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RESEARCH ARTICLE

Attitudes, Barriers, and Experiences Regarding E-Learning and Dental Education during COVID-19 Pandemic

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Abstract:

Background:

Dental schools used e-learning systems to continue teaching during the COVID-19 pandemic.

Objective:

This study aimed to determine attitudes, experiences, and barriers to e-learning during the pandemic among dental students in Saudi Arabia.

Methods:

A cross-sectional study (descriptive) was performed at the Faculty of Dentistry, Umm Al-Qura University. There were 245 responses to the study questionnaire, having a response rate of 90.74%. The questionnaire was validated through a pilot study. A t-test analysis showed a significance level of 0.05.

Results:

Participants had moderate levels of attitudes, with the mean and standard deviation (SD) being 2.99 (SD = 1.21) to 3.41 (SD = 1.19). Clinical year students had significantly ($p < 0.05$) better attitudes than non-clinical year students. The most prevalent personal barrier was "lack of interaction with colleagues" (55.92%), the technical barrier was "the slowness of network" (67.35%), infrastructure/technological barrier was "low bandwidth" (67.76%), the content barrier was "impracticality of some courses" (50.61%), and the barrier related to the instructor was "difficulty contacting academic staff from home" (43.67%). About 83.27% stated that recorded lectures allowed participants to revisit the course, improving learning during the pandemic. However, only 44.08% believed e-learning provided a better opportunity to learn dental clinical procedures because of the zoom function on cameras.

Conclusion:

The overall attitude toward e-learning was moderate, with several barriers highlighted. Nevertheless, the e-learning system seems to have helped during the pandemic, and it might be essential for dental schools to build a hybrid teaching strategy into their curricula for consistent use.

Keywords: Dental education, E-learning, Dental students, Attitude, Barriers, COVID-19.

1. INTRODUCTION

The global revolution in information technology, rapid increase in knowledge, and unexpected appearance of contiguous diseases have necessitated finding teaching methods other than conventional face-to-face education. The COVID-19 pandemic has disrupted many worldwide activities, including education [1], and several countries restricted routine community movement and gatherings to minimize the chance of disease transmission. Due to social distancing requirements, most educational institutions, including dental schools, suspended in-person classes and seminars and minimized pre-clinical and clinical training to ensure the safety of students, teachers, and patients [2 - 4]. As a result, dental schools turned to electronic facilities and resources to maintain educational activities and overcome the impact of COVID-19 on learning [5].

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Conventional in-person education and clinical training remain valuable sources of theoretical information and practical skill acquisition in dental schools. Students can interact and communicate effectively with their instructors, and instructors can supervise the students and maintain their attention to the subject by asking questions [6 - 8]. In terms of clinical sessions, students can see a live demonstration and work with their instructors [9 - 11]. Although there are multiple benefits of in-person education and training, there are nonetheless some concerns. Some students may miss lectures or clinical demonstrations due to other urgent matters, or they may lose attention if the instructor has poor teaching skills and cannot deliver the information clearly [12, 13]. To supplement in-person teaching and enhance students' learning outcomes, some dental schools and instructors began using electronic learning (e-learning) [12, 14].

E-learning is the use of information technology to facilitate and improve students' learning ability [15]. It also provides the opportunity for lifelong learning, regardless of time or location constraints [16]. Nowadays, e-learning is gaining popularity because it is the safest method for delivering scientific materials or practical demonstrations to students while adhering to COVID-19 precautionary measures [17]. E-learning is flexible and convenient for students; they can frequently access electronic materials wherever and whenever they want until they feel satisfied that they have understood the material [18, 19]. Moreover, it simplifies the studying and reviewing of materials that may improve a student's performance [7, 20]. Additionally, e-learning allows the delivery of subjects in many forms, including virtual lectures and labs, audio recording, videotaping, PowerPoint presentations, and portable document format (PDF) for documentation, all of which can maximize students' learning [12, 13].

Despite the benefits of e-learning, there are some challenges for students, instructors, and educational institutions that have hampered its widespread acceptance. For students, the lack of internet access, having an unstable internet connection, having limited e-learning skills and knowledge, or the loss of their attention and engagement during online classes [21 - 23] are the primary obstacles. For instructors, the primary obstacles are that they cannot effectively monitor the students, there is a need for additional time and effort to set up instruction, and having difficulties with adopting the technology [19, 24]. For educational institutions, the main challenges of e-learning are the cost of online software, the requirement for human resources to train students and faculty members on the use of the system, the need for a support team, and the onus of regular software maintenance [24].

