

Original Article

Opportunities and threats of e-learning in dental education in viewpoints of faculty members: A Mixed method study

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ABSTRACT

Background: The aim of the study was to assess the opportunities and threats of e-learning in dental schools and explore the experiences of dental faculty members in the coronavirus disease-19 (COVID-19) epidemic conditions.

Materials and Methods: The present study was a sequential exploratory mixed method study (quantitative-qualitative). In the quantitative phase, a survey study was conducted to investigate the perspectives of faculty members regarding the opportunities and threats of e-learning during the COVID-19 epidemic. The data were analyzed by descriptive indicators (frequency, percentage, mean, and standard deviation) and analytical tests (*t*-test and analysis of variance). In the qualitative phase, data were collected through semi-structured interviews. In the qualitative phase, the inductive content analysis approach of Graneheim and Lundman was used to analyze the interviews.

Results: In this study, 213 faculty members of dental schools of Iran participated; among whom 100 were men (46.9%) and 133 were women (53.1%). The results indicated the mean scores of the perspectives of faculty members regarding the opportunities and threats of e-learning in dentistry (4.05 ± 0.49 out of 5). Experiences of the participants in the qualitative phase were explored in the theme of “ups and downs of e-learning in dentistry” with three categories “unaccountability of e-learning in dental education,” “challenges of human resource empowerment in the e-learning process,” and “planned education.”

Conclusion: The majority of the faculty members agreed with the use of e-learning in dental education and considered it as an opportunity. However, educational design for blended learning, creation of appropriate infrastructures, and empowerment of human resources as e-teacher and e-student were emphasized as key requirements for e-learning development in dental schools.

Key Words: Coronavirus disease-19, dental education, dentistry, e-learning, experience, mixed-method, perceptions, qualitative

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INTRODUCTION

E-learning is introduced as a new method of education, with electronically supported learning and teaching

process by a variety of instructional approaches such as online learning, mobile learning, blended learning,

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computer-assisted instruction, distance learning, e-teaching, simulation-based learning, and virtual learning.^[1-4] To implement e-learning, universities need the equipment and infrastructure such as a proper Internet network, the necessary software, and hardware. In addition, organizational factors are necessary to implement indicators such as planning, information, monitoring, and evaluation.^[5] This type of training requires technical skills in using electronic tools and understanding of electronic space and its functions.^[6] The benefits of e-learning include learning at any time and place, sufficient opportunity to study, facilitation of educational processes, the possibility of reviewing the educational programs, and student-centeredness.^[1,6,7] However, less control over training, inflexibility, and difficulty of implementation in relation to clinical education (including preclinical and clinical dental education) are among the drawbacks and limitations of e-learning.^[1]

Recently, the outbreak of the coronavirus disease-19 (COVID-19) over the entire world led the educational systems to move toward e-learning and virtual learning.^[8-13] Since the education system of medical sciences, especially dentistry, is among the high-risk occupations associated with COVID-19, due to direct contact with the patient, concerns about the rapid spread of the disease were important changes for schools of medical sciences worldwide.^[14,15] At the beginning of this epidemic, face-to-face medical educations were prorogated to reduce the spread of the disease and replace with e-learning.^[16,17] In the meantime, e-learning in this era has faced problems and challenges for the world's medical universities, especially in developing countries. Iyer *et al.*, in their study, discussed the impact of COVID-19 on dental education in the United States (US).^[18] Deery reviewed the impacts of COVID-19 on the provision of dental education in the 67 dental schools in the US. The results of the study showed protecting the health of students, faculty, and staff; ensuring of dental education quality; ensuring confidence in health and safety measures.^[9] Sarwar's study has been shown that in Pakistan, the level of satisfaction of dental students with the effectiveness of e-learning was significantly low due to the poor interaction of the teacher with the student.^[19] Similar situations have been reported in the medical sciences of Jordan and the Philippines regarding the satisfaction of e-learning, and the status of technology infrastructure, interaction with students, and the acquisition of

clinical skills.^[20,21] Yu-Fong Chang *et al.* showed the learning effectiveness of online class learning and physical classroom examination was better than that of traditional learning and examination in viewpoints of dental education. The study was recommended dental schools must improve their infrastructures and capabilities of human resources for the conduction of online courses to respond to the COVID-19 pandemic and the next crisis.^[22] Cheng *et al.* showed that dental students were more worried about coronavirus disturbing their learning, improving financial pressure for their school, and being infected with Coronavirus and were more worried about the virus would continue.^[8] Undoubtedly, comprehensive study and obtaining sufficient evidence in relation to the threats and opportunities in the educational method to achieve effective education is inevitable. Therefore, the present study was conducted to investigate the opportunities and threats of e-learning in dental education and to explore the experiences of dental faculty members in the COVID-19 epidemic condition.

