

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900

Open access books available

186,000

International authors and editors

200M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Impact of COVID-19 on Dental Education

*Isla Camilla Carvalho Laureano,
Alidianne Fábila Cabral Cavalcanti
and Alessandro Leite Cavalcanti*

Abstract

The COVID-19 pandemic has brought impacts and changes on dental education around the world. People who are in close contact with the COVID-19 patients, including students and teaching staff, are at increased risk of contamination, as they work close to the oral cavity of patients in direct contact with salivary fluids and in closed environment. In addition, social isolation and distancing measures have been adopted by governments, with severe restrictions on dental education. At this moment, students should have the teaching and experience for adequate dental practice, dental educators should provide solutions to resume dental education remotely to ensure the well-being of students, employees and teaching staff. This chapter discusses the impact of the COVID-19 on dental education and the role of emergency remote education in the continuity of face-to-face classes and preclinical and clinical education, in addition to addressing the challenges and the Brazilian reality of teaching-service-community activities.

Keywords: COVID-19, dental education, emergency remote teaching, online learning, distance education, dentistry, Brazil

1. Introduction

The pandemic imposed by Coronavirus, in addition to economic, social and health problems, also affected the educational sector, so that in order to comply with determinations imposed by the government agencies of each country, there was a temporary interruption in the teaching activities of undergraduate and graduate courses in all areas of knowledge, including Dentistry [1], since classroom classes - theoretical, preclinical (laboratory) and clinical - were interrupted as a measure of social isolation.

The teaching and learning of dental practice differs from other undergraduate courses in the health and social care disciplines, as dentistry students perform irreversible procedures on patients under the supervision of clinical professors, who assume indirect responsibility for the work of these students [2]. The Dentistry course has large load of practical activities, so it became a great challenge to carry out clinical activities, since teachers and students are isolated at home without access to dental equipment. One of the greatest challenges in dental education was the interruption of direct patient care, which is a key component of the dental

curriculum [3]. This fact resulted in the extension of study terms, and deferral of exams and graduation dates [4].

In order to safeguard the health of students and following the government social distancing rule, teachers and patients, universities were forced to take different measures to ensure the continuity of education. Didactic courses, hands-on workshops, presentations and seminars have transitioned to online instructions in most institutions [5]. In the last few months, emergency remote education became the only option to guarantee the continuity of higher education learning [3]. While online learning is carefully planned and resourced, emergency remote education was quickly constructed with minimal time and resources, as a temporary measure during the crisis [6]. As a way to continue offering remote distance learning, teachers and students had to accept this new reality and adopted new learning technologies. Therefore, adapting to these changes in the curriculum and assessment methods in a short period of time was a challenge not only for teachers and academicians, but also for university directors. However, many educators had never delivered sessions in online environments, which required them to acquire an extensive set of skills over a short period of time [7].

Due to the new normal situation, in many universities, offering preclinical education in the traditional format with synchronous feedback (SFB) was not possible during the pandemic [8]. In several countries, including Brazil, students begin preclinical practice (laboratory) in the third or fourth semester of the course. Although different clinical dental care simulators have been developed and yielded satisfying results, they are insufficient in educational institutions, are not portable, do not cover all areas of dentistry and are very expensive and unaffordable in large scale [9].

Most graduate dental education activities were ceased during the early stages of the pandemic [9]. Face-to-face education was also affected, as was the development of epidemiological, clinical and laboratory research. Researchers, whose studies involved collecting clinical data from patients, had their research abruptly stopped, without being sure when they could resume this stage. Therefore, the serious educational losses and the quality of research developed are also aspects to be carefully analyzed.

Online learning is the use of internet and some other important technologies to develop materials for educational purposes, instructional delivery and program management [10]. With regard to emergency remote education, when compared to traditional teaching methods, there are some advantages such as the theoretical material made available to students can be easily updated and quickly accessed. However, for it to be effective, team development, assessment strategies and technological elements must be well planned and standardized [3].

The training of dentistry students is dynamic and complex, as it involves many factors, such as the curriculum structure of the course, the quality of physical facilities of the educational institution, the number of hours devoted to the development of preclinical and clinical activities, internships developed in health services, the teaching methods used by teachers, among others. Therefore, the interruption of all these activities due to the COVID-19 pandemic may impact the student's education. Therefore, the responsibilities of educators include not only providing adequate theoretical teaching and consistent with the best scientific evidence in force, but also ensuring that students are able and qualified to perform clinical procedures with different degrees of complexity for the correct professional practice.

In light of the above, this chapter discusses the impact of the COVID-19 pandemic on dental education and the role of emergency remote education in the continuity of classes through the various types of methodologies and available digital platforms. There are also possibilities for the continuation of preclinical and clinical

teaching, and advantages and limitations of the adoption of this new model of education through experiences of dentistry educators and students from different countries. Some alternatives for the evaluation of students, the guidelines recommended by competent bodies to control the dissemination of COVID-19 in the resumption of face-to-face dental education activities and the Brazilian panorama of teaching-service-community integration activities has also been discussed.

2. Methods

This is a bibliographic search conducted through the analysis of articles indexed until April 2021 in PubMed (U.S. National Institutes of Health's National Library of Medicine), Web of Science (Clarivate Analytics) and Scopus (Elsevier) databases. For the study, the search keywords used were "Dental Education" AND "Dentistry" AND "COVID-19".

