakistan; sairaamin80@gmail.com

⁴ Department of Community Dentistry, Faculty of Dentistry, Taif University, PO box 11099, Taif 21944, Saudi Arabia, sakeena@tudent.edu.sa

⁵ Orthodontic Division, Preventive Dentistry Department, College of Dentistry, Jouf University, Sakaka, 72341, Saudi Arabia. mkalam@ju.edu.sa

⁶ Oral Medicine & Radiology, Department of Oral & Maxillofacial Surgery & Diagnostic Sciences, College of Dentistry, Jouf University, Sakaka 72345, Saudi Arabia; dr.anil.kumar@jodent.org

* Correspondence: ayeshafahim.af@gmail.com (A.F.) and mkalam@ju.edu.sa (M.K.A.)

Abstract: In 2020, students of Pakistan had to adapt to the online environment for the very first time. This study aims to analyze the perceptions of medical, dental, and allied health students about online education in Pakistan. A descriptive, cross-sectional study was done to assess the level of acceptance of undergraduate students. A pre-validated questionnaire regarding demographics, past-experience of e-learning, advantages/disadvantages of e-learning, and general perception of students towards e-learning was distributed. Descriptive statistics were computed for demographics, Mann-Witney-U test was used to compare the differences of perceptions between pre-clinical year and clinical years students. Kruskal-Wallis test was applied to compare the results of three specialties of students. Chi-square was used to compare overall category-wise positive and negative responses of students. 1200 students participated in the study. The major advantage identified by all students was the 'comfortable environment' in which they studied online. The major disadvantage selected by preclinical year students was 'anxiety due to social isolation' and that chosen by clinical year students was 'lack of patient interaction'. Overall, 72% of students had a negative perception of e-learning. Student-teacher training, student counselling sessions, and innovative techniques need to be introduced to enhance student engagement and reduce pandemic stress.

Keywords: Undergraduate; Medical; Online; Distance Education; Perception

1. Introduction

For the past ten years, an increased number of medical schools have incorporated technology into their learning environment [1]. In this "Era of Multimedia", teaching has transformed from blackboards to PowerPoint, from dissection of the human body to augmented reality software [2]. Students no longer have to wait in lines for their turn to get access to reading material or patient files or histological images. Everything is accessible through cell phones. Team-based and self-directed learning has been implemented which is aimed to promote individualized education. In well-developed countries, competency-based curriculum and entrustable professional activities have brought great reforms in the assessment of medical students [3]. With all these advancements underway, not all medical schools in less developed countries like Pakistan have adopted modern technological ways.

In March 2020, the pandemic outbreak of COVID-19 and the consequent implementation of social distancing has forced students from all disciplines to study at home, and institutions were forced to adopt e-learning for higher education [4]. Since then, there has been a surge of research on perceptions of students about e-learning at the beginning of COVID-19 [5], a few of which were also conducted with medical and dental students of Pakistan [6, 7]. The studies highlighted the level of dissatisfaction amongst students towards this modernistic educational approach adopted in haste. In the past year, most medical institutions have transformed all basic and clinical teaching pedagogies on online portals [8]. To deliver lectures, institutions have adopted e-learning platforms [9]; to take assessments, learning management systems have become popular [10]; teachers are using simulations and virtual patients to teach clinical medicine [11]. Many well-developed countries have endorsed e-learning as a powerful learning medium owing to its immense benefits [12]. The effectiveness of online learning in developing countries is still quite ambiguous and under-researched.

Students in Pakistan are not generally exposed to online education during their pre-college years. Students living in remote areas were equally enforced by the online education system as those living in big cities. It is safe to say that students did not receive uniform teaching experience. Our study is aimed to analyze the perceptions of medical, dental, and allied health students about online education in Pakistan.

2. Materials and Methods

2.1 Study Design

In March 2020, the Government of Pakistan declared a pandemic emergency in the country. Due to this, university students were forced to switch abruptly from face-to-face to e-learning. After almost one year of online education, a descriptive, cross-sectional study was done from January 2021 till May 2021 to assess the level of acceptance of undergraduate students of Medical (MBBS), Dental (BDS), and Allied Health Sciences (AHS) towards e-learning (Figure 1). The literature search for this study was done through PubMed, Web of Science, Scopus, and Google Scholar literature search (2008-2021).