MATERIALS AND METHODS

The present study was a sequential exploratory mixed method (quantitative-qualitative). In the quantitative phase, a survey study was conducted to investigate the perspectives of faculty members four Iran, regarding the pros and cons of e-learning during the COVID-19 epidemic. A qualitative study with inductive content analysis approach was used due to the background knowledge about the phenomenon under study being insufficient and there is scattered knowledge about it.^[23]

The study population comprised faculty members of four dental schools at Iran ($n = 356$). In the quantitative phase, the sample size was determined as 193 members of the dental based on the following formula: $Z^2 = 1.96$, $d^2 = 0.45$ and $\epsilon 10$, and with a 10% increase, the sample size was 212. The inclusion criterion into the quantitative phase was defined by faculty members of dentistry schools who have experience of teaching (undergraduate programs) in didactic/preclinical/clinical teaching through e-learning (either synchronous or asynchronous) (at least 3 sessions). The faculty members who had no e-learning experience or <3 months of face-to-face learning experience were excluded from the study. As well as, incomplete questionnaires were excluded from the study (exclusion criteria). Participants who

met the inclusion criteria were entered by stratified random sampling. Data collection continued until the completed questionnaires reached the number of samples.

Our criteria for inclusion of participants in the qualitative phase were (a) faculty members with teaching experiences in different settings of dental education and who were familiar with the educational approaches in dental education and (b) having prior experience in implementing e-learning education before the epidemic, (c) providing didactic/preclinical/clinical teaching through e-learning. Participants were selected by a maximum variation sampling strategy. In the phase, participants who achieved the lowest and highest score in the first phase participated in the qualitative phase. ($n = 16$).

Data collection

In the quantitative phase, data were collected using a questionnaire in three main sections. The first part, entitled Demographic Information, consisted of 10 items, and the second part included a questionnaire on e-learning threats and opportunities with 28 items in three categories. This questionnaire was designed by Khoshrang *et al.*^[24] (Cronbach's alpha = 0.81). In the third part, items related to the experience of using e-learning education in the dental school about various factors such as feasibility (applicability of e-learning in various departments of dental education and applicability of different resources in dental education) personal and system factors were asked. The validity and reproducibility of the related items in the third part were confirmed in the present study (Cronbach's alpha of 0.86). The electronic form of questionnaires by Porsline survey system was developed and sent through E-mail and social networks to the faculty members of dental schools. In addition, sending a reminder message was done two times to complete the number of samples.

In the qualitative phase, data were collected through individual semi-structured interviews. The semi-structured interview includes a blend of closed- and open-ended questions, often complemented by follow-up of why or how questions.^[25] All of the interviews were performed by a trained interviewer (F.K). The time of interviews was arranged with the participants prior to the interview. Due to the epidemic of COVID-19, the data collection was conducted through face-to-face ($n = 6$) and telephone interviews ($n = 10$). Before the

interview, the researchers clarified the benefits of this study, in such a way that the purpose of the research, the interview method, and the right of individuals to participate in the study were explained to the participants. They were assured of the recording of the interviews and the confidentiality of the information and then their informed consent was obtained. During the data collection, all interviews were recorded. According to the interview guide, and to increase participants' credibility and confidence, all interviews began with the key question "Tell us about your e-learning experience" and "what steps you took in the e-learning process." The probing questions were asked for additional clarification of the participants' experiences. In the qualitative phase, data collection continued until no new code was explored (saturation of data). Each interview lasted 45–70 min.

Data analysis

In the quantitative phase, the data were analyzed by descriptive indicators (frequency percentage, mean, and standard deviation) and the normal distribution of the data was checked by the Kolmogorov–Smirnov test. Student's *t*-test was used to compare the mean scores of participants' perspectives and the variables, which were defined in two groups such as gender, prior experiences of e-learning, experience in e-content production, and empowerment workshop. As well as, analysis of variance (ANOVA) was used to compare the scores of participants and variables with more than two groups such as age groups, dental specialty, academic rank.

In the qualitative phase, the inductive content analysis approach of Graneheim and Lundman was used to analyze the interviews.^[26]

Based on the informed consent of the participants, all of the recorded interviews were transcribed word to word. The interviews were listened to several times and rechecked, reviewed the transcripts repeatedly to reach immersion in the data and make a sense of the data (the transcript of interviews lasted about 1600 min). Then, to extract the codes, significant short words and sentences were identified (meaning units) and codes were explored by taking notes in the margins of the transcription. The codes were then merged and placed in categories based on semantic similarity. After organizing based on the relationship between them, the theme was formed. In sum, based on the inductive content analysis approach, open coding started from specific codes and by combining

them, more general and abstract expressions emerged as themes. In the present study, the qualitative analysis process was conducted through two people who qualified in qualitative methods and was supervised by an expert. In cases of disagreement over the coding, the analysis team members would discuss the codes until a consensus was achieved.