In the medical field, the use of e-learning has steeply increased during the COVID-19 crisis. One study reported that medical students generally accept the time saved, improvement in their performance, and the enhancement in learning pre-clinical subjects due to e-learning; however, there are methodological, technical, and behavioral barriers restricting its proper use [22]. Conflicting studies conducted with nursing, medical, and dental students have reported unfavorable attitudes toward e-learning due to technical problems, lack of information technology support, and instructor characteristics [8, 21, 24]. Another study mentioned that most dental students preferred conventional face-to-face instruction, saying they are not confident in their clinical skills after online classes [6].

In Saudi Arabia, the COVID-19 pandemic significantly impacted dental education, clinical training, and patient treatment [25]. In response to this urgent matter, the Faculty of Dentistry at Umm Al-Qura University has shifted to a hybrid system of e-learning to continue offering lectures and some practical e-learning demonstrations, in addition to clinical education that involves dealing with patients. This sudden dramatic change in the methods of teaching dentistry necessities an evaluation of students' experiences. Therefore, this study aimed to determine dental students' attitudes toward, barriers to, and experiences with e-learning throughout the COVID-19 pandemic in Saudi Arabia.

2. MATERIALS AND METHODS

The Faculty of Dentistry at Umm Al-Qura University Institutional Review Board (IRB) approved this study (IRB, 188-20), which used a cross-sectional descriptive design to investigate attitudes about e-learning and the barriers to its use among dental students during the COVID-19 pandemic. All students in their 2nd through 6th years at Umm Al-Qura University were asked to participate. Data were collected from November 2020 until December 2020. The participants were required to answer the study's questionnaire, which was sent as a link to an online survey. The survey was distributed to students (male and female) via the class leader; the students had to be full-time students (not on leave or withdrawal) in order to participate in the study. The 1st-year dental students were excluded from the study because their courses include are general classes not taught by dental faculty (chemistry and English). Dental interns were also excluded from the study because they do not receive educational lectures. Because the sampling technique was purposeful sampling, all students in the designated years were invited to the study. The invitation was sent again twice as a reminder to the group leader in hopes of increasing the response rate, but no more reminders were given so that the students did not feel irritated irritating to the students.

The questionnaire used in this study was composed of four sections. The first section consisted of questions about demographic variables, including age, sex, study year, marital status, electronic device use, and the availability of internet services at home. Section two included 18 questions about attitudes toward e-learning systems, organized into three subgroups: usefulness, ease of use, and preference for e-learning systems. The answers were obtained through the Likert scale ranging from strongly disagree to strongly agree. Section three asked about 35 potential barriers to e-learning, divided into five subgroups related to the type of barrier: personal, technical, infrastructure, content, and instructor. Sections two and three were taken from a previous study [24]. Section four asked 10 questions about how e-learning was affected by COVID-19, especially in the dental faculty. The questions in sections three and four had possible answers of yes or no. The questionnaire was administered in English because

it is the formal language of education in dental school.

It was expected that participants would need 10 minutes to complete the questionnaire, which the students were asked to answer during their free time. The data were gathered without any identity and were available to the research team on a private desktop in the Faculty of Dentistry at Umm Al-Qura University. These data can be provided upon reasonable request addressed to the study author. The questionnaire went through a round of face and content validation in a pilot study with 10 dental students who assessed the questionnaire's clarity, language, and content. The results of the pilot study were not included in the main study results. SPSS software version 27 (IBM Corp., Armonk, NY, USA) was used to conduct the data analyses, and the continuous and categorical data were displayed as mean, standard deviation, percentages, and counts. T-tests were used to measure the attitudes of the non-clinical and clinical dental students.

3. RESULTS

A total of 245 participants from the Faculty of Dentistry, Umm Al-Qura University, answered the questionnaire, making the response rate 90.74%. The mean (m) age of participants was 21.46, with a standard deviation (SD) of 1.56. Table **1** provides participants' demographic data. A total of 60% of the participants were female. The participants were from different academic years, with second-year students making up 15.1%, third-year students were 23.35%, fourth-year students were

17.14%, fifth-year students were 20.82%, and sixth year students were 16.59%. Only 2.04% of respondents were married. All participants (100%) had at least one device to use for e-learning, but only 11% used a desktop computer, while 49.8% used a laptop, 44.9% used a mobile phone, and 69.8% used a smart tablet. Only 0.82% did not have internet access in their homes.