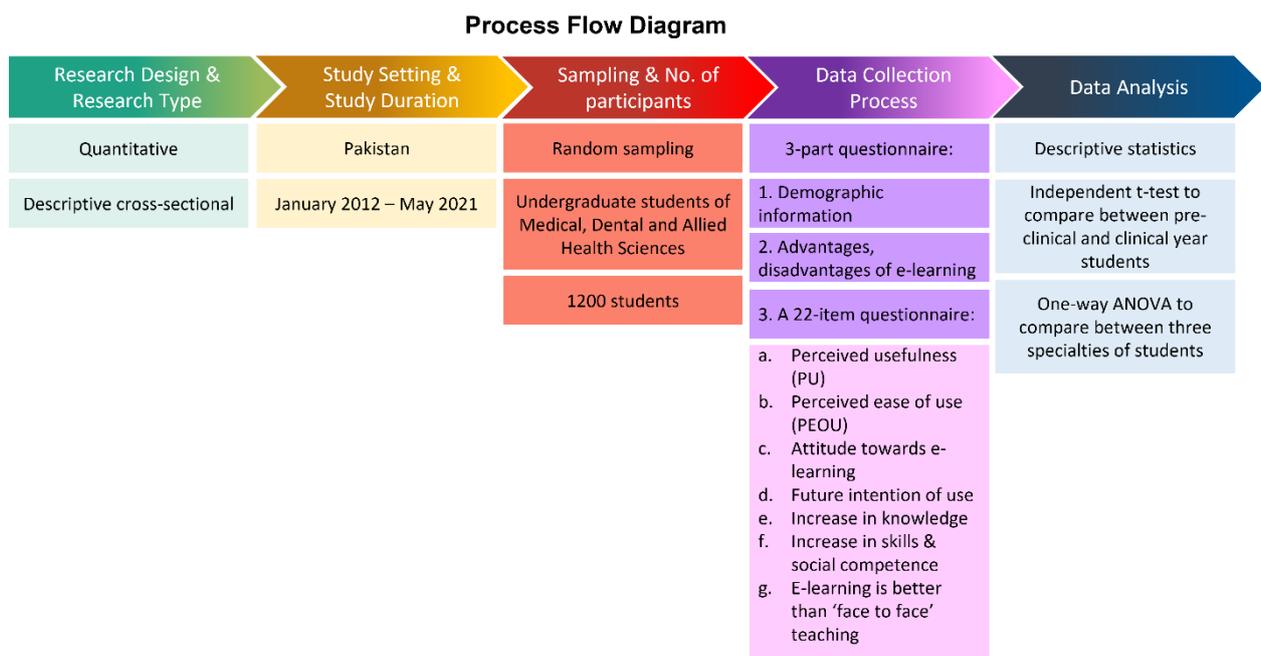


Figure 1: Process flow diagram of research

2.2 Sampling

Purposive, virtual snowball sampling was done. In Pakistan, MBBS is five years whereas BDS and bachelor of Allied health sciences are four-year degree programs. Only the students at undergraduate colleges of Pakistan who have shifted to e-learning during the pandemic were included in the study. The sample was collected until time and data saturation were reached. The study was conducted in accordance with the declaration of Helsinki and ethical approval was obtained from the parent institution ethical board.

