Dental education profile in COVID-19 pandemic: A scoping review

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Abstract

Introduction: This scoping review aimed to determine the frequency of different teaching methodologies, tools and platforms applied in dental education during the COVID-19 pandemic.

Materials and Methods: The search strategy was performed in six databases and grey literature. A total of 28 questionnaire-based studies were included, without language or time restriction, from 20 different countries.

Results: Six thousand five hundred sixty-five participants were assessed: 84% undergraduates, 9% of faculty members, 5% of postgraduate students/residents/trainees and 2% of dental schools/residency programs. The pooled eligible data for teaching methodologies were 62% of a combination of different methods (95% CI, 35.5% to 82.3%), 23% a combination of synchronous and asynchronous formats (95% CI, 8.2% to 50.2%) and 15% for only synchronous lectures (95% CI, 4.3% to 42.2%). The reported tools were laptops (40%), smartphones (40%), tablets (40%), desktops (20%), Blackboard (20%), Respondus Lockdown Browser (20%), eProctor (20%) and PowerPoint (20%). The most used platforms were Zoom (70.6%), Microsoft Teams (23.5%) and Cisco Webex (23.5%). A better time management (17.9%; 95% CI, 7.9% to 35.6%) and the possibility of revision with additional notes (14.3%; 95% CI, 5.7% to 31.5%) was the greatest advantages related to dental e-learning, while the increased levels of anxiety/stress/burnout/exhaustion (35.7%; 95% CI, 21% to 54.2%) and internet connection problems (35.7%; 95% CI, 21% to 54.2%) was the most cited disadvantages.

Conclusion: This scoping review showed promising blended teaching methodologies, tools and platforms in the dental education profile. The evidence suggests that e-learning technologies can widely contribute to dental education during the COVID-19 pandemic. Therefore, this study makes a major contribution to research by assessing the impact of COVID restrictions on dental education and further studies are needed to identify how restrictions in dental practice will affect future professionals.

Keywords
coronavirus disease 19, dental schools, dentistry, educational methodologies, E-learning, evidence-based
1 | INTRODUCTION

The social distance resulting from the COVID-19 pandemic had a significant impact on dental education that needs to be considered and better analyzed. For this reason, many educational institutions have partially or fully closed around the world in the adoption of preventive social distancing strategies to contain the pandemic, which has impacted more than half of the world’s student population. Thus, dental education activities, as well as dental research, faced compulsory modifications and restrictions in teaching and learning methods to ensure continuity of education during the COVID-19 pandemic.

In higher education, it is important to develop pedagogical models that make the student the protagonist of the learning process, instead of the traditional figure of the dental educator. One of the greatest challenges faced by educational institutions is to guarantee the safety of students, faculty members and patients and, simultaneously, assure the delivery of teaching for dentistry students from alternatives, such as e-learning and the use of digital tools. The transition from face-to-face to online in most Dentistry courses was an emergency and occurred abruptly with no associated training. Although the methodological adaptation was quick and with little preparation time, this adaptation to virtual needs represents the possibility of accelerating the digital transformation in dental education. Therefore, with the online format, innovative learning methods are necessary to maintain continuing education in Dentistry.

The results obtained may help professors, students and many other professionals involved in dental education, also in the development and implementation of digitalized teaching. This contribution may be useful not only during the COVID-19 pandemic but also in the future since it is assumed that the use of new technological tools should be definitively incorporated into dental education.

Thus, the objective of this scoping review was to estimate the frequency of use of different teaching methodologies, tools and platforms applied in dental education during the COVID-19 pandemic. Also, as a secondary outcome, it is intended to identify the perceptions of students, professors and faculty members about distance learning.

2 | MATERIAL AND METHODS

Scoping reviews (ScR) are ideal for mapping available literature on a given subject since they provide an overview of the chosen topic, including possible knowledge gaps. Since the association between methodologies, tools and platforms applied in dental education during the COVID-19 pandemic was previously investigated by several studies, and no previous data summary on this broad topic was found, the ScR design was chosen over other review types. This ScR was based on the Joanna Briggs Institute Reviewer’s Manual and the report followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR).