In this study, the trustworthiness of the data was confirmed by using semi-structured interviews, field notes, and lengthy engagement. The analyzing process and findings was reviewed by the research team (peer check). The extracted codes were reviewed by six participants (member check). In addition, the process of data analysis and code classification was thoroughly reviewed by two experts who had experience in the field of inductive content analysis (expert check). Moreover, the interviews were conducted in a specific and continuous period with full focus on the subject. All stages of the research, especially the stages of data analysis in all directions, were documented in detail. To facilitate the transferability of the findings, a clear description of the participants' characteristics was provided.

Ethical considerations

This study was reviewed and approved by the Ethics Committee at Shahid Sadoughi University of Medical Sciences (ID: IR.SSU.REC.1399.032).

RESULTS

In this study, 213 faculty members of dental schools in Iran country context participated, among whom 100 were male (46.9%) and 113 were female (53.1%). The participants have been involved in four universities including I ($n = 58$), II ($n=53$), III ($n = 46$), and IV ($n = 56$).

A Kolmogorov–Smirnov test indicates that the scores of participants' perspectives concerning the e-learning opportunities and threats follow a normal distribution, $D(213) = 0.65$, $P = 0.79$. Demographic information of the participants is reported in Table 1.

50 (23.5%) of the participants had experience in electronic content production before the onset of the COVID-19 epidemic, and 98 (46%) had previously participated in e-learning empowerment workshops.

The present results showed that the scores of the perspective of faculty members of dental schools regarding the e-learning opportunities and threats in dentistry were 4.05 ± 0.49 . The scores of the

Table 1: Demographic information of the participants

Variable	Frequency (%)
Age	
>30	11 (5.2)
30-34.99	56 (26.3)
35-39.99	54 (25.4)
40-44.99	32 (15.0)
45-49.99	16 (7.5)
50-54.99	26 (12.2)
55-59.99	12 (5.6)
<60	6 (2.8)
Total	213 (100.0)
Gender	
Male	100 (46.9)
Female	113 (53.1)
Total	213 (100.0)
Academic degree	
Professor	14 (6.6)
Associate professor	40 (18.8)
Assistant professor	144 (67.6)
Instructor	15 (7.0)
Total	213 (100.0)
Teaching experience	
>2	42 (19.7)
2-4.99	41 (19.2)
5-9.99	62 (29.1)
10-14.99	23 (10.8)
15-19.99	18 (8.5)
20-24.99	10 (4.7)
<25	17 (8.0)
Total	213 (100.0)
Specialty	
Dental public health	16 (7.5)
Pediatric dentistry	14 (6.6)
Orthodontics	17 (8.0)
Radiology	14 (6.6)
Maxillofacial surgery	14 (6.6)
Prosthodontics	26 (12.2)
Oral medicine	22 (10.3)
Pathology	30 (14.1)
Endodontics	22 (10.3)
Restorative dentistry	18 (8.5)
Periodontics	19 (8.9)
Dental material	1 (0.5)
Total	213 (100.0)

perspective of faculty members were reported in domains; cost-effectiveness 4.15 (0.48), subjective factors 3.87 (0.41), teaching factors 4.15 (0.44), threat factors 4.05 (0.33).

The frequency of the participants' viewpoints for items is shown in Table 2. The results showed that the demographic characteristics of the participants did not differ significantly in their perspective ($P > 0.05$).

Table 2: Frequency of participants' perspective on opportunities and threats of e-learning in dental education

