

# Digitalized dental learning and teaching methods during COVID lockdown—a student perspective

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**Background:** Although World Health Organization (WHO) has classified coronavirus disease 19 (COVID-19) as a major event that no longer endangers human beings, the online learning shift brought by COVID-19 is worthy of our reconsideration and provides enlightenment for traditional learning and electronic learning (e-learning) in the future. The present study aims to implement effective and affordable dental education strategies in the dental institute during the COVID-19 lockdown.

**Methods:** A total of 363 students participated in the study. Based on their academic year of Bachelor of Dental Surgery (BDS), all students were registered into the institutional repository iMac server and the data shared into this server can be accessed by the students through the file explorer application only with the intranet facility. Activities were conducted after the virtual teaching, and the students were assessed for knowledge through the Socrative Application. The effectiveness of e-learning tools was evaluated by feedback forms.

**Results:** Awareness of e-learning methods and knowledge of internet usage among dental students is 73.8% and 74.7%, respectively. When given a time limit to finish an online exam or assignment, 72.7% of students considered it as good, and the instant feedback received for their performance on activities like online tests or assignments was ranked up to 69.1%. The ability to communicate with teachers to solve any prevailing problems with virtual teaching and the rate at which they benefited through online teaching methods was surprisingly coincidental, up to 69.1%.

**Conclusions:** Different e-learning methodologies and the tools used for an online education system with proper prior instructions during the COVID-19 lockdown were used and transformed step-by-step to overcome the technology-based problems. This also integrated with activity-based learning that helped students to retain knowledge in the dental profession.

**Keywords:** Coronavirus disease 19 lockdown (COVID-19 lockdown); digital education; electronic learning (e-learning)

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## Introduction

Electronic learning (e-learning) can be defined as using computer and internet technologies to deliver a broad array of solutions to enable learning and improve performance. e-learning is mainly divided into knowing and integrating its components into a professional organization, designing an e-learning course, creating interactive content, and evaluating the learning activities (1,2).

The course and course material are selected for cognitive-based learning curricula based on the subject matter to be taught. The knowledge connected to the specific topic to be taught to the pupils will then be the main focus, as well as how this knowledge is taught. The course and course material are selected in skill-based learning curricula based on the abilities to be developed. Professional expertise is one of the primary considerations when picking content in daily life. The competencies that need to be developed are the main focus. During a pandemic, skill-based learning will have a significant impact on the educational system (2,3).

Traditional learning methods are just teacher-centered, which transmits information or knowledge to the students. But coronavirus disease 19 (COVID-19) infection resulted in a lack of collaboration and communication with students, resulting in a lack of knowledge among dental students needed in every work environment (3,4).

As we all know, technology is advancing continuously, and this technology helps professionals cope with pandemic situations like COVID-19 by shifting the traditional education system to advanced e-learning techniques. e-learning methodology provides an e-learning option for all dental institutions (5,6).

The goal of every institute during the pandemic is to

identify the importance of technology as a prime source of innovation in uplifting services to its stakeholders. Every institute should commit to helping its faculty and students with technology by creating a professional learning culture that drives innovation. The institutions and universities should implement a system that can upscale our academics, patient care, and community outreach services. Amongst these, the importance of technology in bringing up the concept of blended learning and flipped classroom learning methodology with major beneficiaries being students is important in making them competent and efficient in rendering their services to patients and the community at large (6,7).

This worldwide crisis had increased at-home learning settings and tools, working towards a safer manner to interact with learners in many professions. To better engage learners in their industries around the world, people are now attempting to build a blended learning method or flipped classroom scenario.

Blended learning combines traditional classroom instruction with online learning and other course elements. Flipped classrooms, on the other hand, involve the creation of courses, books, or lectures by the instructors that students can view or read at their own pace, with in-class instruction assisting in the practice of the concepts covered in the videos or other course materials. During the pandemic, the concepts of both blended learning and flipped classroom learning were used in online education.