2.1 | Protocol and registration

A protocol was developed based on the Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols (PRISMA-P) and Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews checklist (PRISMA-ScR). The protocol was peer-reviewed and registered at the Open Science Framework (OSF).

2.2 | Eligibility criteria

2.2.1 | Participants, concept and context

Intended to identify the frequency of the methodologies, tools and platforms used in dental education, and the perceptions of students, professors and faculty members about e-learning. The acronym PCC (Population, Concept and Context) was used to formulate the question, in which: (P) Dental professors, faculty members, undergraduate and postgraduate dental students; (C) Methodologies, tools (equipment and applies used for e-learning) and platforms used in dental education and identify the perceptions of students, professors and faculty members about e-learning; and (C) COVID-19 pandemic.

2.2.2 | Types of sources

The inclusion criteria consisted of quantitative observational studies with primary data that estimated the frequency of teaching methodologies, tools and platforms used for dental education during the COVID-19 pandemic, without language restriction or publication time limitation. Only studies with information based on applied analysis were included to ensure the potential of pooling frequency data. Exclusion criteria were as follows: (1) Professors and students not involved in dental education; (2) Studies that are not associated with the COVID-19 pandemic; (3) Studies that only reported experience and/or did not carry out an applied assessment on the methodology, platform and/or tools; and (4) Reviews, editorials, opinion article, commentary and perspectives.

2.3 | Information sources and search

The following bibliographic databases were used for electronic search strategies on 4 January 2021: PubMed/MEDLINE, EMBASE, LILACS, Web of Science, Scopus and Eric. Additional research was also carried out in the grey literature including Google Scholar and OpenGrey, as well as manual search on reference lists of included studies (Appendix 1). An online software reference manager (EndNote X7, Thomson Reuters, Philadelphia, PA) was used to collect references and remove duplicate articles.
2.4 | Selection of sources of evidence

The selection was carried out in two phases. In phase one, two reviewers independently screened titles and abstracts of all identified references using online software (Rayyan, Qatar Computing Research Institute). In phase two, the same two reviewers applied the eligibility criteria to the full text of the studies. A third author was involved when necessary, and any disagreement was solved by a consensus discussion. The final selection was always based on the full text of the publication. The studies that did not fulfill the eligibility criteria were excluded (Appendix 2). Data collected items were author, year, country, educational level, sample size, methodologies, platforms, tools and main results (Appendix 3).

2.5 | Descriptive summary

A qualitative summary was conducted by grouping and comparing data reported in the included studies. The main outcome was the frequency of use of different procedures, tools and platforms used in dental education during the COVID-19 pandemic. Secondary outcomes included the perceptions of students, teachers and faculty members about distance learning. The prevalence of methodologies, tools, platforms and perceptions of e-learning was reported from proportions based on the number of studies. In addition, the 95% confidence interval was calculated by an online statistical calculator (OpenEpi; www.OpenEpi.com).

3 | RESULTS

3.1 | Selection of sources of evidence

After the exclusion of the duplicated references, 1177 records remained. One thousand eighty-nine were excluded during the initial screening of titles and abstracts. After a full-text assessment, 60 studies were excluded (Appendix 2). 28 studies were included (Figure 1) and no articles were identified from the reference lists. All of the included studies were cross-sectional questionnaire-based, published in English.

3.2 | Bibliometric analysis and characteristics of sources of evidence

The 28 included studies were developed in several countries, covering all continents (Figure 2A). Of these, 35.7% were from Asia.17-26
32.2% were from North and South America, 21.4% were from Europe, 7.1% involved more than one continent and 3.6% was from Oceania (Figure 2B). This ScR sample size comprised 6565 individuals, ranging from 11 to 1207 participants. The sample included undergraduate (5451; 83%), faculty members (598; 9.1%), postgraduate students/residents/trainees (375; 5.7%) and dental schools/residency programs (141; 2.1%) (Figure 2C; Appendix 4).