Items	Completely agree	Agree	Moderately	Disagree	Completely disagree
Electronic learning is economically appropriate	99 (46.5)	86 (40.4)	22 (10.3)	5 (2.3)	1 (0.5)
No physical space is required for the student	65 (30.5)	73 (34.3)	16 (7.5)	40 (18.8)	19 (8.9)
Due to the large number of learners compared to the teacher, this method is advantageous	58 (27.2)	87 (40.8)	20 (9.4)	37 (17.4)	11 (5.2)
The facilities required for students in the faculty, dormitories (internet, computer, etc.) should be provided	164 (77)	37 (17.4)	7 (3.3)	5 (2.3)	0
The opportunity to learn and continue education is provided for the employed	93 (43.7)	68 (31.9)	24 (11.3)	16 (7.5)	12 (5.6)
The existence of mobile phones and permanent access to the internet make electronic learning effective	103 (48.4)	84 (39.4)	11 (5.2)	12 (5.6)	3 (1.4)
The availability of internet resources increases the effect of e-learning	108 (50.7)	79 (37.1)	12 (5.6)	12 (5.6)	2 (0.9)
In simultaneous presentation of the content, the disconnection of sound and video reduces the effectiveness of education	118 (55.4)	77 (36.2)	8 (3.8)	8 (3.8)	2 (0.9)
It is possible to access the system and solve problems by people other than students and therefore cheating can happen	93 (43.7)	90 (42.3)	18 (8.5)	10 (4.7)	2 (0.9)
There is a learning opportunity for discontinuous programs	73 (34.3)	86 (40.4)	47 (22.1)	3 (1.4)	4 (1.9)
The necessary culturalization should take place for the concepts of e-learning for professors and students in universities	159 (74.6)	47 (22.1)	5 (2.3)	1 (0.5)	1 (0.5)
Teaching how to work with the system as an IT course is necessary for students	122 (57.3)	57 (26.8)	22 (10.3)	11 (5.2)	1 (0.5)
It is mandatory for professors to hold an introduction to the electronic learning system	140 (65.7)	52 (24.4)	12 (5.6)	9 (4.2)	00
In e-learning, emotional factors and emotion transmission are not considered	74 (34.7)	94 (44.1)	18 (8.5)	20 (9.4)	7 (3.3)
Fear of technology causes resistance in professors and students	40 (18.8)	87 (40.8)	36 (16.9)	39 (18.3)	11 (5.2)
In e-learning, when presenting materials, the efficiency of professors is not reduced due to fatigue	52 (24.4)	73 (34.3)	32 (15)	41 (19.2)	15 (7)
In e-learning, the effect of teacher's personality and communication skills on students is low	83 (39)	89 (41.8)	12 (5.6)	24 (11.3)	5 (2.3)
In electronic learning, learners interact with each other more	6 (2.8)	42 (19.7)	44 (20.7)	77 (36.2)	44 (20.7)
In e-learning, it is more difficult for the teacher to control learners	81 (38)	85 (39.9)	22 (10.3)	17 (8)	8 (3.8)
In e-learning, content production is more difficult for professors	78 (36.6)	64 (30)	18 (8.5)	35 (16.4)	18 (8.5)
A blending of traditional and electronic education is more effective	121 (56.8)	66 (31)	16 (7.5)	10 (4.7)	0
It is possible to teach famous and experienced professors from other universities electronically	150 (70.4)	56 (26.3)	4 (1.9)	3 (1.4)	0
Lesson files are made available to all learners via the Internet	132 (62)	70 (32.9)	7 (3.3)	4 (1.9)	0
It is possible to review educational content several times in electronic method	166 (77.9)	43 (20.2)	2 (0.9)	2 (0.9)	0
The variety of teaching methods in e-learning is higher than the traditional method	67 (31.5)	68 (31.9)	38 (17.8)	29 (13.6)	11 (5.2)
It is possible to review and change the responses sent to exercises with this method	79 (37.1)	81 (38)	43 (20.2)	8 (3.8)	2 (0.9)
Teaching electronically solves the problem of teacher-centeredness of the classroom	22 (10.3)	52 (24.4)	44 (20.7)	57 (26.8)	38 (17.8)
Learning skills is poor through electronic method especially in dental education	121 (56.8)	58 (27.2)	16 (7.5)	15 (7)	3 (1.4)

The results of ANOVA test showed that there was no significant difference between scores of dental faculty members' perspective on the opportunities and threats of e-learning and age groups ($P = 0.25$), dental specialty ($P = 0.46$), professors' academic rank ($P = 0.63$). In addition, the results of Student *t*-test showed that there was no significant difference between faculty members' perspective and gender ($P = 0.33$), prior teaching experience of e-learning ($P = 0.43$), experience in

e-content production ($P = 0.85$), and experience of empowerment workshop ($P = 0.17$).

The majority of participants believed that oral pathology, oral and dental diseases, social dentistry and dental health, dental materials, and oral and maxillofacial radiology are better in terms of implementing e-learning than other disciplines and can provide more of their training virtually and electronically [Table 3].

In this study, feasibility by means of the applicability of e-learning in various departments of dental education was assessed from the viewpoints of participants [Figure 1].

Figure 2 shows the participants' perspective on the feasibility of different resources in dental education compared to the applied educational resources in dental schools during the coronavirus epidemic.

Qualitative phase

The experiences of the participants in the qualitative phase were explained under the theme of "ups and downs of e-learning in dentistry." The theme included three categories: "Unaccountability of e-learning in dental education," "Challenges of human resource empowerment in the e-learning process," and "Planned education" [Appendix 1].