Articles eligible for this chapter were publications that presented data and suggestions about emergency remote teaching in continuing the dental educational process in terms of theoretical, preclinical and clinical education. The analysis of studies was independently carried out by two researchers (ALC and ICCL) through a previous reading of the titles and abstracts of the found references. The selected articles were accessed in their entirety, being read and evaluated. At the end of the analysis, differences were discussed. In lack of consensus, a third researcher (AFCC) decided to include or exclude the article.

Furthermore, this review listed the main international and Brazilian guidelines for providing clinical education and commented Brazilian panorama on teaching-service-community integration. Data were descriptively presented.

3. From face-to-face teaching to the use of digital platforms: a new model for dental education

Due to the COVID-19 pandemic, emergency remote education was temporarily adopted [6] as well as "teleodontology" [11]. The latter term, in addition to referring to remote counseling and diagnosis using technologies, can be used in the form of web-based self-instruction, which allows students the ability to control their learning, or interactive videoconference, in which patient information is transmitted live, with or without the presence of the patient, allowing immediate feedback and review of cases at the students' pace [12]. This type of learning is a distance education modality that uses electronic devices to promote learning, making use of information and communication technologies (ICTs) [13].

Among so many interrupted activities, patient care, research continuity and scientific meetings stand out; in addition, changes in academic calendars, with the inclusion of extra semesters and postponement of the entry of new students [14, 15]. In this context, the current challenges of dental education are to ensure that students have the training and experience necessary to guarantee competence for the dental practice and that educators have solutions to resume distance dental education, ensuring the well-being of employees, students and teachers.

The Bachelor's degree in Dentistry ranges from four [16] to six years of formal education [17], and, in general, it is divided into preclinical and clinical years [16]. In the preclinical years, students mostly learn basic science subjects, with practice in laboratories, where they practice on mannequins and teeth. In the clinical years, students mainly have activities with patients, under the supervision of teachers [16].

Usually, classes are physically assisted by students and are an essential component of dental education [11]. With emergency remote education, several types of methodologies are available, which consist of synchronous teaching - students and teachers meet in real time, and asynchronous, which does not require students and teachers to be online at the same time, through the use of digital platforms [18]. These methodologies include video classes, flipped classroom, case studies, discussions, problem based-learning (PBL) [19, 20], among others.

In the synchronous method, the advantages are live interaction and immediate reaction; in the asynchronous method, the user can control the learning pace and review the material several times whenever necessary [12]; in the flipped classroom method, students need to have prior knowledge of the subject, and in PBL approaches, students develop critical thinking [20].

There are several platforms for conducting emergency remote education, such as Zoom®, G Suite®, Skype®, Moodle®, Microsoft Teams®, Jitsi®, WebEx®, Instagram®, Facebook®, WhatsApp®, Telegram® and YouTube® [21, 22]. For the use of these technologies, adequate training of the teaching staff must be carried out [20], as this change in teaching methodology can be of difficult adaptation for these individuals, and students must be familiar with these tools [21].

A recent systematic review identified that the Zoom® platform was the preferred one among interviewees in studies included in this research [23]. Zoom® offers videoconferencing services for up to 1000 participants, with several possibilities, such as recordings, transcriptions, screen sharing, sending and receiving of files and chatting [24].

The Google Classroom® and Google Meet® compose the G Suite® platform. The first is a free tool for the management and evaluation of students, while the second allows connection and communication through video calls, using a computer or mobile device, which can be recorded and shared [25]. Skype® allows communication by voice and video calls with up to 100 people, sending of messages, screen sharing, meeting recordings of up to 24 hours and offers call captions in ten languages and chats in more than 60 languages in real time, for different devices [26]. Moodle® is a learning platform that provides a unique system to create personalized education environments, trusted by institutions around the world, in addition to being easy to use and free of cost [27]. In Moodle®, it is possible to send didactic material, post videos, conduct discussion forums, tasks, assessments and organize communication with students [22].

Microsoft Teams® is a platform that brings together conversations, content and applications, offers the creation of online classrooms, tasks, synchronous meetings, with recordings and screen sharing, in addition to enabling the use of a digital notebook for storing texts, images, notes, documents, links, voices, videos and others, allowing teachers to create personalized learning environments [28].

Likewise, Jitsi® [29] and WebEx® [30] are free voice, video conference and messaging software, with screen sharing, which allow meetings of up to 100 participants; however, they have paid plans with more advantages. Other social media platforms, such as Instagram® and YouTube®, are also used as teaching alternatives through “lives”, which can be discussed on WhatsApp® [22].

4. Preclinical teaching

Preclinical teaching includes laboratory learning for the practice of human and dental anatomy [31], use of the optical microscope to observe histological sections [18], radiographic image interpretation exercises [32], simulation models in typodont, after demonstration performed by teachers [18, 21], among others.

However, these activities have been suspended in many countries due to social distancing [21, 31].

Alternatives that apply technology in laboratory activities have been described [19, 31, 33] and suggested [32, 34] in some studies. Education using virtual anatomy was the solution for the practice of anatomy [31]. Virtual microscopy helped in the practical learning of oral histology and histopathology, in which conventional sections were digitized and shared on online platforms - synchronous and asynchronous formats - allowing observation similar to optical microscope [19, 33], with structures illustrated and marked in detail [19]. There is also the possibility to carry out radiology interpretation activities through social networks [32].