Participant attitudes toward the e-learning system's ease of use and their preferences are displayed in Table **2**. Each statement was presented with a Likert scale response as categorical data (count and percentages) and again as continuous data (using mean and standard deviation) for later statistical comparison. For attitudes toward the e-learning system, the least frequently chosen statement was "e-learning improves my learning efficiency" (m = 3.13; SD = 1.18), and the most frequently chosen statement was "e-learning is useful as a learning tool for distance education" (m = 3.71, SD = 1.17). For attitudes toward e-learning's ease of use, the lowest statement score was for "e-learning provides flexible interactions with instructors and classmates" (m = 2.88, SD = 1.19), and the highest was for "e-learning reduces educational costs" (m = 3.41, SD = 1.19). In terms of preferences regarding e-learning, the lowest statement score was for "e-learning is better than face-to-face education in its learning process" (m = 2.49, SD = 1.32), and the highest statement score was for "I recommend using e-learning systems for other students" (m = 3.09, SD = 1.23).

Table 1. Participants' demographic data.

-	-	*n*	*%*
Gender	Male	98	40.00
	Female	147	60.00
Academic Year	2nd year	37	15.10
	3rd year	67	27.35
	4th year	42	17.14
	5th year	51	20.82
	6th year	48	19.59
Academic Year	Non-clinical year (2nd and 3rd)	104	42.4
	Clinical year (4th through 6th)	141	57.6
Marital Status	Married	5	2.04
	Unmarried	240	97.96
Desktop	Yes	27	11.00
	No	218	89.00
Laptop	Yes	122	49.80
	No	123	50.20
Mobile	Yes	110	44.90
	No	135	55.10
Tablet	Yes	171	69.80
	No	74	30.20
Internet	Yes	243	99.18
	No	2	0.82

Table 2. Participants' attitudes toward e-learning systems, ease of use, and preferences.

-	1	2	3	4	5	-
Statement	*n* (%)	*n* (%)	*n* (%)	*n* (%)	*n* (%)	M (SD)
Attitudes toward E-learning System	-	-	-	-	-	-
Allows me to complete the learning activities more quickly	22 (8.98)	27 (11.02)	73 (29.8)	74 (30.2)	49 (20)	3.41 (1.19)
Enhances my success in my studies	15 (6.12)	43 (17.55)	97 (39.59)	65 (26.53)	25 (10.2)	3.17 (1.03)
Is useful as a learning tool for distance education	17 (6.94)	21 (8.57)	47 (19.18)	91 (37.14)	69 (28.16)	3.71 (1.17)
Encourages me to search for extra material and resources	19 (7.76)	44 (17.96)	81 (33.06)	67 (27.35)	34 (13.88)	3.22 (1.13)
Improves my learning efficiency	27 (11.02)	41 (16.73)	82 (33.47)	62 (25.31)	33 (13.47)	3.13 (1.18)
E-learning content is informative	13 (5.31)	41 (16.73)	95 (38.78)	66 (26.94)	30 (12.24)	3.24 (1.04)
Attitudes about E-learning Ease of Use	-	-	-	-	-	-
Provides flexible interaction with instructor and classmates	36 (14.69)	64 (26.12)	58 (23.67)	68 (27.76)	19 (7.76)	2.88 (1.19)
Reduces the cost of education	16 (6.53)	41 (16.73)	67 (27.35)	68 (27.76)	53 (21.63)	3.41 (1.19)
Makes my learning easier	24 (9.8)	62 (25.31)	62 (25.31)	68 (27.76)	29 (11.84)	3.07 (1.18)
Helps me to efficiently manage my time	35 (14.29)	38 (15.51)	45 (18.37)	70 (28.57)	57 (23.27)	3.31 (1.36)
Provides all the resources and materials I need for my studies	12 (4.9)	39 (15.92)	96 (39.18)	75 (30.61)	23 (9.39)	3.24 (0.99)
It is easy to handle e-learning content	24 (9.8)	36 (14.69)	72 (29.39)	80 (32.65)	33 (13.47)	3.25 (1.16)
Attitudes Regarding E-learning Preference	-	-	-	-	-	-
I am interested in taking courses that are in e-learning mode	37 (15.1)	47 (19.18)	64 (26.12)	76 (31.02)	21 (8.57)	2.99 (1.21)
I prefer to use e-books for my studies	31 (12.65)	57 (23.27)	61 (24.9)	57 (23.27)	39 (15.92)	3.07 (1.27)
Better than face-to-face education as a learning process	76 (31.02)	54 (22.04)	56 (22.86)	36 (14.69)	23 (9.39)	2.49 (1.32)
Efficient as a teaching method	36 (14.69)	25 (10.2)	91 (37.14)	78 (31.84)	15 (6.12)	3.04 (1.12)
I recommend e-learning systems for other students	40 (16.33)	30 (12.24)	67 (27.35)	83 (33.88)	25 (10.2)	3.09 (1.23)
I enjoy using e-learning systems in my studies	44 (17.96)	29 (11.84)	68 (27.76)	69 (28.16)	35 (14.29)	3.09 (1.3)

