

INFLUENCE OF COVID-19 PANDEMIC ON DENTAL EDUCATION IN CYPRUS: PRECLINICAL AND CLINICAL IMPLICATIONS WITH E-LEARNING STRATEGIES

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During the COVID-19 pandemic, the necessity of social isolation led education to be distance- and online instead of face-to-face (F2F). Education strategies became more challenging for the educationalists at dentistry faculties, since dental education is based on mostly practical tutorials. All over the world, the faculties tried to develop policies to protect the health of students and academic staff, as well as to ensure the continuity and quality of education. In our faculty (Near East University Faculty of Dentistry), online education was held for the spring semester with the aid of distance learning and the information technology centre of the university. In this study, it was aimed to examine the background of the virus, the proactive measures in the dental setting to combat COVID-19 outburst, and information technology-based educational measures adopted in Cyprus to ensure the continuation of dental education. The strategies used for online education in our faculty, the difficulties that were encountered, and future recommendations for e-learning were declared. Moreover, students' perception and satisfaction regarding online education model both for theoretical (120 students, response rate 78%) and practical lectures (220 students, response rate 82%) were investigated. With this regard, students were asked to answer reflective questions. Descriptive data were presented. A considerable number of the students stated that practical implementations should have been conducted F2F. Most of the students emphasised that online theoretical courses are more advantageous than F2F ones.

Keywords: blended education; dentistry; distance learning; e-learning; face-to-face education; online education.

Introduction

In early December 2019, the novel coronavirus emerged in Wuhan, Hubei Province of China, in patients presenting pneumonia of unknown origin (Izzetti et al., 2020; Barabari & Moharamzadeh, 2020). The cases were epidemiologically linked to seafood and the wet animal wholesale market (Odeh et al., 2020). Through human transmission, the virus has been spread out of Hubei and later to the rest of the world becoming a global threat (Bennardo et al., 2020; Barabari & Moharamzadeh, 2020). Day by day, globally devastating numbers of new cases were reported, and the WHO declared coronavirus disease as a pandemic (Izzetti et al., 2020). As of the 1st of September, COVID-19 has been recognised in more than 215 countries, with a total of over 25 million laboratory-confirmed cases and more than 844,000 deaths (WHO, 2020).

Background of the Virus

By January 7, 2020, Chinese scientists have isolated this virus from patients in Wuhan (Wang et al., 2020). The pathogen has been identified as a novel enveloped RNA beta-coronavirus genus 2b lineage (Odeh et al., 2020). It has firstly been designated as 2019-nCoV (Izzetti et al., 2020); then officially named as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) by the International Committee on Taxonomy of Viruses and as coronavirus disease (COVID-19) by World Health Organization (WHO). Coronaviruses are prone to mutation and recombination (Barabari & Moharamzadeh 2020). This viral disease has an estimated incubation period of 1-14 days (Izzetti et al., 2020). The transmission route of COVID-19 to humans was reported to be via airborne droplets, blood-borne droplets, saliva, body secretions, touching, hand-shaking, close contact with an infected person as well as virus-contaminated surfaces (Izzetti et al., 2020; Barabari & Moharamzadeh, 2020). Dominant signs are fever, dry cough, fatigue, breathing difficulties (Barabari & Moharamzadeh, 2020; Bennardo et al., 2020; Guan et al., 2020; Izzetti et al., 2020; Odeh et al., 2020; Özverel & Kurtulmus-Yilmaz, 2020). However, it was reported that virus spread can happen in the absence of clinical symptoms (Barabari & Moharamzadeh, 2020; Izzetti et al., 2020) and these cases are named as either super-spreaders or carriers (Odeh et al., 2020; Wang et al., 2020).

Normal in Dental Education

The education in Near East University Faculty of Dentistry is formal and five years. It is conducted both in Turkish and English languages as two separate programmes including not only national but also international students from European, Middle Eastern, and African countries. As the ability to integrate scientific knowledge obtained from various disciplines is crucial to ensure accomplishment in clinical decision-making (Plasschaert, 2006; Snyman & Kroon, 2005); a horizontally-integrated education system is conducted for 2 years in our faculty (Figure 1).