There are technological teaching tools that allow the development of preclinical skills, which use virtual reality, augmented reality, and haptic technology [35], such as Simodont®, PerioSim®, Forsslund and Individual Dental Education Assistant (IDEA) simulators attached to a stand PHANTOM omni [4]. Virtual reality refers to simulation generated by computer graphics with virtual sense of reality [36]. Augmented reality is the integration of real and virtual environments [37]. Haptic technology allows the tactile sensation when interacting with computer generated objects [38]. These technologies can overcome the disadvantages of typodont practice, because with these devices, it is not possible to calibrate the evaluation process due to the focus on the result of the activity, and there is strong dependence on the subjective evaluation of the teacher [35].

These technologies, if made portable, can simulate meetings with the patient and assist in the continuity of education and clinical evaluation during the COVID-19 pandemic and the “new normal”, as they are versatile, immersive and accessible [18]. However, they have many disadvantages, as they are generally very expensive, require training [35], are not portable and, therefore, cannot be used at this time [20]. Thus, researchers proposed the use of a mannequin attached to the micromotor for students to carry out practical training at home through videoconferences [34].

In this context, a group of researchers has recently created a compact and portable teaching-learning resource, DenTeach, composed of an instructor workstation (DT-Performer), a student workstation (DT-Student), advanced wireless networking technology, and cloud-based data storage and retrieval [4]. The platform synchronizes the instructor's and student's operations with real-time video, audio, feel, and posture (VAFP). It was developed for use in teaching, shadowing, and practice modes. In the first, the student can perceive how the instructor is conducting the dental operation through the tactile feedback obtained from the dental tool on the instructor workstation [4]. In the second, the student can watch, feel and repeat the tasks alone, downloading the videos. Finally, students can use the system to perform tasks and have their dental performance skills automatically assessed in terms of key performance indices (KPIs). DenTeach has proven to be a useful system for educational and professional purposes, which can be used to train and educate students in remote clinics/laboratories [4].

5. Clinical teaching

With the pandemic, health organizations asked for caution about the clinical care of institutions due to the risks of procedures that generate aerosols, limited supplies of personal protective equipment (PPE) and difficulties in individual supervision of students [39]. Teleodontology can be used to assist students in clinical teaching. In some disciplines, patient data can be used and subsequently discussed [12].

PBL [2], case-based discussion [2, 22, 40] and virtual patients (VPs) [11, 22] used in the simulation of clinical cases, in interviews, in the analysis of ethical cases [41], to improve students' skills in decision making and diagnosis, are also alternatives that can develop clinical reasoning [22]. VPs are efficient, interactive, enable experience with rare cases and allow for the improvement of skills in a less intimidating environment [41]. In addition, virtual meetings between students and simulated patients (actors) can be held, representing clinical interaction [42].

Research carried out with students before and after teleodontology meetings using actors as patients found that most participants reported some level of discomfort before using this type of care and after, 23% still reported discomfort when leading remote care [42]. Therefore, teleodontology should be stimulated in higher education, so that students become more qualified and future professionals more experienced in providing guidance, thus avoiding unnecessary dislocations in this new world context.

In Brazil, teachers and course managers are encouraged to use this technology to improve their teaching activities [43], since the Federal Council of Dentistry (CFO), which regulates the practice of distance dentistry, prohibits the use of teleodontology by undergraduate students [44], which can be used in the following situations:

- Tele-education in health: synchronous or asynchronous meeting associated with information on preventing situations that may represent the need for urgent care.
- Telescreening: comprises anamnesis and initial screening, prior to scheduling dental care.
- Telemonitoring: assessment of the need for the patient's face-to-face return, with ongoing treatment.
- Teleinterconsultation: exchange of opinions between dental surgeons through technologies, with or without the presence of the patient, for the construction of the diagnosis or therapeutic assistance.
- Teleconsulting: communication, through technologies, between health professionals and managers for the exchange of information in order to clarify doubts, oral health actions and issues related to the work process.
- Second Formative Opinion: source of information originated from questions from teleconsultants and based on the best evidence and on relevant criteria of primary health care [43, 44].

However, remote strategies should not replace clinical practice with patients in the acquisition of skills inherent to dental training [3, 45]. Studies corroborate this information, in which the majority of Jordanian students considered that clinical training was the experience most affected by the pandemic and dental specialties most negatively affected were conservative dentistry (73.2%), followed by prosthodontics (69.4%) [3], and only 27.1% of American students reported good performance of their teachers in providing clinical experience during the lockdown [39].

Students suggest that it would be interesting to have review classes and practical teaching after the pandemic is under control [40]. In addition to all issues resulting from the sudden change in dental education, the psychological impact of this pandemic on students' mental well-being is another issue that should not be neglected, as it can influence their future practices [3].