Response scale: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree

All attitude statements were examined in continuous format (mean and standard deviation) against gender and academic year. The t-test showed that none of the statements were significantly different between males and females in terms of attitude items except for one statement (e-learning reduces education costs), which males chose significantly ($p < 0.001$) more (m = 3.73, SD = 1.03) than females (m = 3.2, SD = 1.23). The same statements were examined again in their categorical format (count and percentage) with the gender variable using a chi-square test, and similar results were found.

The attitude statements were examined in a continuous format against non-clinical and clinical year students using a t-test, which showed that the majority of attitude statements were selected significantly more often among clinical year students (fourth, fifth, and sixth years) than among non-clinical students (second and third years), as displayed in Table **3**.

Participants reported any barriers they encountered in using the e-learning system within five categories in terms of the type of barrier: personal, technical, infrastructure and technological, content, and instructors. They are shown in Table **4**. The most commonly chosen personal barrier was "lack of interaction with my colleagues through the e-learning platform" (55.92%). The most common technical barrier was "the slowness of networks is an obstacle to my learning online" (67.35%). The most common infrastructure/technical barrier was "low bandwidth (slow internet connection), with frequent breakdowns" (67.76%). The most common content barrier was a concern about "the practical nature of some courses that are not offered electronically" (50.61%). The most common instructor barrier was that students had "difficulty contacting

academic staff at home" (43.67%).

Table 3. Comparison of attitudes toward e-learning among non-clinical students (second and third years) and clinical students (fourth, fifth, and sixth years).

Statement	Non-clinical Year Students	Clinical Year Students	-
Attitudes toward E-learning Systems	m (SD)	m (SD)	P-value
Allows me to complete the learning activities more quickly	3.23 (1.24)	3.55 (1.13)	0.042*
Enhances my success in my studies	3.01 (1.06)	3.29 (1)	0.037*
Is useful as a learning tool for distance education	3.39 (1.22)	3.94 (1.07)	< 0.001*
Encourages me to search for extra material and resources	3.13 (1.09)	3.28 (1.16)	0.327
Improves my learning efficiency	2.88 (1.05)	3.33 (1.23)	0.002*
E-learning contents are informative	3.00 (1.02)	3.42 (1.02)	0.002*
Attitude toward E-learning Ease of Use	-	-	-
Provides flexible interaction with instructor and classmates	2.76 (1.17)	2.96 (1.21)	0.183
Reduces education costs	3.15 (1.25)	3.60 (1.1)	0.004*
Makes my learning steps easier	2.93 (1.21)	3.16 (1.16)	0.135
Help me manage my time efficiently	3.11 (1.3)	3.46 (1.39)	0.041*
Provides all the resources and materials I need in my studies	3.00 (1)	3.41 (0.95)	0.001*
It is easy to handle e-learning content	2.88 (1.1)	3.53 (1.12)	< 0.001*
Attitude toward E-learning Preference	-	-	-
I am interested in studying courses that are in e-learning mode	2.87 (1.13)	3.08 (1.25)	0.167
I prefer to use e-books for my studies	2.87 (1.29)	3.21 (1.24)	0.035*
Better than face-to-face education in learning process	2.5 (1.32)	2.49 (1.32)	0.950
Efficient as teaching method	2.89 (1.04)	3.16 (1.17)	0.066
I recommend using e-learning systems for other students	2.9 (1.19)	3.23 (1.25)	0.037*
I enjoy using e-learning systems in my studies	2.84 (1.28)	3.28 (1.29)	0.008*

* Statistically significant at *p* < 0.05

Table 4. Participant reports of barriers to e-learning.