Unaccountability of e-learning in dental education

The "Unaccountability of e-learning in dentistry" category addressed the drawback of e-learning in dental education. They believed that e-learning in cognitive and theoretical courses could be used as a complementary tool to develop students' knowledge and diagnostic and reasoning skills, but it was not effective in teaching practical skills. Patient communication skills and practical skills are requirements that cannot be achieved except in real environments. The participants believed that

e-learning in dental programs alone could not be sufficient in dental education. In this regard, one of the participants of dentistry said: (Associate Professor, 46 years old, man):

"In dentistry, we cannot just rely on e-learning. A student needs to see in practice to understand in the dentistry school. We can reduce the attendance time of students, but it must be face-to-face education in the clinical part."

From the participants' perspective, in addition to the lack of interaction, the lack of appropriate evaluation

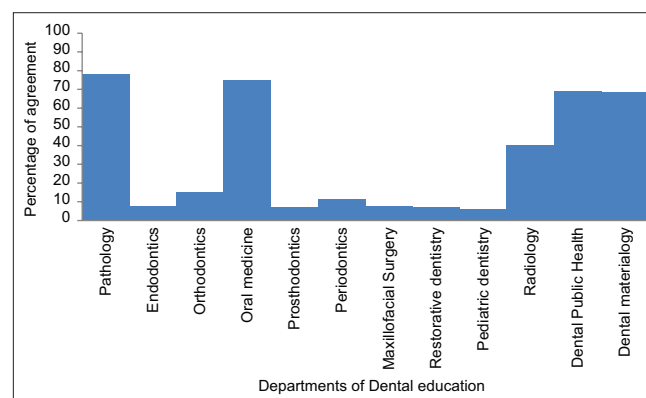


Figure 1: Percentage of participants' agreement about feasibility of e-learning in different dental departments in viewpoints of dental faculty members during the coronavirus epidemic.

Table 3: Faculty members' perspective on e-learning in dental schools

Items	Completely agree	Agree	Moderately	Disagree	Completely disagree
Considering the current situation regarding the number of students and facilities and educational patients, adding e-learning in dental education is necessary	85 (39.90)	88 (41.30)	17 (8.00)	15 (7.00)	8 (3.80)
E-learning can provide scientific communication with leading faculties in the country and the world	127 (59.60)	70 (32.90)	11 (5.20)	2 (0.90)	3 (1.40)
Holding theoretical classes electronically and allocating the relevant time to practical training is one of the important advantages of e-learning in the present situation	114 (53.50)	59 (27.7)	22 (10.3)	13 (6.10)	5 (2.30)
Considering the experiences of current conditions, after the end of the epidemic and returning to normal conditions, to improve dental education in the country, e-learning is essential in combination with traditional methods	105 (49.30)	70 (32.90)	15 (7.00)	18 (8.50)	5 (2.30)
Internet network and bandwidth restrictions	52 (24.40)	41 (19.20)	76 (35.70)	30 (14.10)	14 (6.60)
Hardware restrictions including the lack of enough computers	54 (25.40)	49 (23.00)	53 (24.90)	37 (17.40)	20 (9.40)
Lack of motivation in faculty members for e-teaching	27 (12.70)	48 (22.50)	79 (37.10)	42 (19.70)	17 (8.00)
Lack of motivation in students for e-learning	32 (15.00)	44 (20.70)	79 (37.10)	41 (19.20)	17 (8.00)
Weakness of necessary technical capabilities in faculty members	17 (8.00)	48 (22.50)	83 (39.00)	51 (23.90)	14 (6.60)
Shortage of experienced IT personnel in the faculty	51 (23.90)	58 (27.20)	63 (29.60)	29 (13.60)	12 (5.60)
Shortage or lack of positive perspective on the subject and sufficient support from university support authorities	23 (10.80)	31 (14.60)	67 (31.50)	50 (23.50)	42 (19.70)
Shortage or lack of positive attitude toward the subject by faculty officials	16 (7.50)	17 (8.00)	56 (26.30)	51 (23.90)	73 (34.30)
Lack of suitable space in faculty for e-learning activities of professors	51 (23.90)	66 (31.00)	44 (20.70)	29 (13.60)	23 (10.80)
Dissatisfaction with the publication of educational content on the web without respecting its intellectual rights by others	60 (28.20)	50 (23.50)	51 (23.90)	27 (12.70)	25 (11.70)