6. Advantages and limitations of online education

Despite all the negative impact on dental education, this moment of transition can also generate opportunities with regard to the replacement of classes for online courses during the pandemic, which can be disseminated on the internet to a large number of students [21]. It was found that, for the teaching staff, emergency remote education helps to ensure learning and allows accessibility between students and teachers [40]. For students, it is comfortable, reduces costs, facilitates access to teaching materials [13, 40], given the chat option, timid students can be more participatory [18], and, both for students and teachers, emergency remote education modalities encourage a focus on the student [40], as they demand more responsibility and protagonism [19]. In online clinical teaching, the absence of the patient caused students to make mistakes, without compromising patient safety [2].

Reported difficulties included the limited knowledge of the teaching staff on technology, the availability and quality of students' connection to the internet [13, 23, 31], extra expenses for increasing internet franchise [13], inadequacy of some topics for the online version [23, 41], lack of development of clinical skills and communication with patients [2], lack of attention on the part of students [13, 31, 40], lack of motivation and lack of adequate books or study material in their homes [31], the intensive nature of resources, student misbehavior [40], time management difficulties [31] and lack of electronic devices, especially in middle- [41] and low-income countries [46].

A study with Indian students [31] found that most of them used smartphones for emergency remote education. However, the small dimension of the screen can impair the proper understanding of three-dimensional structures, as for example in anatomy [31].

As recommendations for emergency remote education, everyone involved in this process should be prepared for a paradigm shift, with the establishment of practices and initiatives to promote improvements [19], with improvement of the teaching staff, reduction in the cognitive load and stimuli related to interactivity [40].

7. Alternatives for student assessment

Student assessment is a mechanism by which learning outcomes are analyzed, comprising two main forms: formative and summative. The first assesses the learning process throughout the school term, provides feedback to students and assists in obtaining improvements. The summative assessment is carried out mainly at the end of the course and may include several methods, among them the Objective Structured Clinical Examination (OSCE) [35].

In this context, exams can be applied through Socrative [40], Kahoot [19, 40] and Moodle® [19]. Tools with quizzes, such as Kahoot, can stimulate interaction, and also provide the possibility of an immediate feedback from the teacher [19]. Google Forms® [31], the use of software that prevents cheating such as ExamSoft; online supervision, such as ProctorU, Honorlock, Respondus Monitor and Examity [20], remote supervision integrated with block browser - prevents students from searching the internet to find an answer during assessment [21] - using Eproctor [47] and real-time question platforms, such as the Mentimeter [48] can also be alternatives. Preclinical and case-based activities can be delivered as videos, with incorporated questions using platforms like EDpuzzle, which allows questions to be asked with instant feedback while students watch the video [20].

In many institutions, OSCE is considered to be an adequate tool for identifying the clinical competencies of undergraduate students. During the pandemic, it was necessary to adapt OSCE to the online environment - virtual OSCE (VOSCE). According to studies carried out in the United Kingdom [49] through Zoom, and in Finland [50] through Moodle, experiences of the evaluation process have been positive.

Even with all these possibilities, more than half of students consider that the online assessment is not a good method of evaluating the acquired knowledge [3]. Therefore, the combination of several evaluation methods can minimize dishonesty, recover possible negative results from internet connection failures and stimulate commitment and critical reflection.

8. Biosafety in the return to face-to-face activities

The resumption of face-to-face dental education activities depends on the pandemic situation of each country. Currently, some dentistry schools have returned to face-to-face education or are preparing to reopen after government decisions; therefore, recommendations for resuming face-to-face activities are necessary [45].

Guidelines recommended for the dental team by the World Health Organization (WHO) [51], by the Centers for Disease Control and Prevention (CDC) [52] and by the health agencies of countries to control the COVID-19 dissemination must be considered. The Brazilian Dental Education Association (ABENO) [43] and the Association for Dental Education, Asia Pacific (ADEAP) [53], in July 2020, published safety guidelines for dental education. Among them, recommendations for teaching in classroom, in laboratories and in clinical environments and biosafety protocols were addressed to ensure the safety of students, teachers, employees and patients [43, 53].

The main guidelines are: wash and sanitize hands, practice social and respiratory etiquette, check temperature, keep distancing, clean and decontaminate objects and surfaces, ensure the ventilation of environments, mandatory use of face masks, use full PPE during dental care, screening patients and offering mouthwash rinses containing effective antiseptics, choosing procedures that produce little or no aerosol and using manual instruments, and when possible, using high power suckers and absolute isolation and, preferably, work with 4 hands [43, 53].

9. Teaching-service-community integration: brazilian panorama

In Brazil, as well as in Europe [54], the scope of undergraduate dental education is defined by the Ministry of Education. In the Brazilian territory, the student's trajectory and the consequent training of dental surgeons are guided by the so-called "National Curriculum Guidelines", which are valid for the entire country, including public and private institutions [55].

The aforementioned directive provides that professionals have a generalist and humanistic profile, so that through critical and reflective performance, they can act at all levels of health care, providing improvements in the oral health conditions of the population. For this to occur, it is necessary to carry out internships, which correspond to a supervised educational act developed in the work environment [56] and should account for at least 20% of the total hours of the undergraduate Dentistry course and needs to be developed in an articulated manner and with increasing complexity throughout the training process [55].

In this formative path, there is interaction between higher education institutions and health services that make up the Unified Health System (SUS), which was created in 1988 [57] and, considering the many advances and setbacks, is considered the largest public health system in the world. Thus, in the perspective of SUS as the locus of learning and training agent, the Brazilian dental surgeon is trained. It means that the articulation between the health system and higher education institutions materializes in the insertion of students in the health care network [58] and in the implementation of the teaching-service-community integration [59].