It is important to know provide information about what elements constitute e-learning methodology, educating and motivating students about different e-learning systems. The e-learning team for an institute will help in knowing and applying the appropriate learning methods to enhance learning through technology. The new e-learning methodology will provide to manage the sharing of the material, conduct assignments, and discuss special cases to retain knowledge among all the dental students during this lockdown (7,8).

The most popular digital education tools used for communication between the students and teachers during online education in our dental institute were Socrative, Edmodo, eduClipper, and the online video and audio conferencing software used were Zoom, Microsoft Teams, and Moodle e-Abhyas (9,10).

The study's main objective is to evaluate the online learning strategies in dental education during the COVID-19 lockdown and to instill knowledge among dental students COVID-19 the lockdown through e-learning methodology.

### Highlight box

#### Key findings

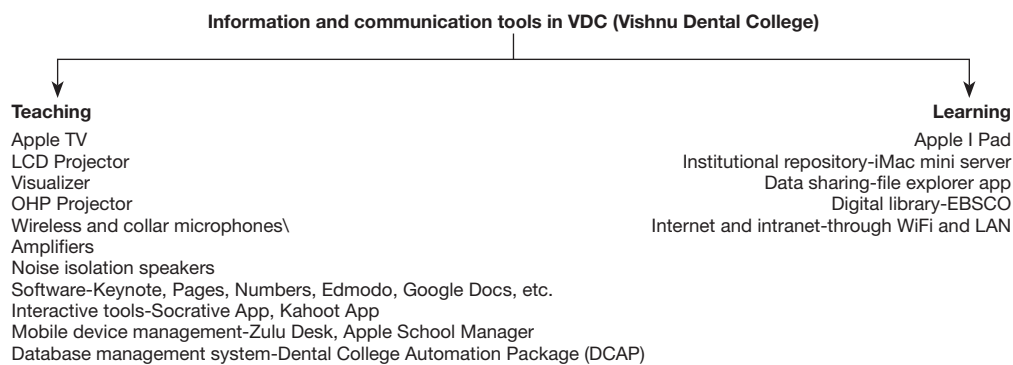
- Digital dental education helped students to learn the subject efficiently by active participation

#### What is known and what is new?

- Both faculty and the students benefitted through digitalized learning and teaching methods.
- Faculty should enhance their innovative skills and thought processes for effective teaching and student engagement.

#### What is the implication, and what should change now?

- e-learning methodology provides an e-learning option for all dental institutions so that students acquire and retain knowledge and skills to face global advancement in every profession.



**Figure 1** Information and communication tools used in our institute. LCD, liquid-crystal display; OHP, Overhead Projector; EBSCO, Elton B. Stephens Company; LAN, Local Area Network.

### *e-learning trainees and participants*

With only innovation in mind, we started our journey towards it in the year 2017. There were many challenges we faced initially from the selection of tools that fit our small group teaching ecosystem and making our faculty and students digitally literate in the virtual education space (Figure 1). We began conducting various faculty development programs and student empowerment programs designed by our dedicated e-learning team and Vishnu Educational Development and Innovation Centre (VEDIC).

The academic dean of the dental institute selected an e-learning team. The team members should be aware of technology and internet usage. Once the team was formed and approved by the institute's head, they were sent for training under faculty development programs conducted by a peer group of institutions in VEDIC.

Faculty from the dental institute underwent training in Vedic-Hyderabad and Vishnu educational institutes, Bhimavaram, Andhra Pradesh, on newer technology used for online learning and teaching. In faculty development programs, all the e-learning team members focused on learning and knowing about different education tools and software systems (11).

Our educational group conducted hands-on courses on using tools like Zoom, Microsoft Teams, Moodle e-Abhyas, Edmodo, and Socrative applications for activity-based learning. All the team members of e-learning actively participated and received certificates after hands-on course completion (12).

The e-learning team, once trained in all aspects of the online education system, introduced e-learning methods to undergraduate students of our dental institute. They

also provided guidelines for e-learning methods, including registering with institutional mail Ids to the educational tools and software systems followed in our institute.