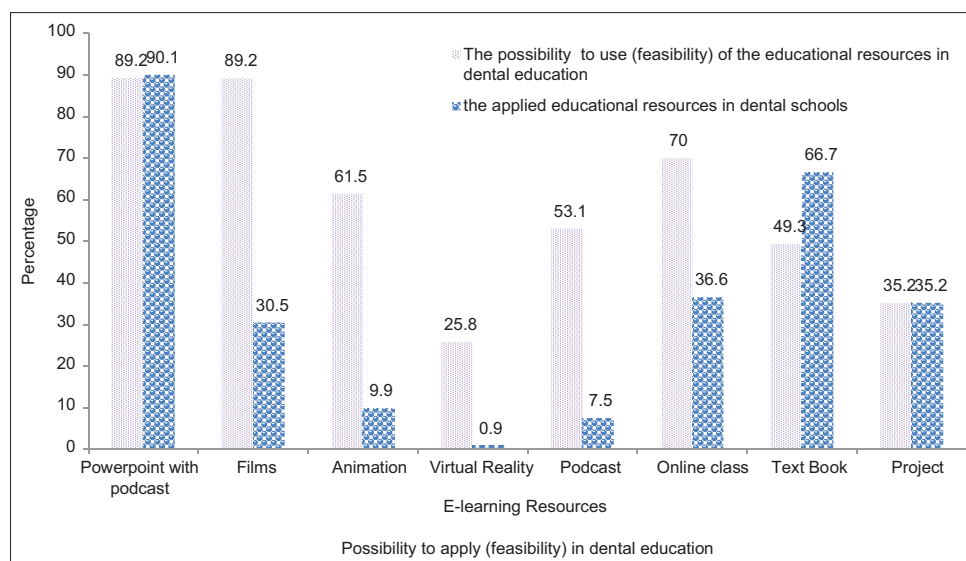


Figure 2: Comparison of participants' perspective regarding the feasibility of different resources in dental education verses the applied educational resources in dental schools during the coronavirus epidemic.

and control over students is one of the challenges of e-learning. One of the participants stated: (associate professor, Female – 39 years old).

“When a student comes to class, he/she is a little worried about being asked by the teacher, but he/she does not have this concern in e-learning. Maybe this goes back to evaluation. Yes, it should be an assignment and evaluation, although the student may copy the assignment from another student, but it should be solving in e-learning.”

In another subcategory related to problems of the educational system, factors such as lack of educational planning in e-learning courses, lack of clear educational rules in e-learning, and problems related to e-learning infrastructure were discussed.

Regarding the educational system, one of the participants said: (Female, associate Professor –46 years old).

“I think there is a weakness in the legislative part of e-learning and the regulations were vague. Another argument was that a series of systemic norms had been created that prevented them from taking virtual education too seriously, and this affected others.”

Challenges of human resource empowerment in the e-learning process

The second category, entitled challenges of human resources in the e-learning process, deals with the problems related to people involved in the educational process, including teachers and students.

In this category, students' problems such as inability to master e-learning skills, lack of commitment to educational regulations, lack of participation in the e-learning process, and lack of motivation were discussed. In this regard, one of the teachers said (Professor, 64 years old):

“Students did not have abilities such as self-study. They preferred to eat a prepared morsel as I call it. During class, it obliged students to read. The students were face to face and were required to study, but in e-learning, students did not have to study and that was a weakness.”

Another participant considered the lack of knowledge of students as one of the problems of inefficient e-learning: (Male – 38 years old, associate professor):

“I think the students themselves are confused about this e-learning.”

In the next subcategory, lack of motivation among students is explained as an important factor in the inefficiency of e-learning. In this regard, one of the participants stated: (Female – 36 years old, associate professor):

“Students get online in an online class, but only the laptop is on, but they are not present.”

“It seemed that this COVID-19 period was a holiday to students and they had no motivation and even I had to follow them. When I asked the students, they said it was not clear what would happen and I told them that whatever happens during Corona, you have to do

your homework so use holidays but students were not active.”

In this category, teachers’ resistance to the use of e-learning, lack of previous experience, lack of ability to design and implement e-learning in the past were explained as challenges of teachers in the e-learning process.

In relation to the resistance of teachers for various reasons such as unfamiliarity with the e-learning environment and lack of experience and belief in ineffective e-learning was raised. In this regard, one of the participants stated: (Assistant Professor – 35-year-old woman).

“There was definite resistance among the faculty members, they did not like it very much, and they were very worried, they were very afraid that they would not be successful in e-learning compared to routine class. They did not have the satisfaction they had to prefer face-to-face training than in e-learning.”

Another teacher stated (38-years old, female, associate professor).

“Lack of commitment, perhaps discouragement, ineffective training and lack of motivation make them reluctant to cooperate and resist in some way.”

Regarding the lack of familiarity with the technologies and tools of e-learning, one of the teacher said: (Female, Associate Professor – 40 years old).

“They thought that they were going to do extra work that made them escape. I think lack of knowledge or avoidance of technology was prevalent among faculty members.”

Planned education

In the third category, entitled “Planned Learning,” participants’ experiences were explained in relation to the key factors of effective e-learning. In a subcategory, participants considered educational design and proportion among the successful components of the e-learning process. They believed that the appropriateness of the type of tools used with the purpose and educational content, the use of a blended approach tailored to the purpose of education and educational design to provide e-courses were among the success factors in the e-learning process. In this regard, a teacher stated: (Associate Professor– 47 years old man).