Experiences based on the teaching-service-community integration are not exclusive to Brazilian dental education, since at the University of British Columbia, in Canada, students are inserted in the community context, a fact that allows them to understand the challenges faced by vulnerable segments of the population and actively reflect on experiences acquired [60].

But since March 2020, when WHO announced that COVID-19 had reached a pandemic state [61], dental education has taken on new shapes. Face-to-face education was completely interrupted and the impact on the training of professionals was overwhelming [21, 39], since teaching-service-community activities were discontinued, given the current sanitary situation and the impossibility of carrying out them remotely. It is possible to state that dentistry training faces serious challenges, something that in addition to Brazil can be extrapolated to other countries [21]. Students have experienced increasing levels of stress and feel that their clinical education has been impaired [39].

In Brazil, in the first weeks of the pandemic, the Ministry of Health recommended the suspension of elective oral health care and the maintenance of emergency care throughout the national territory [62]. The Ministry of Education, in turn, prohibited the substitution of face-to-face classes with classes in digital media when it came to professional practices, such as internships [63].

However, additional guidelines outlined months later, with the revocation of Ordinances No. 343, of March 17, 2020, that the application of the substitution of practical activities, in compliance with National Curriculum Guidelines, could include specific work plans, approved at institutional level dentistry courses and attached to the pedagogical project of the course [64].

The position of the Ministry of Education regarding the possibility of internships occurring in the distance education mode in Dentistry caused controversy and caused the Federal Council of Dentistry (CFO) to be strongly opposed to such guidance [65].

Due to the continuation of the pandemic scenario in the year 2021, the effects on students' knowledge and skills are difficult to assess and the consequences may be visible in the near future. For Gaudín et al. [54], less productive and efficient students are expected.

Undoubtedly, dentistry students face a global health crisis, whose direct reflection in their education is the closure of educational institutions and the challenges to practice and improve their clinical skills [39], whether in school clinics based in their own universities, or within the scope of public health services, a place where the technique is practiced and experiences are accumulated in the community. Therefore, dentistry students are unable to complete these requirements [14].

In the Brazilian context, the perspective in view of the epidemiological changes in states and municipalities, is the establishment of new parameters to guide and promote the gradual and responsible return of habitual activities. Thus, as this is a moment of transition, it is possible, in some places, to plan the return of elective care in different services and to expand the offer of care [62], as a consequence, there is the possibility, still without an expected date, of return to teaching-service-community activities, so important during the training of dentistry students.

10. Conclusion

The COVID-19 pandemic strongly impacted the development of theoretical, laboratory and practical activities in the student, teacher and university trinomial, so that higher education institutions adopted different teaching technologies to ensure the continuity of the teaching-learning process. Clinical practice and experiences in the teaching-service-community context were those most impacted by the temporary interruption and await new government and institutional guidelines for their resumption.

We highlight the need for more research in this area, to assist in decision-making by managers and institutions and in the adaptation of professors and students. Educational bodies should be encouraged to invest in infrastructure and training for new teaching modalities and to formulate institutional policies that generate diversified learning options, in order to reduce students' unequal access to very expensive technologies and quality internet, which can compromise the performance of remote activities. To return to face-to-face activities, large investments must be made in dental clinics and in the SUS, covering the new biosafety standards.

Conflict of interest


The authors report no conflicts of interest.

Author details

Isla Camilla Carvalho Laureano, Alidianne Fábila Cabral Cavalcanti
and Alessandro Leite Cavalcanti*
State University of Paraíba, Campina Grande, Paraíba, Brazil