Barriers	*n*	*%*
Personal Barriers	-	-
Lack of interaction with my colleagues through the e-learning platform	137	55.92
Lack of time management skills to keep up with the pace of the course	125	51.02
Lack of sufficient knowledge and skill using e-learning	107	43.67
No internet connection	87	35.51
Lack of confidence and shyness when learning online	86	35.1
Lack the language and typing skills for online learning	79	32.24
Lack of devices to use for e-learning	68	27.76
Technical Barriers	-	-
The slowness of network is an obstacle to learning online	165	67.35
Faced with system errors and lack of access to the e-learning platform	158	64.49
Lack of technical assistance to handle technological problems	98	40.00
Lack of support services such as tutors	89	36.33
The college does not provide technical support for using e-learning	67	27.35
The e-learning system is unavailable most of the time	62	25.31
University books are not compatible with the use of e-learning	52	21.22
Infrastructure Technological Barriers	-	-
Low bandwidth (slow internet connections) and frequent breakdowns	166	67.76
The cost of internet fees/charges for using the internet for e-learning	109	44.49
Lack of counseling availability when taking e-learning courses	94	38.37
Lack of proper training before using e-learning platforms	93	37.96
Erratic power supply at home hinders my use of e-learning resources	82	33.47
E-learning system design is not flexible and difficult to use	74	30.20

(Table 4) contd.....

Barriers	n	%
The rules and program directions in using online discussion platforms are difficult for me	67	27.35
Content Barriers	-	-
Concerns about the practical nature of some courses that are not offered electronically	124	50.61
Lecture notes are supported by multimedia tools (flash animations, simulations, videos, audio recordings, etc.)	118	48.16
Difficulty understanding the content of the subject through e-learning	99	40.41
Difficulty learning the content of my subject using e-learning	89	36.33
Learning and teaching resources that are available on the e-learning system are not aligned with the curriculum	82	33.47
Disproportion of e-learning and curriculum content	67	27.35
Difficulty accessing e-resources from the e-platform when at home	58	23.67
Instructor Barriers	-	-
Difficulty contacting academic staff when at home	107	43.67
My teachers prefer conventional methods of teaching and research	98	40.00
Instructors do not have enough knowledge and skill to use e-learning	96	39.18
Lack of timely feedback from the instructor	88	35.92
My teacher's delay in submitting course information online affects my performance	82	33.47
Lack of clear instructions from my teacher	79	32.24
My teachers are not confident with using e-learning	59	24.08

Table 5. Participant attitudes toward e-learning during COVID-19.

Statement	Answer	n	%
E-learning is a preventive measure to minimize the transmission of COVID-19	Yes	220	89.80
	No	25	10.20
Recorded lectures allowed me to revisit the course and control my learning better during the COVID-19 pandemic	Yes	204	83.27
	No	41	16.73
COVID-19 was helpful for introducing me to more e-learning	Yes	188	76.73
	No	57	23.27
Using e-learning for lectures that can be seen from home allowed me to better manage my time in the dental clinic	Yes	185	75.51
	No	60	24.49
E-learning is not suitable for teaching clinical skills	Yes	174	71.02
	No	71	28.98
Clinical demonstrations sometimes were a problem because of the quality of the videos	Yes	153	62.45
	No	92	37.55
E-learning made studying dentistry less stressful	Yes	151	61.63
	No	94	38.37
I want to continue using the e-learning system after COVID-19 ends	Yes	136	55.51
	No	109	44.49
E-learning can be used for clinical training only with clinical demonstrations	Yes	112	45.71
	No	133	54.29
During the COVID-19 pandemic, E-learning provided better opportunities to learn dental clinical procedures because of using a camera with a zoom lens	Yes	108	44.08
	No	137	55.92

Participants' attitudes toward e-learning during COVID 19 are displayed in Table **5**. In general, participants had a good attitude (44.08% to 89.80%) toward the use of e-learning during COVID-19. A total of 89.80% agreed that e-learning is a preventive measure that minimizes the transmission of COVID-19 infections. Also, 83.27% agreed that recorded lectures allowed them to revisit the course and better control their learning. Conversely, 45.7% agreed that e-learning can be used in clinical training only for clinical demonstration. However, 44.08% agreed that during the COVID-19 pandemic, e-learning provided a better opportunity to learn dental clinical procedures because of using zoom camera functions.