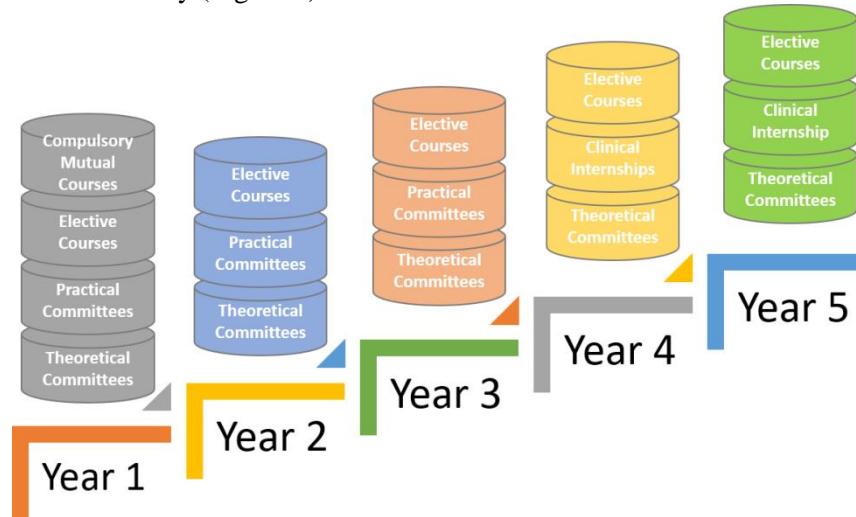


Figure 1. Horizontally-integrated education system

(Theoretical committees [TC] include courses of basic medical and clinical sciences; practical committees [PC] include pre-clinical laboratory courses of different disciplines and are conducted to enhance the manipulations of the students; TC and PC have to be held as face-to-face education; compulsory mutual courses and elective courses can be held as either face-to-face or distance education)

Summative exams are held at the end of each theoretical committee and students are requested to study certain modules. In practical committees, students submit assignments throughout the year, receive grades weekly, and thereby, both educationalists and students can observe the improvement in manipulation and ability to synthesise theoretical knowledge with practices. A multidisciplinary practical final exam is held at the end of the academic year and students are asked to perform an intended practical work in a limited time at the preclinic and simulation laboratories in order to monitor the practical status of the student (Figure 2).