3.3 Results of individual sources of evidence and data synthesis

The methodologies used during the distance learning in the COVID-19 pandemic were applied in isolated and combined modes. In general, 62% of the reports combined many different methodologies (95% CI, 35.5% to 82.3%). The main combination was between synchronous and asynchronous formats, with a frequency of 23% (95% CI, 8.2% to 50.2%). Although isolated synchronous lectures presented a frequency of 15% (95% IC, 4.3% to 42.2%), any study reported the use of isolated asynchronous lectures with support of only previously edited and prepared videos (95% CI, 0% to 22.8%). Other different combinations, in addition to synchronous and asynchronous classes, were also mentioned: self-learning, clinical simulation laboratories, online clinical case-based discussion, online tutorials, educational videos, adapted virtual Objective Structured Clinical Examination (OSCE) and Massive Open Online Courses (MOOC). Less often, there are also reports from virtual journal clubs, interdisciplinary online conferences, group work and social media groups.

Regarding the tools used in e-learning, the most used equipment were laptops (40%; 95% CI 11.7% to 77%), smartphones (40%; 95% CI, 11.7% to 77%), tablets (40%; 95% CI, 11.7% to 77%) and desktops (20%; 95% CI, 3.6% to 62.4%). Besides, most faculty members delivered lectures with the support of PowerPoint presentations (20%; 95% CI, 3.6% to 62.4%). Furthermore, in the virtual assessments, was mentioned the use of surveillance tools to prevent cheating among students, such as Blackboard (20%; 95% CI, 3.6% to 62.4%), the Respondus Lockdown Browser (20%; 95% CI, 3.6% to 62.4%).
62.4%) and the eProctor (lockdown browser) (20%; 95% CI, 3.6% to 62.4%) (Figure 3B).

Seventeen studies referenced the platforms used in e-learning, which were the following: 70.6% of Zoom (95% CI, 46.8% to 86.7%), 23.5% of Microsoft Teams (95% CI, 9.5% to 47.2%), 23.5% of Cisco Webex (95% CI, 9.5% to 47.2%), 11.8% of Ding Talk (95% CI, 3.3% to 34.3%), 11.8% of Moodle (95% CI, 3.3% to 34.3%), 5.9% of Abhyas (95% CI, 1.1% to 27%), 5.9% of Blackboard Collaborate (95% CI, 1.1% to 27%), 5.9% of BlueJeans (95% CI, 1.1% to 27%), 5.9% of Dudaal (95% CI, 1.1% to 27%), 5.9% of Echo360 (95% CI, 1.1% to 27%), 5.9% of Google Classroom (95% CI, 1.1% to 27%), 5.9% of Google Hangouts (95% CI, 1.1% to 27%), 5.9% of Google Meet (95% CI, 1.1% to 27%), 5.9% of GoToMeeting (95% CI, 1.1% to 27%), 5.9% of Instructional LMS (95% CI, 1.1% to 27%), 5.9% of JLU Stud.IP (95% CI, 1.1% to 27%), 5.9% of Knowledge-Based Medical Education (k-MED) (95% CI, 1.1% to 27%), 5.9% of Rain Classroom (95% CI, 1.1% to 27%), 5.9% of Sakai (LMS) (95% CI, 1.1% to 27%), 5.9% of Skype (95% CI, 1.1% to 27%), 5.9% of Superstar Learning (95% CI, 1.1% to 27%), 5.9% of Tencent Classroom and Pmphmooc (95% CI, 1.1% to 27%), 5.9% of Tencent Meeting (95% CI, 1.1% to 27%) and 5.9% of YouTube (95% CI, 1.1% to 27%) (Figure 4). Among them, the most used was Zoom, referenced in 12 studies (70.6%).25–33,38,39 In addition, virtual learning environments Moodle and systems developed by the own universities were also used for distance education classes and activities, such as Learning Management Systems (LMS).24,31,33,37
The main advantages pointed out by both students and faculty members are as follows: better time management (17.9%; 95% CI, 7.9% to 35.6%), possibility of revision and make additional notes (14.3%; 95% CI, 5.7% to 31.5%), increase motivation (7.1%; 95% CI, 2% to 22.6%), greater comfort (3.6%; 95% CI, 1% to 18%), increased focus (7.1%; 95% CI, 2% to 22.6), and greater flexibility (7.1%; 95% CI, 2% to 22.6%. The most cited disadvantages were as follows: increased levels of anxiety/stress/burnout/exhaustion (35.7%; 95% CI, 21% to 54.2%), internet connection problems (35.7%; 95% CI, 21% to 54.2%), interaction difficulty (communication) (32.1%; 95% CI, 18% to 51%), low e-learning effectiveness (17.9%; 95% CI, 8% to 35.6%), lack of focus and engagement (17.9%; 95% CI, 8% to 35.6%), concerns about cheating on exams (14.3%; 95% CI, 8% to 35.6%), decreased motivation (14.3%; 95% CI, 8% to 35.6%), need for training on digital platforms (14.3%; 95% CI, 8% to 35.6%), distractions (10.7%; 95% CI, 4% to 27.2%), decreased clinical skills (10.7%; 95% CI, 4% to 27.2%) and limited computer skills (3.6%; 95% CI, 1% to 18%).