4. DISCUSSION

The COVID-19 crisis is the main challenge to education today. It caused a significant interruption in the primary method of delivering a dental education, which is face-to-face teaching, but distance learning using electronic platforms was the best way to deliver educational instruction and practical demonstrations while avoiding gathering of students therefore, lessening the chances of the disease spreading. Several dental schools have now implemented and activated e-learning to continue teaching basic, pre-clinical, and clinical courses in order to overcome the impacts of COVID-19 on education. This substantial change in dental teaching requires evaluation

to ensure successful implementation, effective use, and positive influences on learners.

Because of its material differences from traditional learning frameworks, the successful implementation of e-learning requires several important elements. Easy handling, a fast and stable internet connection, access to gaining experience with the technology, and readily available technical support are all necessary components of the appropriate use of e-learning. This study aimed to determine attitudes, barriers, and experiences of dental students with regard to e-learning during the COVID-19 pandemic in Saudi Arabia. Nearly all students had internet access and at least one smart device, mostly tablets (70%), that were used for e-learning. Additionally, this study found no significant influence of gender on attitudes toward e-learning except with regard to the reduction of education costs reported by male students, and that the non-significant influence of gender on e-learning was consistent with previous studies [26].

In this study, the main advantages of e-learning that were agreed upon by most students were its usefulness as a tool for distance learning (65%), efficiency in time management (54%), and reduction of education costs (50%). These findings were consistent with previous studies of dental and medical students that reported e-learning consumed less time and money than traditional on-site learning [22, 27]. Conversely, however, more than half of the students (53%) disagreed that e-learning is better than face-to-face in dental education. This finding was similar to previous studies [6 - 8, 24], which suggests that dental education's practical nature, which requires physical presence and interaction among students, cannot be entirely replaced by the e-learning system.

Regarding the relationship of attitudes about e-learning and its ease of use with the students' academic year, this study revealed a significantly more positive attitude among clinical year dental students (fourth, fifth, and sixth years) versus non-clinical (second and third) year students, which was consistent for the usefulness of e-learning, improvement in learning ability, informative content, time management, lower education costs, study enhancement, enjoyment of use and ease of working with the e-learning system. The significant influence of students' academic year on attitudes toward e-learning was in agreement with previous research [24], which reported that non-clinical year students had more negative attitudes toward e-learning than clinical year students. However, this finding was contrary to a previous study that reported dental students in early academic years adapted more readily to e-learning than clinical year students. This was believed to be due to the nature of the subjects being taught at that time, as these courses depend more on the theoretical knowledge than practical skills acquisition [27]. Our explanation is that clinical year students having more experience with dental materials, technology, and college policy than non-clinical year students means that they more rapidly adjust to newly implemented e-learning systems.

Although e-learning provides many advantages for students, there were also challenges. In this study, we divided the barriers dental students faced with e-learning into five categories: personal, technical, infrastructure/technological, content, and instructor barriers. The most frequently indicated personal barriers for students were the lack of student interaction on e-learning platforms (56%), lack of time management (51%), and lack of knowledge and skills for using the e-learning platform (44%). The lack of interaction in e-learning systems was in agreement with many prior studies [28, 29]. We recommend improving student interaction by conducting virtual classes that include asking questions and using case-based discussion during e-learning. Our results further support the conclusion that students are not ready to adapt to e-learning, perhaps due to the sudden transition and their lack of previous exposure to online courses. We recommend more support for students through counseling, guidance, and training to maximize their benefits from the e-learning modality.