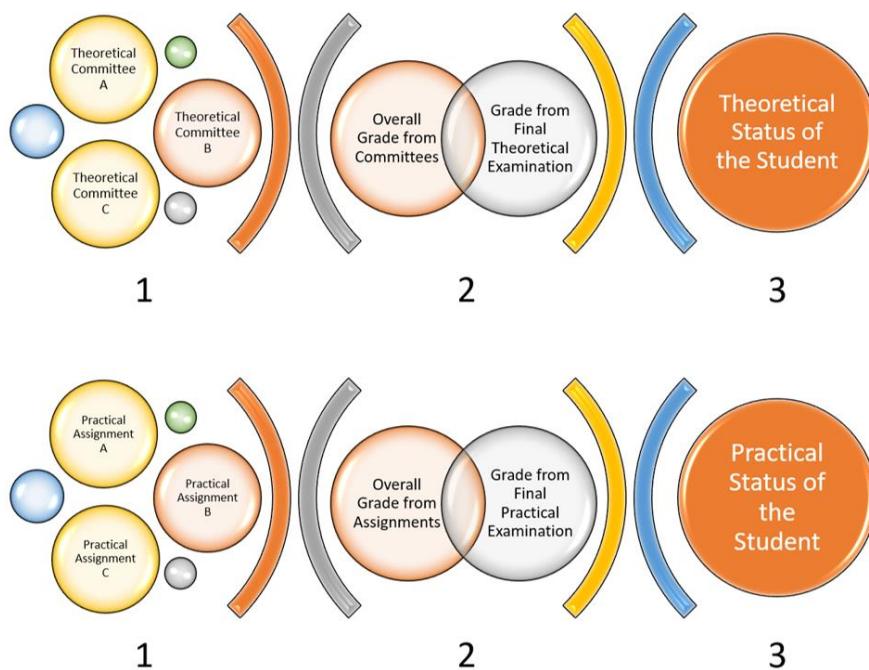


Figure 2. Determination of theoretical and practical status of the student

New Normal in Dental Education and E-learning Strategies

Since March 10, all schools and universities suspended education to minimise the spread of coronavirus (Barabari & Moharamzadeh, 2020; Deery, 2020; Prati et al., 2020). In line with the measures around the world, the following measures were taken within our Faculty: (i) Undergraduate and post-graduate students were banned from coming to the dental school and hospital, (ii) Clinics were closed as this virus can easily spread person-to-person through aerosols and contact with oral mucous membranes, and remained available only for dental emergencies, (iii) Traditional teaching methods such as F2F courses, presentations, practical implementations, and seminars have shifted to a completely online (non-face-to-face [NF2F]) dental curriculum (Bennardo et al., 2020; Odeh et al., 2020; Wu et al., 2020). Supportively, the University and the Council of Higher Education announced that all courses will be held online during the spring semester and students will not be allowed to attend F2F courses or examinations.

As of March 16, our university started asynchronous and synchronous online education on its own distance learning and information technology centre (UZEBIM, www.uzem.neu.edu.tr). In the asynchronous approach, all course materials including narrative video and resources were weekly uploaded to the UZEBIM. Theoretical courses were conducted asynchronously throughout March. Synchronised online education started at the beginning of April and the online courses in this approach were interactively performed on either Google Meet or Big-Blue-Button platforms at home-made studios under quarantine exactly on the day and time that should be done in the academic calendar. Course materials including recorded interactive video, burning questions video, and resources were daily uploaded to the UZEBIM.

The strain will be most felt by current third-year students as the third class is considered as a threshold to be prepared for clinical internships and by fifth-year students as they have clinical requirements to complete before they can be deemed “ready for graduation”. Initially, for compensating all missed practical courses that will be held during the spring term, a condensed practical schedule (starting in early June and lasting until mid-July) was prepared. However, the prolonged pandemic caused this programme to lose its applicability. Subsequently, it was decided to conduct live practical courses in the same manner with online theoretical courses with the aid of the Google Meet platform. These live practices were accompanied by the responsible instructors and assistants of the committee. Firstly, the demonstration videos of all practical assignments were uploaded to the UZEBIM. Subsequently, students were allowed to practice and consult the academic staff regarding their manipulations for 3 to 4 weeks. First-year students carved soap and dental wax to learn the anatomy and morphology of permanent dentition. Second- and third-year students used dental models (ANA-4, Frasaco GmbH, Tettnang, Germany) for prosthetic and restorative practical assignments. Second-year students were asked to perform tooth and cavity preparations. On the other hand, third-year students were asked to perform tooth alignment for partial/complete dentures and fillings in addition to the assignments of the second year. Then students were asked to submit their assignments through UZEBIM to the educationalists by acquiring the photographs and/or recording videos of their practical works. The educationalists graded and informed students regarding their assignments through UZEBIM. This approach has been applied in all practical sub-committees except for endodontics since the image quality to be obtained is not sufficient to successfully evaluate endodontic implementations and even if self-solution films are used, there is no beam device to exposure.

Clinical rotations of the 4th- and 5th-year students were another challenge for dental education during the pandemic. A plausible way to compensate for the missed clinical internships of 4th-year students is thought to be recovered in the next academic year. However, 5th-year students would graduate at the end of the spring term. In this sense, the students were asked to carry out case-report presentations, scientific article reading and reviewing, and patient-based assignments as depicted in supplemental file 1. In terms of disciplines, these assignments differed from each other. Students were asked to create their own clinical scenarios and multidisciplinary treatment plans. Questions about clinical perspectives were asked to the students through the cases they created. With this attempt, individual search strategies and analytical ideology of the students were enhanced.