There is a preference for traditional classroom instruction (32.1%, 95% CI, 18% to 51%) over e-learning (7.1%, 95% CI, 2% to 22.6%), both among students and professors.8,17-19,24,25,32,35,38,39,41 (Figure 5A). The perception of e-learning during the COVID-19 pandemic was positive in 32.1% of the reports (95% CI, 18% to 51%) and negative in 14.4% (95% CI, 6% to 31.4%)8,11,21,23,24,26,29,31,32,34-37 (Figure 5D).

4 | DISCUSSION

During the COVID-19 pandemic, educational institutions have had to adapt immediately to remote methodologies, to make class maintenance feasible. This educational modality is mediated by technology in such a way that the peculiarities of face-to-face classes are carried out through digital platforms, which differs from the activities known as distance education. The shift from traditional education to remote education required a reformulation of pedagogical strategies and methodologies with the need for investments in technological resources and professor training to ensure that there is no impairment to the learning process.42 Digital teaching is a general challenge for all courses, being especially demanding for Dentistry due to the practical load.43 In this way, new teaching methods are being implemented and technologies are being developed.44
In this study, the results showed that the most used teaching methodologies during the COVID-19 pandemic were synchronous lectures, asynchronous lectures and a combination of both modalities. Furthermore, the minority understood e-learning as a useful tool for the acquisition of clinical knowledge, as well as for the development of manual skills. This ScR showed that there was a greater preference for synchronous recorded live lectures and asynchronous pre-recorded lectures over non-recorded live lectures and there was a preference for the use of educational videos. In general, both students and lecturers were satisfied with the quality of the classes given, even though they disagreed with the effectiveness. None of the included studies reported about how clinical training might have been conducted in dentistry e-learning. However, in Medicine, the reported solution to overcome the restrictions imposed on clinical education was the use of telemedicine, especially among students in clinical training at university hospitals. With this, medical students were able to train anamnesis and communication, and diagnostic skills.

Educators were forced to find alternatives to continue delivering content. In this sense, e-learning requires the use of different technologies and online assessment strategies. For this, some tools, like Respondus Lockdown Browser and eProctor, were used to prevent the student from cheating and consulting external information or copying materials, including internet browsers or other software while the assessment was open. Another tactic reported was the facial monitoring of students through an extra camera during the test run, in which face time on-screen and off-screen was compared to speculate the probability of cheating. Also, some dental institutions implemented virtual Objective Structured Clinical Examination (OSCE), as an alternative for evaluating clinical performance. In this appraising practice, most used in medical education, clinical reasoning is verified, how patient care is conducted, in addition to objective questions. This is an important tool that can be used, mainly, among undergraduates that are already in the clinical phase or nearing completion of the course, given the great difficulty observed in replacing clinical practical classes.

The use of different platforms was also implemented. Thus, the use of software and electronic platforms (such as Zoom, Microsoft Teams, Google Meets and Moodle) for video conferences and for the development of the proposed activities, already occurred in distance learning. As in dental education, the Zoom and Microsoft Teams virtual platforms have been widely adopted for formal medical education through virtual training webinars, simulation-based training and theoretical reviews in video sessions. One study reported that students felt that Zoom allowed an increase in the ability to access, share and discuss among educators and classmates. However, compared with traditional dental education, Zoom’s educational meetings were considered academically better (60% agreed), while for clinical learning, they were worse (100% agreed). It is important to make the technology widely available, have stable internet connections, and ensure that both students and professors can use these tools for remote learning to happen successfully. Internet instabilities were usually reported, which also functioned as a stress-inducing factor. Also, students who had more advanced computer skills and previous experience in distance learning courses before the pandemic showed greater ease and a more positive attitude towards e-learning. Another study showed the use of social media as preferred by the students for notification of class schedules. In the use of technology by the faculty members, the difficulty in dealing with the tools was higher and they pointed out that it was more challenging to present a web-based lecture instead of a face-to-face lecture. In some cases, some professors have developed new learning technologies for the exclusive use of their students, such as mobile applications to study traumatic dental injuries and local anaesthesia application simulators in a 3D virtual environment.