The most frequently cited technical barriers for students were slow networks (67%), system errors with a lack of access to the e-learning platform (65%), and a lack of technical assistance (40%). This result is consistent with previous studies pointing to difficulties with the e-learning platform's accession, network disconnection, and lack of information technology support as major obstacles to the effective use of e-learning [24, 30]. Regarding infrastructural/technological barriers, most students (68%) reported slow internet with frequent disconnection during e-learning classes. These findings were also similar to previous studies indicating that a slow and unstable internet connection hindered the appropriate use of e-learning systems [6, 22, 24, 29]. From our point of view, the availability of good quality internet along with the presence and prompt response of a technical support team is essential for ensuring the success of an e-learning system.

The current study's results indicated that in terms of the content barriers, many students were concerned about the practical application of some courses that are not offered electronically (50%), as well as difficulty in understanding a subject's content with e-learning methods (40%). These findings were congruent with a previous publication [24] and suggest that faculty instructors need to supplement their online lecture content with virtual and videotaped practical application demonstrations related to the lectures to enhance student learning. In addition, it is essential for students to incorporate interaction and communication with their instructors in online classes to improve their understanding of the lecture content.

The instructor barriers reported by many students were difficulty contacting faculty members (44%) and the instructor's lack of adequate skill with the e-learning technologies (40%). This is also in accordance with a prior study [24] and demonstrates that faculty members play an essential role in managing students' learning by providing support, motivation, and responsiveness to students' inquiries, which enhances students' overall satisfaction with e-learning. This finding was in support of a previous study that mentioned that teachers are the key to education, and their favorable attitudes about e-learning have a positive influence on students' motivation and acceptance of the e-learning platform [30].

The present study highlighted the benefits of using e-learning during the COVID-19 pandemic. The majority of students (90%) agreed that e-learning was an effective method

for protecting against COVID-19 transmission. Other benefits included 83% of respondents appreciating the flexibility of recorded online lectures allowing them to assess the content as many times as they wanted, 75% noting that e-learning saved time that could be used to perform other educational activities, and 62% reporting that e-learning made dental education less stressful. Of course, the study also revealed some negative aspects of e-learning. The majority of students said that e-learning is not suitable for teaching clinical skills (71%) or even for clinical demonstration (54%). Moreover, only 44% said they believed that e-learning provided better opportunities to learn dental clinical procedures because of the use of zoom camera features during the pandemic. These findings are congruent with a previous study demonstrating that clinical training was the part of studies that were most affected according to 86% of students [6].

This study had some limitations. First, it was performed in only one dental institution, therefore, there is a need for a multi-institution study to generalize the findings. Another limitation is that this study did not compare the effectiveness of different e-learning modalities, such as virtual versus recorded lectures. Also, this study did not assess students' performance after using the e-learning system. This study recommends that dental schools review their teaching policies and prepare a plan for future unexpected disruptions in dental education and clinical training. Moreover, dental schools should incorporate a hybrid teaching strategy in their curricula and use it regularly and continuously after the pandemic. There should also be an investment in more technological infrastructure and the training of faculty members and students in using new technologies in dental education.

CONCLUSION

The current study indicates that students have a moderate attitude toward e-learning. The main advantages of the e-learning system were its usefulness as a tool for distance learning, efficiency in time management, reduction of education costs, effective protection against COVID-19 transmission, flexibility and time saving, and making dental education less stressful. The most prevalent barriers were a lack of interaction through the e-learning platform, the slowness of the network, low-bandwidth connections with frequent breakdowns, the practical nature of some courses not offered electronically, and difficulties in contacting academic staff at home. This study also demonstrated a significantly more positive attitude among clinical year dental students (fourth, fifth, and sixth) versus non-clinical year students (second and third) in many aspects. Overall, the e-learning system seems very helpful and useful when facing similar crises, making it possibly essential for dental schools to build a hybrid teaching strategy for consistent use, even after the COVID-19 pandemic.

LIST OF ABBREVIATIONS

COVID-19	=	Coronavirus disease of 2019
E-learning	=	Electronic learning
M	=	Mean
SD	=	Standard Deviation

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The Faculty of Dentistry at Umm Al-Qura University Institutional Review Board (IRB), Saudi Arabia approved this study (IRB, 188-20).

HUMAN AND ANIMAL RIGHTS

No animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013.

CONSENT FOR PUBLICATION

Participants in this study were advised that their response to the questionnaire would indicate consent to publication.

AVAILABILITY OF DATA AND MATERIALS

The data supporting this article's findings are available from the corresponding author [E.A] upon reasonable request.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest, financial or otherwise.

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