During the COVID-19 pandemic, F2F examinations have become impossible to sustain. Thereby, NF2F formative examinations were done and questions that support analytical thinking and which must be answered by synthesising information were asked. Examinations were conducted over UZEBIM with the aid of quiz activity which enables the lecturer to create exams including various types of questions and deliver immediate feedback about the exam performance of the student. Prior to NF2F committee examinations, an online mini-quiz was held to train both students and educationalists on online examination, receive feedback regarding the adaptation process, and have an idea about its sustainability. The concerns about the security of online exams led the administrative staff of our faculty to develop different methods to eliminate the possibility of cheating. A Google Meet link with grid view extension was created for every 15 students

before the online exam and students were monitored by 2 examiners during the exam on UZEBIM. Precautions were taken when setting exams to prevent cheating and answer-sharing (Lee et al., 2020): (i) the order of the questions was shuffled into a different random order, (ii) only one question was displayed per page, (iii) navigating among questions was not permitted, (iv) students could not turn back the previous pages, and (v) choices of multiple-choice questions were shuffled.

In the current study, it was aimed to evaluate the e-learning strategies used during the pandemic period and information technology-based educational measures adopted in Cyprus to ensure the continuation of dental education. Moreover, attitudes of the dentistry students towards online education during pandemic were evaluated with the aid of a questionnaire-based survey.

Methods

Research Design

This study used the combined research technique: Quantitative data generate objective, conclusive and numerical figures and thereby permit readers to identify the attitude of the dentistry students to the online education model on the basis of the reflective questions; qualitative data allow readers to focus on understanding students' opinions and to interpret the experience on the basis of the open-ended reflective questions. To validate the results of the current research, a questionnaire-based survey focusing on the attitudes of dentistry students towards the online education model was developed in UZEBIM.

Sample

Grade 2 and 3 dentistry students of Near East University ($n=120$ and $n=220$, respectively) who had the chance to study F2F in the previous years and could compare this with online education were included in the study. Grade 1 dentistry students were excluded from the study since they have not received F2F dentistry training before and cannot make comparisons

Instruments and Procedures

Students were, subsequently, asked to answer 9 yes-no type and 2 open-ended reflective questions. Thereby, the feedback regarding the way of education, online courses, provided e-materials, and examinations separately for theoretical and practical courses was received from students. The data were blindly collected from the period of March 2020 to August 2020 and subsequently interpreted.

Data Analysis

Both quantitative and qualitative data from the questionnaire-based survey were collected in a form of SPSS data sheet and statistically analysed providing frequencies and percentages. Descriptive statistics were also used to describe all variables.

Ethical Issue

No personal data (name, surname, student number, age, country) were obtained from the students and participation in the survey was carried out on a voluntary basis. In accordance with the ethical considerations for qualitative research (Traianou, 2014), all students were informed regarding the purposes of this survey and of their right to withdraw from it at any time.

Results

For the practical course (Table 1), 220 students were included in the study. The response rate was 82%. In accordance with the results of the current study, it was detected that 67% of the students found it beneficial to provide lecture materials before the scheduled time. Moreover, 56% of the students stated that the lecturer conducted a synchronised lecture for the relevant week. 84% of the students mentioned that the live lecture was conducted at the time of the course as scheduled on their timetables. The vast majority of students reported that they could ask questions and get answers in live lessons (94%) and that they received feedback/answers to their questions regarding the relevant week's topic (87%). It was also found that 69% of the students re-watched the live lecture record later. 97% of the students stated that they were satisfied that the synchronised courses are also uploaded to the system and that they can be accessed whenever they want. A significant number of students (76%) deemed the computer as of today's most effective education tool. 72% of the students presented the imperative skills to effectively use web-based learning platforms. For open-ended questions, the most common answer(s) were given in Table 1 with descriptive data. A considerable number of the students stated that practical implementations should have been conducted F2F.