2.3 Questionnaire

A pre-validated, online, anonymous questionnaire was circulated to medical, dental, and allied health sciences all over Pakistan through social media groups and email. The questionnaire consisted of three parts; in the first part, the Initial introduction and objectives of the study were explained followed by the statement of consent. A participant information sheet was provided which stated that student participation is purely voluntary, and it will not affect their assessment or performance in any way. Students were inquired about their demographics and whether they have previous experience of e-learning. Names of students and their institutions were not asked to maintain the anonymity of research and maintain participant confidentiality. In the second part, students were given options regarding the advantages and disadvantages of e-learning. They could choose as many options as they liked. The third part consisted of a 22 item questionnaire, with a 5-point Likert scale designed by Linkoping University [13]; Strongly disagree 1, Somewhat disagree 2, Neutral 3, Somewhat Agree 4, strongly Agree 5. The questions were distributed into seven broad categories: Perceived Usefulness (PU) of e-learning, Perceived ease of use (PEOU), attitude toward e-learning, the future intention of use, increase in knowledge, increase in skills and social competencies, 'e-learning' is better than 'face to face teaching'. All items were entered into Google forms (Google LLC) and distributed online to undergraduate students via WhatsApp and email in three waves of invitation: wave 1 (10th January 2021), wave 2 (10th February 2021), and wave 3 (10th March 2021). Data collection was stopped on 10th April 2021 due to time saturation.

2.4 Data analysis

All items in the online questionnaire were made mandatory to inhibit missing items [14]. A Mean of 22 items was calculated with scores ranging from 22-110. The Mean score came out to be 55. The respondents who scored more than 55 were considered to have an overall positive perception and those with a score of less than 55 were considered to have an overall negative perception towards e-learning. The items were divided into 7 groups with the following mean values:

- a. Perceived usefulness (PU) of e-learning - 4 items (score 4-20, mean 10)
- b. Perceived ease of use (PEOU) – 4 items (score 4-20, mean 10)
- c. Attitude towards e-learning - 4 items (score 4-20, mean 10)
- d. Future intention of use – 4 items (score 4-20, mean 10)
- e. Increase in knowledge – 1 item (score 1-5, mean 3)
- f. Increase in skills and social competencies- 2 items (score 2-10, mean 5)
- g. E-learning is better than 'face to face' teaching – 3 items (3-15, mean 8)

Descriptive statistics (mean, frequencies and percentages) were computed for all demographics. Mann-Witney U test was used to compare the differences of perceptions between pre-clinical year students (Year 1 and 2) and clinical years students (3 till 5). Kruskal-Wallis test was applied to compare the results of three specialties of students. Chi-square was used to compare overall category-wise positive and negative responses of students. All analyses were done using IBM SPSS statistical software, version 24 (IBM Corporation, New York) and Microsoft Excel 2013 (Microsoft Corporation, Redmond, Washington).

3. Results

3.1 Characteristics of Respondents

A total of 1200 students participated in the study, out of which 797 (66.4%) were from pre-clinical years and 403 (33.6%) were from clinical years. The demographics are presented in table 1. The majority of the students considered themselves good at IT (~94%) and 37.75% of students had previous experience of e-learning.

Table 1: Demographics of students and their Past experience of E-learning

	Frequency	Percentage
Gender		
Male	564	47%
Female	636	53%
Discipline		
MBBS	363	30.2%
BDS	420	35%
AHS	417	34.7%
Year		
1 st year	279	23.3%
2 nd year	252	21%
3 rd year	266	22.2%
4 th year	244	20.3%
5 th year	159	13.3%
Previous experience in e-learning		
Yes	453	37.75%
No	747	62.25%
IT skills		
High	468	39%
Moderate	684	57%
Low	48	4%

3.2 Advantages and disadvantages of E-learning

The most frequent advantage of e-learning chosen by students was comfortable surroundings (70%), followed by the ability to stay at home (69%) and learning at your own pace (64%). A total of 89% of students listed technical problems with IT equipment as the main disadvantage of e-learning. The second most frequently chosen disadvantage varied for clinical and pre-clinical years. For clinical year students, the lack of interaction with patients was a significantly bigger disadvantage ($p < 0.05$), whereas, for pre-clinical years, the development of anxiety due to social isolation and lack of interaction with teachers was the second most chosen disadvantage ($p < 0.05$) (Table 2). The results were non-significant across the three disciplines.