“It is better to write a lesson plan for each session so that we know what was discussed and said in each

session, and it is better to put it in the LMS system in the lesson introduction section, lesson plan and each session plan so that the student gets aware of it.”

Regarding the use of tools proportionate to the purpose and educational content, one of the teachers said: (Assistant Professor – 39 years old female).

“Depending on the lesson conditions, we chose the tool. Sometimes it is possible to use only the audio file and it is enough, but sometimes we need to use other tools such as animation, film and someone else.”

In the process of e-learning, the use of interactive classroom techniques, conducting analytical discussions and simulations in the context of e-learning were explained as effective factors.

“One of the issues is the student’s motivation. If the lesson is interesting and the teacher is masterful and explains attractively, the student will also be motivated, and this goes back to the teacher’s experience and expression, and the teacher’s teaching should not be artificial and memorized” (Male professor – 65 years old).

“I think scenario writing, assignments, and reasoning questions helped, and I think these scenarios can help the student to improve analytical and reasoning skills” (Female associate professor – 48 years old).

DISCUSSION

The present results showed that the status of e-learning for dentistry from the participants’ viewpoint is considered as an opportunity. Creating the necessary infrastructure and empowering faculty members about e-learning and blended learning methods^[27] can be a valuable opportunity in dental education.

The results showed that the use of e-learning in dentistry was considered as an opportunity due to the low economic burden, greater access, and lack of space and time constraints for learning. However, the e-learning infrastructure such as the internet and access to e-tools influence the lack of supply was a threat in this process. In this regard, the qualitative results showed the limitations of e-learning infrastructure; the weakness of e-learning in clinical dental education is major challenge. These increase the need for proper blending of face-to-face and e-learning. Participants believed that e-learning was not appropriate for all dental education courses. Deficiency of e-learning in clinical education,

insufficient infrastructure, limitations of observation, and interaction with real patients in e-learning is some of key barriers that have been a serious threat to e-learning in dentistry. Participants stated that the limitation of creating an interactive triangle in the educational process among teacher-student-patient, as well as, in appropriate educational design, weakness in teaching skills, learner assessment, and evaluation is explored as e-learning challenges. The results of various studies showed e-learning as an effective method to support traditional education but were not acceptable as an alternative.^[28,29] The usefulness of e-learning depends on the educational objectives at the desired knowledge or skill levels. For example, diagnosis skills using online education provide better learning opportunities and automatic feedback.^[3] The effectiveness of e-learning in psychomotor objectives needs further investigation.^[3,28,29] Participants in the study found the use of e-learning to be more effective in specialized areas including pathology and oral and maxillofacial diseases, oral health and dental materials, and oral and maxillofacial radiology. In line with our results, Botelho *et al.* showed that using e-learning is introduced an effective method for learning of visual diagnosis skills.^[3] It seems that the topics in the sections are mainly based on the cognitive domain, and e-learning can provide a good opportunity to develop diagnostic and decision-making skills among learners. Regarding the tools used, the quantitative results showed that more than 50% of the participating faculty members agreed with the use of PowerPoint, instructional videos, animations, texts, and online classes in dental education. The use of PowerPoint and texts were more common in dental schools, the use of online classrooms, instructional videos, and projects was second level. Despite the importance of the use of a problem-solving approach to develop high levels of cognition, teachers mostly used noninteractive tools that focus on providing knowledge. This can be due to limited facilities, lack of familiarity with e-learning technologies, and virtual reality in dentistry. Given, dentists are expected to have good capabilities in a high level of cognition for patient diagnosis and management, the use of interactive tools based on problem-solving and simulation is recommended.^[30]

The category of affective and communication factors addressed teacher-student, learners' interaction with each other and with the teacher. The present results showed reducing the relationship between teacher and