Table 1. Reflective questions and descriptive statistics for practical course (n=220, response rate: 82%)

Reflective Questions			
	Yes	No	No Answer
Is providing lecture materials before the scheduled time beneficial?	67%	33%	0%
The lecturer conducted synchronous or asynchronous lecture for this week	56%	44%	0%
The live lecture was conducted at the time of the course as scheduled on our timetables	84%	16%	0%
I was able to ask and answer questions during the live lecture	94%	6%	0%
I was able to receive feedback/answers to my questions about this week's topic	87%	11%	2%
Do you re-watch the live lecture record later?	69%	28%	3%
Is it useful for you to have synchronised lectures available in the system to re-watch later?	97%	3%	0%
The computer is today's most effective education tool	76%	23%	1%
Have you had trouble while orienting and handling the online system	28%	72%	0%
Open-Ended Reflective Questions			
Fill in the blank. <i>If I were the lecturer, I would for this week's topic.</i>	I would do it as the lecturer did. (54%) I would explain it more simply. (12%) In addition to the live lectures, I would do question-answer sessions. (38%)		27%
Do you find it advantageous to take the course online? Why? / Why not?	I do prefer face-to-face practical lectures. Displaying demonstration videos online is more student-friendly. (83%)		11%

For the theoretical course (Table 2), 120 students were included in the study. The response rate was 78%. The results of the current study indicated that 74% of the students found it beneficial to provide lecture materials before the scheduled time. 78% of the students mentioned that the lecturer conducted a synchronised lecture for the relevant week. 87% of the students emphasised that the live lecture was conducted at the time of the course as scheduled on their timetables. 98% of the students reported that they could ask questions and get answers in live lessons (98%) and that they received feedback/answers to their questions regarding the relevant week's topic (92%). It was also found that 86% of the students re-watched the live lecture record later. 99% of the students stated that they were satisfied that the synchronised courses are also uploaded to the system and that they can be accessed whenever they want. 68% of the students deemed the computer as of today's most effective education tool. 79% of the students presented the imperative skills to effectively use web-based learning platforms. For open-ended questions, the most common answer(s) were given in Table 2 with descriptive data. Most of the students emphasised that online theoretical courses are more advantageous than F2F ones.

Table 2. Reflective questions and descriptive statistics for theoretical course (n=120, response rate: 78%)

Reflective Questions			
	Yes	No	No Answer
Is providing lecture materials before the scheduled time beneficial?	74%	26%	0%
The lecturer conducted synchronous or asynchronous lecture for this week	78%	19%	3%
The live lecture was conducted at the time of the course as scheduled on our timetables	87%	13%	0%
I was able to ask and answer questions during the live lecture	98%	0%	2%
I was able to receive feedback/answers to my questions about this week's topic	92%	5%	3%
Do you re-watch the live lecture record later?	86%	7%	7%
Is it useful for you to have synchronised lectures available in the system to re-watch later?	99%	0%	1%
The computer is today's most effective education tool	68%	23%	9%
Have you had trouble while orienting and handling the online system	21%	79%	0%

Open-Ended Reflective Questions		
Fill in the blank. <i>If I were the lecturer, I would for this week's topic.</i>	I would do it as the lecturer did. (54%) I would explain it more simply. (12%) In addition to the live lectures, I would do question-answer sessions. (38%) I would upload the lecture notes to the system before the relevant live lecture day. (47%)	27%
Do you find it advantageous to take the course online? Why? / Why not?	I find online theoretical lectures advantageous. (87%)	11%

Discussion

The COVID-19 pandemic, indeed, forced 1.5 billion students and 63 million educationalists to emend their F2F practices, wherever possible. This issue indicated the strengths and weaknesses of education systems encountering the challenge of digitalisation (Valverde-Berrocoso et al., 2020). On the other hand, this disruption has forced everyone to adapt quickly and collaboratively (Saeed et al., 2020). Cyprus still suffers from the COVID-19 pandemic and exhibits a great effort to control the spread of the virus by strictly adhering to comprehensive multi-sectoral precautions such as lock-down leaving only essential services to continue (Sultanoglu et al., 2020).