Table 2: Advantages and disadvantages of E-learning

Variables	Pre-clinical years (n=531)	Clinical years (n=669)	<i>p-value</i>	MBBS (n=363)	BDS (n=420)	AHS (n=417)	<i>p-values</i>	Total
Advantages of online learning								
Access to online material	187	221	0.24	121	140	147	0.76	408 (34%)
Learning at your own pace	350	418	0.1	242	256	270	0.92	768 (64%)
Ability to stay at home	410	418	0.2	271	290	267	0.25	828 (69%)
Classes interactivity	51	45	0.14	33	29	34	0.06	96 (8%)
Improvement in virtual communication and technical skills	211	149	0.65	127	122	111	0.06	360 (30%)
Comfortable surrounding	450	390	0.07	281	259	300	0.84	840 (70%)
Disadvantages of online learning								
Reduced interaction with teachers	346* (65.2%)	158	<0.05*	177	178	149	0.08	504 (42%)
Frequent technical problems	510	558	0.09	346	365	357	0.54	1068 (89%)
Lack of interaction with patients	40	660* (98.6%)	<0.05*	252	231	217	0.24	700 (58.3%)
Poor learning conditions at home	136	128	0.1	89	84	91	0.07	264 (22%)
Lack of self-discipline	107	133	0.1	97	80	63	0.06	240 (20%)
Anxiety due to social isolation	478* (90%)	194	<0.05*	209	230	233	0.47	672 (56%)

MBBS: medical students, BDS: dental students, AHS: allied health sciences students

^a Mann-Witney U test was used to compare the differences of perceptions between pre-clinical year students (Year 1 and 2) and clinical years students (3 till 5)

^bKruskal-Wallis test was applied to compare the results of MBBS, BDS, and AHS students
**p-value* is significant i.e., less than 0.05

3.3 Perception of students towards E-learning

Student perceptions about e-learning were collected (Table 3). There was no significant difference between the gain in knowledge during face-to-face and online learning ($p > 0.05$). However, students had a negative perception about the use, intended use, and increase in skills and social competencies during online learning ($p < 0.05$). there was no significant difference between the responses of pre-clinical and clinical years students and interdisciplinary students ($p > 0.05$), hence results were not included.

Table 3: Overall perception and Category wise responses of students towards E-learning

Category	Responses	N (1200) (%)	Mean (S.D)	<i>p-value</i> ^c
Overall Perception	Positive	337 (28%)	37.25 (8.36)	0.00*
	Negative	863 (72%)		
Perceived Usefulness (PU) of e-learning	Positive	241 (20%)	7.37 (1.38)	0.00*
	Negative	959 (80%)		
Perceived ease of use (PEOU)	Positive	350 (29.1%)	6.55 (0.89)	0.00*
	Negative	850 (70.8%)		
Attitude toward e-learning	Positive	384 (32%)	8.85 (2.25)	0.00*
	Negative	816 (68%)		
Future intention of use	Positive	339 (28.3%)	7.14 (1.01)	0.00*
	Negative	861 (71.8%)		
Increase in knowledge	Positive	628 (52.3%)	3.48 (0.84)	0.12
	Negative	572 (47.7%)		
Increase in skills and social competencies	Positive	226 (18.8%)	3.21 (1.27)	0.00*
	Negative	974 (81.2%)		
'E-learning' is better than 'face to face' teaching	Positive	192 (16%)	1.89 (0.24)	0.00*
	Negative	1008 (84%)		

^cChi-square was used to compare the overall perception of students
**p-value* is less than 0.05

4. Discussion

In this study, we assessed medical, dental, and allied health students' perceptions about E-learning. This study was conducted one year after the abrupt advent of the online education system in Pakistan. It was noticed that only 37.75% of students had previous experience of online learning, which is different from previous studies where the majority of the students were not new to online education [15-17]. The difference is not surprising since online educational courses have been offered to students in the USA, UK, and other well-developed countries even before COVID-19 [18], whereas, only 'Virtual University of Pakistan' was offering online teaching programs in Pakistan until a couple of years ago [19]. For higher education courses of Pakistan, especially the medical field, this shift was entirely new. The participants in this study who have experienced online education would probably be those who have attended online classes during COVID lockdown. Owing to limited resources and the level of inhibition towards faculty development programs, several institutions, despite being unprepared, dived into the stream of online education. This system is not only new for faculty but students as well.