*Address all correspondence to: alessandrouepb@gmail.com

IntechOpen

© 2022 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

References

- [1] United Nations Educational, Scientific and Cultural Organization. Education: from disruption to recovery [Internet]. 2020. Available from: <https://en.unesco.org/covid19/education-response> [Accessed: 2020-04-16].
- [2] Nasseripour M, Turner J, Rajadurai S, San Diego J, Quinn B, Bartlett A, et al. COVID 19 and dental education: transitioning from a well-established synchronous format and face to face teaching to an asynchronous format of dental clinical teaching and learning. *J Med Educ Curric Dev*. 2021;8:1-3. DOI: 10.1177/2382120521999667
- [3] Hattar S, AlHadidi A, Sawair FA, Alraheam IA, El-Ma'aita A, Wahab FK. Impact of COVID-19 pandemic on dental education: online experience and practice expectations among dental students at the University of Jordan. *BMC Med Educ*. 2021;21(1):151. DOI: 10.1186/s12909-021-02584-0
- [4] Cheng L, Kalvandi M, McKinstry S, Maddahi A, Chaudhary A, Maddahi Y, et al. Application of DenTeach in remote dentistry teaching and learning during the COVID-19 pandemic: a case study. *Front Robot AI*. 2021;7:611424. DOI: 10.3389/frobt.2020.611424
- [5] Wu DT, Wu KY, Nguyen TT, Tran SD. The impact of COVID-19 on dental education in North America—Where do we go next? *Eur J Dent Educ*. 2020;24(4):825-827. DOI: 10.1111/eje.12561
- [6] Hodges CB, Moore S, Lockee BB, Trust T, Bond MA. The difference between emergency remote teaching and online learning. *Educause Rev*. 2020:1-14.
- [7] Rad FA, Otaki F, Baqain Z, Zary N, Al-Halabi M. Rapid transition to distance learning due to COVID-19: Perceptions of postgraduate dental learners and instructors. *PLoS One*. 2021;16(2):e0246584. DOI: 10.1371/journal.pone.0246584
- [8] Puranik CP, Mack E, DeLapp J, de Peralta T. Digital preclinical education and assessment in pediatric dentistry during COVID pandemic. *J Dent Educ*. 2021;1-3. DOI: 10.1002/jdd.12595
- [9] Thilakumara IP, Jayasinghe RM, Jayasinghe RD. Facing challenges of COVID-19 on dental education in Sri Lanka. *J Multi Dent Res*. 2021;6(2): 75-80.
- [10] Fry K. E-learning markets and providers: Some issues and prospects. *Education+ Training* 2001;43(4/5):233-9. DOI: 10.1108/EUM00000000005484
- [11] Farooq I. Interpretive versus didactic learning approach towards oral biology: a student's perspective. *J Coll Physicians Surg Pak*. 2014;24(10):772-774. DOI: 10.2014/JCPSP.772774
- [12] Chen JW, Hobdell MH, Dunn K, Johnson KA, Zhang J. Teledentistry and its use in dental education. *J Am Dent Assoc*. 2003;134(3):342-346. DOI: 10.14219/jada.archive.2003.0164
- [13] Amir LR, Tanti I, Maharani DA, Wimardhani YS, Julia V, Sulijaya B, et al. Student perspective of classroom and distance learning during COVID-19 pandemic in the undergraduate dental study program Universitas Indonesia. *BMC Med Educ*. 2020;20(1):392. DOI: 10.1186/s12909-020-02312-0
- [14] Desai BK. Clinical implications of the COVID-19 pandemic on dental education. *J Dent Educ*. 2020;84(5):512. DOI: 10.1002/jdd.12162
- [15] Emami E. COVID-19: perspective of a dean of dentistry. *JDR Clin Trans Res*. 2020;5(3):211-213. DOI: 10.1177/2380084420929284

- [16] American Dental Education Association. Dental School Curriculum [Internet]. 2021. Available from: https://www.adea.org/GoDental/Future_Dentists/Dental_school_curriculum.aspx [Accessed: 2021-04-12].
- [17] Dalanon J, Matsuka Y. The Evolution of Dental Education in the Philippines. *Health Prof Educ*. 2018;5(3):172-176. DOI: 10.1016/j.hpe.2018.07.001
- [18] Elangovan S, Mahrous A, Marchini L. Disruptions during a pandemic: Gaps identified and lessons learned. *J Dent Educ*. 2020;84(11):1270-1274. DOI: 10.1002/jdd.12236
- [19] Spalding M, Rauen C, de Vasconcellos LMR, da Cruz Vegian MR, Miranda KC, Bressane A. Higher education challenges and possibilities: a Brazilian experience in times of COVID-19. *Res Soc Dev*. 2020;9(8):e534985970. DOI: 10.33448/rsd-v9i8.5970
- [20] Iyer P, Aziz K, Ojcius DM. Impact of COVID-19 on dental education in the United States. *J Dent Educ*. 2020;84(6):718-722. DOI: 10.1002/jdd.12163
- [21] Chang TY, Hong G, Paganelli C, Phantumvanit P, Chang WJ, Shieh YS, et al. Innovation of dental education during COVID-19 pandemic. *J Dent Sci*. 2021;16(1):15-20. DOI: 10.1016/j.jds.2020.07.011
- [22] Machado RA, Bonan PRF, Perez DEDC, Martelli Júnior H. COVID-19 pandemic and the impact on dental education: discussing current and future perspectives. *Braz Oral Res*. 2020;34:e083. DOI: 10.1590/1807-3107bor-2020.vol34.0083
- [23] Santos GNM, da Silva HEC, Leite AF, Mesquita CRM, Figueiredo PTS, Stefani CM, et al. The scope of dental education during COVID-19 pandemic: A systematic review. *J Dent Educ*. 2021. DOI: 10.1002/jdd.12587
- [24] Zoom Video Communications, Inc. [Internet]. 2021. Available from: <https://zoom.us/meetings> [Accessed: 2021-04-12].
- [25] Google for Education. Google Classroom. [Internet]. 2021. Available from: <https://edu.google.com/products/classroom/> [Accessed: 2021-04-12].
- [26] Microsoft. Skype. [Internet]. 2021. Available from: <https://www.skype.com/pt-br/features/> [Accessed: 2021-04-12].
- [27] Moodle. About Moodle [Internet]. 2020. Available from: https://docs.moodle.org/310/en/About_Moodle [Accessed: 2021-04-12].
- [28] Microsoft. Educator Center. [Internet]. 2021. Available from: <https://education.microsoft.com/pt-BR/resource/d5b62e3e> [Accessed: 2021-04-12].
- [29] 8x8, Inc. Jitsi. [Internet]. 2021. Available from: <https://meet.jit.si/> [Accessed: 2021-04-12].
- [30] Cisco. Webex. Pricing [Internet]. 2021. Available from: <https://www.webex.com/pricing/index.html> [Accessed: 2021-04-12].
- [31] Singal A, Bansal A, Chaudhary P, Singh H, Patra A. Anatomy education of medical and dental students during COVID-19 pandemic: a reality check. *Surg Radiol Anat*. 2021;43(4):515-521. DOI: 10.1007/s00276-020-02615-3
- [32] Pontual MLA, do Nascimento EHL, da Cruz Perez DE, Pontual AA, Ramos-Perez FM. Challenges in oral radiology teaching during COVID-19 pandemic. *Dentomaxillofac Radiol*. 2020;49(5):20200178. DOI: 10.1259/dmfr.20200178