One of the main problems encountered during a pandemic is that face-to-face (F2F) education had to be postponed. Since education is a key criterion in the economic and social development of the commonwealth; the potentially tragic and catastrophic influences of the prolonged outbreak on dental education should not be overlooked (Liu et al., 2020). COVID-19 pandemic, indeed, forced students and educationalists to emend their F2F practices and led dentistry education to face a myriad of challenges (Valverde-Berrocoso et al., 2020; Saeed et al., 2020; Emami, 2020). To circumvent the vast majority of these challenges, great help was received in information technology strategies such as e-learning and continuation of the dental education was provided (Bennardo et al., 2020).

Information technology provides assistance in the education and competence enhancement of dental students (Mattheos et al., 2008). The digital conversion of education systems has permitted the incorporation of a new teaching-learning ecosystem called e-learning (Valverde-Berrocoso et al., 2020). E-learning is advantageous to students since it can compensate for the F2F material sacrificed because of restricted curriculum time (Bains et al., 2011). From the pedagogical perspective, e-learning produced a paradigm shift from passive teacher-centred learning to active learner-centred learning (Santos et al., 2016). Moreover, in a previous study, it was perceived that having the chance to re-visit e-materials of relevant tutorial allows students to hone in on personal areas of weakness and thereby, to improve comprehension ability (Mehta et al., 2016). This result provides consistency with that of the current study in accordance with the data obtained from reflective questions.

Another study concluded that virtual learning package is more effective than traditional learning despite the difficulties faced in designing the virtual learning environment (Moazami et al., 2014). Meckfessel et al (2011) noted that e-learning is appreciated by students as it allowed students to manage their own learning, improve competence in decision-making, opinion, and reflection. This ideology was reinforced with another study by Brumini et al. (2014) reporting positive attitudes towards e-learning amongst dental students. This result provides consistency with that of the current study in accordance with the data obtained from reflective questions. Students found that online theoretical courses are more student-friendly and advantageous. However, they think that practical implementations should be F2F. Besides these, in a study, although the learners exhibited positive attitudes; they did not present the imperative skills to effectively use web-based learning platforms (Liaw et al., 2007). Inevitably, potential drawbacks exist for e-learning. First, a number of requirements such as internet connection, hardware technology, and the ability to use media are necessary to be ensured that the information is successfully received by the student (Liu et al., 2020). Second, there is a lack of accountability of learners and difficulty in encouraging assiduous use of the resource (Mehta et al., 2016). Third, to create influential e-learning environments, the necessary technological skills, teaching strategies, and pedagogical principles have to be learned by educationalists (Dziuban et al., 2004). Due to the above-mentioned drawbacks, still, the e-learning approaches cannot be considered as a primary medium for higher education (Mahmoodi et al., 2016).

E-learning courses can be conducted in either an asynchronous or synchronous manner. However, it is not clear yet which one is more beneficial (Liu et al., 2020). Our students reported the synchronous manner as a superior way of learning. In both manners, video recording was taken and uploaded to UZEBIM. The use of videos has been an integral part of the psychomotor skill training. It offers advantageous properties

such as standardised content delivery, close-up viewing, on-demand access, and control of playback functionality to allow students for skill training, note-taking, and knowledge assimilation (Botelho, 2019).

As a future consideration for dental education, it can be noted that the blended education model will presumably be a cornerstone (Bennardo et al., 2020). Thereby, the institutes have to be well-prepared and adapted as rapidly as possible. In this manner of education, e-learning is used as a complement of F2F, not a substitute (Bains et al., 2011; Cruz et al., 2014). Supportively, in a study, students have been found to prefer online modules as a supportive modality to learning, likewise blended education model, and the complete replacement of traditional tutorials with online instructions was disapproved by the students (Linjawi et al., 2009).