Only 4% of students did not claim to have good command over IT skills, the rest were well versed with technology. Our questionnaire did not specify the IT skills; thus, we expect that participants who are frequent social media users also consider themselves good at IT. It has been previously reported that young people tend to over-report their IT skills [20, 21]. Alternatively, this data may also suggest that students have markedly improved their IT skills in the last year after being exposed to an online education system [6, 15]. Lack of technical skills is considered as one of the major barriers in acceptance towards online learning [22]. With good to excellent knowledge of IT skills and having to experience online education in the past year, it could be expected that students must have grown accustomed to the new dawn of education. In contrast, it was observed that 72% of students had a negative overall perception towards e-learning. This result links to the disadvantages of online learning selected by participants, however, further studies are required to prove the hypothesis. The biggest disadvantage selected by participants was frequent technical problems during an online class. This result is in contrast to previously done studies where lack of engagement and improper feedback were considered the greatest disadvantages [23, 24]. E-learning requires a steady internet connection and continuous electrical supply [25]. Unfortunately, this problem is far from being resolved in a low-income country like Pakistan. Even before COVID, Pakistan has not been able to successfully run online programs and the electricity crisis has been presented as a major cause of this [26]. Although different internet providers have invested heavily in Pakistan in an attempt to provide seamless internet connection, but electricity problems especially in rural areas make it difficult to maintain ICT (information communication technology) [27]. Studies have associated frequent technical problems with a high level of anxiety amongst students that lead to poor learning [28].

The strongest advantage of online learning as perceived by medical, dental, and allied students is the availability of a comfortable environment, followed by the opportunity to learn at their own pace. These results are consistent with previous studies [5]. Student concentration increases substantially with a favorable environment [29]. Some studies contradict this result. A study conducted on Dutch students concluded that although student motivation decreased during stay-at-home study, their academic performance did not decrease [30]. These results support the notion that self-directed and instructor-directed e-learning allows learners to manage their time independently and effectively. Several studies advocate self-directed learning as being more effective than face-to-face learning [31].

Where self-directed e-learning has its advantage, it causes social isolation in students sitting at home [32]. This is reflected in our results as well where most of the pre-clinical years students have chosen 'anxiety due to social isolation' and 'reduced interaction with teachers' as a major disadvantage of online learning. Clinical year students' biggest concern was the lack of patient interaction. These results are consistent with previously conducted studies [15, 33]. All these studies were conducted almost a year ago. Since then, a

lot of innovation has been done in teaching clinical years through 3D software, augmented reality, virtual interactive patients, and telemedicine [34], but it seems that students still face the same problems.

Based on the results, 72% of the students had a negative perception towards online learning. Students do not believe that e-learning can enhance their clinical or social skills. They do not perceive its usefulness and do not find it easy to use. It's not surprising since students have listed the same disadvantages as a year before. To our surprise, students did not find any significant difference in the gain of knowledge between online and face-to-face learning. E-learning involves the use of animated videos, WhatsApp groups, and other social media platforms for instructions, which actively engages students leading to a better understanding [35].

To our knowledge, this is the first study that aims to analyze perceptions of students after one year of online education. Although students in Pakistan have been subjected to online learning for the past year, the level of satisfaction amongst students is still quite poor. This perception is unanimous amongst medical, dental, and allied health sciences. Immense research has been conducted in the last few years, adding a variety of innovations in health professionals education [36]. Various researchers have presented 'tips' for online student engagement [37], on how to conduct clinical sessions [38] and to cope with Pandemic stress disorder [39]. Faculty training sessions are required to train teachers on student engagement. Similarly, students should be counseled regularly, and their academic progress must be monitored continuously to note signs of anxiety and lack of interest. We recommend that longitudinal studies must be conducted to assess the improvement of student perception. Future qualitative studies can help us better understand students' emotional responses and ways of improving them in health sector education.