- [33] Zhong Y, Sun W, Zhang W, Liu L, Xu Y, Jiang Y. Application of remote online learning in oral histopathology teaching: an acute response to the COVID-19 pandemic. *Res Sq.* 2020. DOI: 10.21203/rs.3.rs-51823/v1
- [34] Galibourg A, Maret D, Monsarrat P, Nasr K. Impact of COVID-19 on dental education: How could pre-clinical training be done at home? *J Dent Educ.* 2020;84(9):949. DOI: 10.1002/jdd.12360
- [35] Khalaf K, El-Kishawi M, Mustafa S, Al Kawas S. Effectiveness of technology-enhanced teaching and assessment methods of undergraduate preclinical dental skills: a systematic review of randomized controlled clinical trials. *BMC Med Educ.* 2020;20(1):286. DOI: 10.1186/s12909-020-02211-4
- [36] Haleem A, Javaid M, Khan IH. Virtual reality (VR) applications in dentistry: An innovative technology to embrace. *Indian J Dent Res.* 2020;31(4):666-667. DOI: 10.4103/ijdr.IJDR_501_19
- [37] Huang TK, Yang CH, Hsieh YH, Wang JC, Hung CC. Augmented reality (AR) and virtual reality (VR) applied in dentistry. *Kaohsiung J Med Sci.* 2018;34(4):243-248. DOI: 10.1016/j.kjms.2018.01.009.
- [38] Sreelakshmi M, Subash TD. Haptic Technology: A comprehensive review on its applications and future prospects. *Materials Today: Proc.* 2017;4(2, Part B):4182-7. DOI: 10.1016/j.matpr.2017.02.120
- [39] Hung M, Licari FW, Hon ES, Lauren E, Su S, Birmingham WC, et al. In an era of uncertainty: Impact of COVID-19 on dental education. *J Dent Educ.* 2021;85(2):148-156. DOI: 10.1002/jdd.12404
- [40] Mukhtar K, Javed K, Arooj M, Sethi A. Advantages, Limitations and Recommendations for online learning during COVID-19 pandemic era. *Pak J Med Sci.* 2020;36(COVID19-S4):S27-S31. DOI: 10.12669/pjms.36.COVID19-S4.2785
- [41] Chavarria-Bolaños D, Gómez-Fernández A, Dittel-Jiménez C, Montero-Aguilar M. E-learning in dental schools in the times of COVID-19: a review and analysis of an educational resource in times of the COVID-19 pandemic. *Odovtos-International J Dent Sci.* 2020;22(3):69-86. DOI: 10.15517/ijds.2020.41813
- [42] Patel SA, Halpin RM, Olson GW, Franklin A. Global pandemic and the rise of teledentistry. *J Dent Educ.* 2020. DOI: 10.1002/jdd.12355
- [43] Pires FS, Fontanella V. Abeno consensus: biosafety in post-pandemic dental education on COVID-19. *Porto Alegre: Brazilian Association of Dental Education,* 2020. 86 p.
- [44] Federal Council of Dentistry. Resolution 226/2020: CFO presents Clarification Guide on the practice of Dentistry at a distance [Internet]. 2020. https://website.cfo.org.br/resolucao-226-2020-cfo-apresenta-guia-de-esclarecimento-sobre-exercicio-da-odontologia-a-distancia/?doing_wp_cron=1619048002.8169128894805908203125 [Accessed: 2021-04-13].
- [45] Gurgel BCV, Borges SB, Borges REA, Calderon PS. COVID-19: Perspectives for the management of dental care and education. *J Appl Oral Sci.* 2020;28:e20200358. DOI: 10.1590/1678-7757-2020-0358
- [46] Tuladhar SL, Pradhan D, Parajuli U, Manandhar P, Subedi N. Study on the effectiveness of online classes for undergraduate medical and dental students of Gandaki Medical College during COVID 19 pandemic period in

Nepal. *Orthod J Nepal*. 2020;10(2):36-40. DOI: 10.3126/ojn.v10i2.31146

[47] Moore Z, Stallard J, Tittermore A, Lee JY. The COVID-19 pandemic: opportunity for integration of educational technology. *J Dent Educ*. 2020. DOI: 10.1002/jdd.12344

[48] Patterson K, Ritwik P, Kerins C, Adewumi A. Real-time measurement for effectiveness of novel educational endeavors during the COVID-19 pandemic. *J Dent Educ*. 2020. DOI: 10.1002/jdd.12363

[49] Donn J, Scott JA, Binnie V, Bell A. A pilot of a Virtual Objective Structured Clinical Examination in dental education. A response to COVID-19. *Eur J Dent Educ*. 2020. DOI: 10.1111/eje.12624

[50] Hytönen H, Näpänkangas R, Karaharju-Suvanto T, Eväsoja T, Kallio A, Kokkari A, Tuononen T, Lahti S. Modification of national OSCE due to COVID-19 - Implementation and students' feedback. *Eur J Dent Educ*. 2020. DOI: 10.1111/eje.12646

[51] World Health Organization. Considerations for the provision of essential oral health services in the context of COVID-19 [Internet]. 2020. Available from: <https://www.who.int/publications/i/item/who-2019-nCoV-oral-health-2020.1> [Accessed: 2021-04-13].