Learning model (F2F, e-learning, and blended learning) can become influential (i) in the outcome of the theoretical education, (ii) in the sustainability of the practical education, and (iii) on the knowledge retention. E-learning is effective and presents results that are similar to or even better than the traditional methodology (Camargo et al., 2011). Supportively, a study reported that computer-aided learning and reference tools are superior to reference books in terms of preference among physicians (Gutmark et al., 2007). It has also been shown that the e-learning strategy has the potential of improving students' knowledge of atraumatic restorative treatment (Camargo et al., 2014). The results of another study proved that e-learning in oral radiology is at least as effective as an in-class traditional learning method (Santos et al., 2016). The blended education model was noted as comparable to e-learning and F2F courses or, in some cases, better than the F2F model in terms of students' grades (Dziuban et al., 2004). Also, in other studies, students in the blended education model presented higher marks than those in F2F learning only (Kavadella et al., 2012; Tan et al., 2009). Although a completely online education model was used in the pandemic period; the above-mentioned result provides consistency with that of the current data obtained from UZEBIM as higher grades were achieved by students at online examinations. Additionally, although e-learning was appreciated by our students; the students consider the blended education model to be more acceptable. Interactive-teaching strategies increase long-term knowledge retention of the students (Turkyilmaz et al., 2019). This result is in accordance with that of the current data obtained from UZEBIM. The committee examinations for the spring semester were held online, and the ones for the fall semester were held face-to-face. While preparing for the final theoretical examination at the end of the academic year, the students reported in reflective questions that knowledge retention was more long-lasting in e-learning.

As mentioned, practical assignments were submitted to the educator through UZEBIM. According to the reflective questions, it can be stated that the online submission and evaluation process was appreciated by the students in terms of lecturer-student interaction. In our faculty, practical implementations were carried out online in all disciplines except endodontics due to the lack of stuff to obtain the radiographies of root-canal treated teeth and the difficulty of capturing high-quality images for evaluation of the assignments. But, regardless of equipment-drawback, four-component instructional design was successfully used in a distance education course (regenerative endodontic procedures) for continuing endodontics education (Kolcu et al., 2019). Thereby, in case that F2F training fails to start, a four-component instructional design may be suggested to complete missed endodontics courses.

There are a number of future recommendations for educators: (i) As uncertainty exists, it is of significance to plan a theoretical and practical curriculum. There is a possible need to extend the virtual curriculum in some manner in order to combat the strain caused by the virus. (ii) Even if e-learning is positively influencing the students, there is a necessity to evaluate the contexts in and purposes for it should be used. (iii) It can be noted that the blended education model will presumably be a cornerstone of future dental education. (iv) For the safety of dental teams, clinical internships should be reorganised in accordance with the guidelines for dental treatments. (v) Computer-assisted learning strategies may be incorporated into dental education with the aid of virtual reality programmes and simulators. This can be helpful, particularly in the pandemic period as distancing is of paramount importance in the prevention of the virus spread. Under normal circumstances, this may enhance the quality of education, especially where the classes are bustling. (vi) Online proctoring programmes may be recommended to expand the borders of security and thereby, to realise online examinations under a high level of safety. At last, carrying out the surveys aimed at revealing the students' perception towards online education can help both administration and teaching staff to identify and solve the complications in dentistry education.

Limitations

This study has several limitations. First, the number of students included in the study is small. Different results can be obtained from larger study groups. Second, only 11 reflective questions were asked to the

students. The number of questions can be increased in future studies and different question types can be preferred. Thereby, more extensive data on the subject can be obtained.

Conclusions

Dentistry students receive practical training for the first 3 years and clinical training for the next two years. Although practical training is carried out online during the pandemic period; 4th and 5th-grade students who received clinical training had a serious negative impact.

The emergence of COVID-19 brought new challenges and responsibilities to institutions providing dental education. There is no golden standard or guideline that can be followed during the pandemic period. Each faculty has developed its own way to combat the detrimental consequences of the virus. This will shed light on future dental education.

Therefore, in this study, students' attitudes were taken into account in order to evaluate the sustainability and success of the applied e-learning strategies. Moreover, applicable strategies for the future are stated. Within the limitations of the current study, the following statements can be drawn: (i) A considerable number of the students stated that practical implementations should have been conducted F2F, (ii) Most of the students emphasised that online theoretical courses are more advantageous than F2F ones. Future studies should focus on web-based approaches in dentistry, the usability of simulators, training of educators.

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