5. Conclusions

Based on our findings, it is clear that a gap still exists in essential areas of e-learning that needs to be addressed; like time management, student-teacher training on online educational platforms, student engagement ideas, effective feedback on learning, isolation anxiety, effective collaboration between all stakeholders and a general attitude towards e-learning. Pakistan, being a middle to low-income country, cannot be expected to provide stable and fast internet connections throughout the country especially in rural areas within the next 5 years. But all other aspects can be pondered upon and improved with proper training and an open mind.

Conflict of interest

None to declare

Funding and Acknowledgement: The present research work was supported by Taif University Researchers support project number (TURSP-2020/62), Taif University, P.O Box-11099, Taif-21944, Saudi Arabia.

Ethical Approval

The study was conducted in accordance with the declaration of Helsinki and ethical approval was obtained from the parent institution ethical board (Reg no: ANDC/RAC/20/04).

Data Availability Statement

All data generated and analysed in this study are included within the article or available from the corresponding author on reasonable request.

References

1. Rose, S., *Medical Student Education in the Time of COVID-19*. JAMA, 2020. **323**(21): p. 2131-2132.
1. 2. Irby, D.M., M. Cooke, and B.C. O'Brien, *Calls for Reform of Medical Education by the Carnegie Foundation for the Advancement of Teaching: 1910 and 2010*. 2010. **85**(2): p. 220-227.
2. 3. Emanuel, E.J., *The Inevitable Reimagining of Medical Education*. JAMA, 2020. **323**(12): p. 1127-1128.