[52] Centers for Disease Control and Prevention. Interim Infection Prevention and Control Guidance for Guidance for Dental Settings During the COVID-19 Response. [Internet]. 2020. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/dental-settings.html> [Accessed: 2021-04-13].

[53] Association for Dental Education, Asia Pacific. Guideline for Dental Education under COVID-19 situation [Internet]. 2020. Available from:

<https://adeap.org/wp-content/uploads/2020/07/> [Accessed: 2021-04-13].

[54] Gaudin A, Arbab-Chirani R, Pérez F. Effect of COVID-19 on Dental Education and Practice in France. *Front Dent Med*. 2020;1:5. DOI: 10.3389/fdmed.2020.00005

[55] Brazil. National Council of Education Chamber of Higher Education resolution CNE / CES 3, of February 19, 2002. Institutes National Curricular Guidelines for the Undergraduate Dentistry Course. [Internet]. 2002. Available from: <https://portal.mec.gov.br/cne/arquivos/pdf/CES032002.pdf> [Accessed: 2021-04-18].

[56] Brazil. Law No. 11,788, of September 25, 2008. Provides for the internship of students; changes the wording of art. 428 of the Consolidation of Labor Laws - CLT, approved by Decree-Law No. 5,452, of May 1, 1943, and Law 9,394, of December 20, 1996; repeals Laws 6,494, of December 7, 1977, and 8,859, of March 23, 1994, the sole paragraph of art. 82 of Law No. 9,394, of December 20, 1996, and art. 6th of Provisional Measure No. 2,164-41, of August 24, 2001; and makes other arrangements. [Internet]. 2008. Available from: https://www.planalto.gov.br/ccivil_03/_Ato2007-2010/2008/Lei/L11788.htm [Accessed: 2021-04-18].

[57] Brazil. Constitution. Constitution of the Federative Republic of Brazil. Brasília, DF: Federal Senate; 1988.

[58] Brazil. Ordinance No. 4,279, of December 30, 2010. Establishes guidelines for the organization of the Health Care Network within the scope of the Unified Health System (SUS). [Internet]. 2010. Available from: https://bvsms.saude.gov.br/bvs/saudelegis/gm/2010/prt4279_30_12_2010.html [Accessed: 2021-04-18].

[59] Forte FDS, Pontes AA, Morais HGF, Barbosa AS, Nétto OBS, Barros NF.

Teaching-service-community integration in Dentistry: a cultural study. Interface (Botucatu). 2020;24:e200166 DOI: 10.1590/Interface.200166

[60] Brondani MA. Teaching social responsibility through community service-learning in predoctoral dental education. J Dent Educ. 2012;76(5): 609-619.

[61] World Health Organization. WHO characterizes COVID-19 as a pandemic [Internet]. 2020. Available from: <https://www.paho.org/pt/news/11-3-2020-who-characterizes-covid-19-pandemic> [Accessed: 2021-04-18].

[62] Brazil. Ministry of Health. Health Surveillance Secretariat. Secretariat of Primary Health Care. Guide to guidelines for dental care in the context of Covid-19. Brasília, DF, 2020. [Internet]. 2020. Available from: https://www.gov.br/saude/pt-br/media/pdf/2020/novembro/17/17_12_guia-de-orientacoes-para-atencao-odontologica-no-contexto-da-covid-19.pdf [Accessed: 2021-04-18].

[63] Brazil. Ordinance No. 343, of March 17, 2020. Provides for the substitution of face-to-face classes with classes in digital media while the pandemic situation of the new coronavirus - Covid-19 lasts. [Internet]. 2020. Available from: <https://www.in.gov.br/en/web/dou/-/portaria-n-343-de-17-de-marco-de-2020-248564376> [Accessed: 2021-04-18].

[64] Brazil. Ordinance No. 544, of June 16, 2020. Provides for the replacement of face-to-face classes with classes in digital media, while the pandemic situation of the new coronavirus - Covid-19 lasts, and revokes MEC Ordinances No. 343, of March 17 2020, n° 345, of March 19, 2020, and n° 473, of May 12, 2020. [Internet]. 2020. Available from: <https://www.in.gov.br/en/web/dou/-/portaria-n-544-de-16-de-junho-de-2020-261924872> [Accessed: 2021-04-18].

[65] Federal Council of Dentistry. CFO officiates Ministry of Education and seeks in court to prevent internship in distance education in Dentistry [Internet]. 2020. Available from: <https://website.cfo.org.br/cfo-oficial-ministerio-da-educacao-e-busca-na-justica-impedir-estagio-na-modalidade-ead-em-odontologia/> [Accessed: 2021-04-18].