Regarding the pointed-out advantages, remote education enables the comfort of attending classes at home and spending more time with family. Some students believe they can study more efficiently, and digitization of teaching provides more collaborative approaches. For lecturers and students, the advantages can be the reduction of traffic time, time management, flexibility in learning, the facility to access national and international events, the possibility of less distraction and greater concentration on presentations and the opportunity to review recorded classes repeatedly to take additional notes. Comparatively, the use of digital devices in nursing education allows safe and facilitated communication and collaboration between classmates and faculty, and promotes independent learning. Besides that, some studies have cited that e-learning can increase motivation and interest, and make students more engaged with course content, so, remote education is still the safer methodology at this moment in many countries.

The difficulties found in the literature are the increase in exhaustion, especially caused by excessive screen usage, the lack of human contact and home life distractions. This exhaustion consequently impacts pre-clinical learning, leading to difficulties in retaining the content, understanding the available material, and staying focused or motivated. As well, technical difficulties such as unstable internet connection, video and audio problems, external noise and interrupted electrical supply have been reported. Stress and anxiety were also experienced, perhaps associated with the lack of clinical activities, the doubt about graduation completion, and the fear of being infected and of contaminating family members. This condition could impact the performance of learning and reduce the level of physical and mental health. Likewise, increased stress and mood alterations were also observed among medical students, who reported feeling more depressed and feeling exhausted (23.6%). Thus, it is important to provide ideal conditions for equal and quality internet access, ensure non-stressful teaching and allow knowledge to be acquired.

Students must assume an active and autonomous posture to develop their teaching-learning process in remote learning. However, this protagonism is not perceived by most students, which plays a negative role in more active and interactive studies. Unfortunately, given the new scenario, many of them were unable to establish initial concepts, and this is compromised due
to the construction of knowledge, which occurs hierarchically.\textsuperscript{54} The students must be able to use the technologies and in the same way, realise why this can be beneficial for the learning process. Moreover, lecturers need to face these new technologies as a complement in teaching and not as a limitation.\textsuperscript{55} Therefore, it is essential to personalise diverse educational strategies to promote interactive, accessible and less stressful methods, to deliver quality education.

Overall, the limitations of this ScR are the heterogeneity of the studies despite using questionnaires to evaluate the perceptions of the students and professors, the fence cannot be inferred of learning effectiveness. Furthermore, not all the studies included in these ScRs have deeply assessed the perception of e-learning among undergraduates, postgraduate students, residents, trainees, faculty members, dental schools and residency programs. Moreover, it is not possible to make an inference about actual levels of learning. The positive perceptions about online teaching and getting good grades does not reflect the knowledge acquired, not even when evaluating traditional classroom teaching. Besides, we considered that only studies with information based on applied analysis were able to ensure the potential for clustering frequency data. Thus, qualitative studies were excluded. As this is a ScR, we do not carry out a quality assessment based on the risk of bias, and no critical quality assessment was performed.

5 | CONCLUSION

The COVID-19 pandemic introduced several challenges to dental education. Thus, there has been an increased use of blended methodologies, tools and platforms in the dental education profile. The evidence suggests that e-learning technologies can widely contribute to dental education during the COVID-19 pandemic. However, the preference is still for traditional methodologies and the perception of students and professors for the need of improving online classes. This study assessed the impact of COVID-19 restrictions on dental education; meanwhile, further studies are needed to identify how restrictions in dental practice will affect future professionals.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

We declare that all data that support the results of this article study will be available as supplementary materials.

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**SUPPORTING INFORMATION**

Additional supporting information may be found in the online version of the article at the publisher’s website.

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