student, reducing student monitoring, and diminishing role models were identified as a threat in viewpoints' of dental teachers that are consistent with qualitative findings. Participants stated that the human resources involved in providing e-learning services did not acquire basic skills and competencies. E-learning faced challenges such as teachers' resistance to using new approaches and educational technologies due to lack of basic competencies and demotivation due to lack of belief in the effectiveness of this type of education in dental schools. Participants cited a lack of understanding of the need for e-learning before the outbreak of the COVID-19 virus and a lack of compulsion to use e-learning in schools as one of the reasons they were unprepared to use e-learning during the COVID-19 era. They argued that although supportive activities had previously been taken in the universities of medical sciences to use a blended and electronic approach, due to the lack of understanding of the need at management levels and faculty members, empowerment programs and moving toward using this approach was slow and was not prepared them for using e-learning during the Corona era. Likewise, Chavarría-Bolaños *et al.* showed teachers need to empower the application of virtual strategies and technology in e-learning.^[4] Bjekic D *et al.* in their study stated that empowering teachers in the e-learning process have an important role in the success of e-learning.^[31] Learners were also a key factor whose capabilities as an e-learning user are important. Participants believed that unfamiliarity with learning management systems, and how to work with educational tools and technologies, weakness in self-directed learning skills were among the threats to e-learning development. In addition, the habit of teacher-centered culture, lack of motivation, and noncompliance with the requirements of learning in the e-learning process explored the threats of e-learning. The lack of a culture of using the e-learning methods, the weakness of development of self-directed learning skills, being a good e-teacher and the use of educational technologies have caused many difficulties in the development of e-learning in the Corona era. The results of the study by Eslaminejad *et al.* have introduced educational and technical factors as two main factors in e-learning education.^[32] Familiarity with the learning management system, and new technologies, the ability to produce electronic content for teaching in the technical preparation of teachers must be considered. In Eslaminejad's study, the readiness of teacher for e-learning was assessed

at a moderate level.^[32] The results of Kim's study showed that teachers' attitudes toward the use of e-learning was not positive and the individual and systemic factors in teachers' resistance require further study.^[33] Organizational support increased awareness and empowerment of faculty members on how to integrate e-learning into curricula are recommended.^[33] Similarly, systemic problems, lack of e-learning rules aimed at increasing the efficiency of education among teachers and students were explored as threats in the present study. Participants believed that the lack of planning at the managerial and individual levels for e-learning is a key obstacle to the development of efficient e-learning. Therefore, creating rules and support mechanisms at the management level along with empowering people to play the role of e-teacher and e-learner, as well as creating a constructive culture at the various levels of educational systems as solutions for the development of e-learning is suggested.

Participants identified the use of blended education in dentistry as an appropriate opportunity for schools. They identified the use of diverse teaching-learning techniques, the ability to access educational resources, and expertise teachers the possibility of reviewing and learning topics over and over as valuable opportunities in e-learning at dental schools. Lack of problem-solving skills and poor learning skills among learners in virtual situations were explored as e-learning challenges in dentistry. The results of Ali Baig *et al.* study showed that students and teachers mostly used asynchronous blended education in dental school. In this study, the use of e-learning is introduced as an educational supplement to move toward lifelong and self-directed learning based on the competency-based approach.^[34] In the study, Asiry *et al.*, students suggested the blending of traditional education and e-learning as the best option and the provision of internet and computer infrastructure are important to conduct the method. In this study, the acceptability and applicability of e-learning in dentistry from the viewpoint of students were emphasized,^[35] which is consistent with the present results from the viewpoint of teachers.

Limitation

The limited sample size and type of sampling restricts the generalization of results. The lack of response to the questionnaires on time, which continued with repeated reminder calls and messages until the required sample size was completed. In the present study, the

perceptions of faculty members were assessed and the viewpoints of learners in the postgraduates and Ph.D. dental students were not considered. The second part of the present study was conducted by the qualitative method, which can decrease the generalizability of the findings.

CONCLUSION

The results showed the faculty members of the dental schools agreed with the use of e-learning in dental education process and considered it an opportunity. From the viewpoint of dental teachers, the acceptability and usefulness of e-learning in didactic and preclinical courses of dental education are desirable. Instructional design is recommended for the purposeful blending of face-to-face and e-learning, creation of appropriate infrastructures and empowerment of human resources (e-teacher and e-student) which was introduced requirements for the development of e-learning in dental schools.

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Conflicts of interest

The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or nonfinancial in this article.

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Appendix 1: Participants' experiences related to e-learning in dental schools

Subcategory	Category	Theme
Challenges of e-learning	Unaccountability of e-learning in dental education	The ups and downs of e-learning in dentistry
Lack of reliable evaluation		
Lack of interaction in the educational process		
Electronic limitations in clinical education		
Inadequate e-learning platform in dentistry		
Limitation of observation and interaction with the patient in e-learning		
Systemic problems		
Lack of e-learning rules		
Lack of structured evaluation of e-learning process		
Lack of e-learning planning		
Nonparticipation of students	Challenges of human resource empowerment in the e-learning process	
Students' unpreparedness		
Inability of students to learn in the process of e-learning		
Students' lack of motivation		
Resistance of professors	Planned education	
Avoidance of technology		
Lack of belief in the effectiveness of e-learning		
Educational design in e-learning process		
Planning to implement e-learning planning for feedback to learners		
Execution of educational program		
Capable effective teacher in the process of effective e-learning		
Use of interactive techniques in e-learning process		
Growing capabilities of educational technologies		