3. 4. Shetty, S., et al., *Academic Crisis During COVID 19: Online Classes, a Panacea for Imminent Doctors*. Indian Journal of Otolaryngology and Head & Neck Surgery, 2020.
4. 5. Gohel, K.H., et al., *Knowledge and perceptions about COVID-19 among the medical and allied health science students in India: An online cross-sectional survey*. Clinical Epidemiology and Global Health, 2021. **9**: p. 104-109.
5. 6. Sarwar, H., et al., *Self-reported effectiveness of e-Learning classes during COVID-19 pandemic: A nation-wide survey of Pakistani undergraduate dentistry students*. European Journal of Dentistry, 2020.
6. 7. Abbasi, S., et al., *Perceptions of students regarding E-learning during Covid-19 at a private medical college*. Pakistan journal of medical sciences, 2020. **36**(COVID19-S4): p. S57-S61.
7. 8. Rafi, A.M., P.R. Varghese, and P. Kuttichira, *The pedagogical shift during COVID 19 pandemic: online medical education, barriers and perceptions in central Kerala*. Journal of medical education curricular development, 2020. **7**: p. 2382120520951795.
8. 9. Mian, A. and S. Khan, *Medical education during pandemics: a UK perspective*. BMC medicine, 2020. **18**(1): p. 1-2.
9. 10. Tang, B., et al., *Online lectures in undergraduate medical education: scoping review*. JMIR medical education, 2018. **4**(1): p. e11.
10. 11. Sahi, P.K., D. Mishra, and T.J.I.p. Singh, *Medical education amid the COVID-19 pandemic*. 2020. **57**(7): p. 652-657.
11. 12. Al-Fraihat, D., et al., *Evaluating E-learning systems success: An empirical study*. Computers in Human Behavior, 2020. **102**: p. 67-86.
12. 13. Mamattah, R.S., *Students' perceptions of e-Learning*. 2016.
13. 14. Scott, A., et al., *A randomised trial and economic evaluation of the effect of response mode on response rate, response bias, and item non-response in a survey of doctors*. 2011. **11**(1): p. 126.
14. 15. Bączek, M., et al., *Students' perception of online learning during the COVID-19 pandemic: A survey study of Polish medical students*. Medicine, 2021. **100**(7): p. e24821-e24821.
15. 16. Brockman, R.M., et al., *Student perceptions of online and in-person microbiology laboratory experiences in undergraduate medical education*. Med Educ online, 2020. **25**(1): p. 1710324-1710324.
16. 17. Barzani, S.H.H., *Students' perceptions towards online education during COVID-19 pandemic: An empirical study*. Int J Soc Sci Educ Stud, 2021. **8**(2): p. 28-38.
17. 18. Mather, M. and A. Sarkans, *Student perceptions of online and face-to-face learning*. Int J Curr Instr, 2018. **10**(2): p. 61-76.
18. 19. Perveen, A., *Synchronous and asynchronous e-language learning: A case study of virtual university of Pakistan*. Open Praxis, 2016. **8**(1): p. 21-39.
19. 20. Palczyńska, M. and M. Rynko, *ICT skills measurement in social surveys: Can we trust self-reports?* Quality & Quantity, 2021. **55**(3): p. 917-943.
20. 21. Pieschl, S., *Will using the Internet to answer knowledge questions increase users' overestimation of their own ability or performance?* Media Psychology, 2021. **24**(1): p. 109-135.
21. 22. O'Doherty, D., et al., *Barriers and solutions to online learning in medical education – an integrative review*. BMC Medical Education, 2018. **18**(1): p. 130.
22. 23. Dumford, A.D. and A.L. Miller, *Online learning in higher education: exploring advantages and disadvantages for engagement*. Journal of Computing in Higher Education, 2018. **30**(3): p. 452-465.
23. 24. Tareen, H. and M.T. Haand, *A case study of UiTM post-graduate students' perceptions on online learning: Benefits & challenges*. Int J Adv Res Pub, 2020.
24. 25. Barteit, S., et al., *Evaluation of e-learning for medical education in low- and middle-income countries: A systematic review*. Computers & Education, 2020. **145**: p. 103726.
25. 26. Ahmed, M.U., S. Hussain, and S. Farid, *Factors influencing the adoption of e-learning in an open and distance learning institution of Pakistan*. Electronic Journal of e-Learning, 2018. **16**(2): p. 148-158.
26. 27. Hassan, u.M. and A.A. Aziz, *Investigating the use of Computer Technology for E-learning in Pakistani Maddaris: Case of Religious Teachers*. International Journal of Distance Education E-Learning, 2019. **5**(1): p. 44-56.
27. 28. Fawaz, M. and A. Samaha, *E-learning: Depression, anxiety, and stress symptomatology among Lebanese university students during COVID-19 quarantine*. 2021. **56**(1): p. 52-57.
28. 29. Kweon, B.-S., et al., *The link between school environments and student academic performance*. Urban Forestry Urban Greening, 2017. **23**: p. 35-43.
29. 30. Meeter, M., et al., *College students' motivation and study results after COVID-19 stay-at-home orders*. PsyArXiv, 2020.
30. 31. Geng, S., K.M.Y. Law, and B. Niu, *Investigating self-directed learning and technology readiness in blending learning environment*. International Journal of Educational Technology in Higher Education, 2019. **16**(1): p. 17.
31. 32. Usher, K., N. Bhullar, and D. Jackson, *Life in the pandemic: Social isolation and mental health*. 2020, Wiley Online Library.
32. 33. Thomas, A., et al., *Survey among medical students during COVID-19 lockdown: the online class dilemma*. International Journal of Medical Students, 2020. **8**(2): p. 102-106.
33. 34. Adedoyin, O.B. and E. Soykan, *Covid-19 pandemic and online learning: the challenges and opportunities*. Interactive Learning Environments, 2020: p. 1-13.
34. 35. Kee, C.n.L., *Face-to-Face Tutorial, Learning Management System and WhatsApp Group: How Digital Immigrants Interact and Engage in E-Learning?* Malaysian Online Journal of Educational Technology, 2020. **8**(1): p. 18-35.

35. 36. Dedeilia, A., et al., *Medical and Surgical Education Challenges and Innovations in the COVID-19 Era: A Systematic Review*. In Vivo, 2020. **34**(3 Suppl): p. 1603-1611.
36. 37. Reyna, J., *Twelve Tips for COVID-19 friendly learning design in medical education*. MedEdPublish, 2020. **9**.
37. 38. Hunukumbure, A.D., et al., *Twelve tips for surgeons to maximise medical student learning in the operating theatre*. Medical Teacher, 2021: p. 1-6.
38. 39. Jahagirdar, B., *Five tips to manage student pandemic stress disorder*. 2020, ACM New York, NY, USA.