Once the e-learning team introduced the technology to the students, the content was uploaded through software collaborations we followed. The e-learning team helped the other faculty conduct online classes and engages students with activities. Managing academic content and assessing the student's knowledge is done immediately after the virtual studies through online assessment tools like Socrative and Edmodo app.

### **Methods**

Our institute had taken the following initiatives during the pandemic-induced lockdown to maintain equilibrium in regular studies.

#### *To facilitate online teaching of the remaining syllabus (pre-lockdown) and bring in real-time conversation or teaching with students*

We were using the Microsoft Teams & ZOOM software applications. Vishnu Dental College (VDC) faculty were digitally literate even before the COVID-induced lockdown as we have visionary management, faculty of VEDIC, and a dedicated VDC e-learning team. They received training and implemented blended learning into our academic system in 2018.

#### *To conduct online activity-based learning*

We utilized the Socrative app and Google Forms for

Multiple Choice Questions (MCQ) and short answer-based questions. We implemented these applications immediately after the workshop we attended on instructional technology as part of the faculty development program. VDC faculty and students are well versed in using it since we have integrated it into our activity-based small group teaching.

#### *To communicate with students and faculty*

We used our institutional email ids created for both faculty & students and dedicated WhatsApp groups. We have VDC e-learning groups year-wise with respective in-charge faculty and students as participants. We were regularly communicating with students and shared timetables and teaching schedules through it. Faculty allotted to facilitate a lecture will post the meeting link through WhatsApp and institutional email ids and students need to click on the link and join the class. We shared the general instructions with faculty and students to facilitate an effective teaching and learning process.

#### *To facilitate the students with a lecture that they have missed due to various reasons*

We asked the faculty to use the record option in the Microsoft Teams app. Once we received the video, we uploaded them to a private YouTube channel which can be viewed only with permission. We haven't communicated this option with students to promote thicker attendance to the online lectures. If they report to us that they couldn't attend the lecture only then, we forwarded the link to the student to view it from our private YouTube channel.

#### *Student and parent's feedback on online academic activities during the pandemic*

Periodic feedback was taken to increase efficiency and effectiveness. We observed students' ability to communicate with teachers to solve any prevailing problems with virtual teaching and the rate at which they benefited through online teaching methods.

We were interacting with parents and collecting their feedback too. According to 86.2% of parents, the online lectures that took place during the lockdown were properly thought out. Because of the online educational system, 85.9% of parents said that their wards were actively engaged. Parents' satisfaction with the institution's overall online education strategy was 80.2%. Effective planning

and implementation of the lesson, student interaction and motivation, subject knowledge, effective communication and student achievement are a few of key criteria and their descriptions. When all five of the aforementioned requirements are met, a score of 5 can be assigned on a scale of 0 to 5.

On a scale of 0 to 5, 33.9% of parents rated excellent for the faculty and management's efforts during online classes. The online education system was deemed beneficial by 86.2% of parents for their wards.

#### *Assessments for learning*

Formative assessments were conducted during the Pandemic period. Two sets of internal examination papers were forwarded to the internal assessment committee 4 days before the commencement of the internal examination date. On the day of the exam, students were instructed to log into Microsoft Teams and then the question paper was forwarded to their respective institutional email ids. Respective department faculty is allotted to proctor the exam virtually. Students downloading the question paper started answering it on A4 sheets. On completion of the exam or at the end of the examination time students were instructed to scan written answer scripts and forward them to the respective department institutional mail ID with the subject bearing their registered roll number.

Valuation of answer sheets was done by the respective faculty within a week. Faculty were requested to send a copy of internal marks sheets along with an attached copy of absentees, failures with reasons, and necessary action plan taken by the mentor towards the slow learners within 10 days of the examination. Obtained marks and remedial measures were forwarded to students' respective institutional mail ids.

#### *Digital access to study material*

(I) Appropriate videos and course material were collected from the internet viz., YouTube, Google, etc. Its URLs were documented and forwarded to students. (II) Soft copies of licensed textbooks were uploaded into the drive and the drive link was shared with students. (III) Scientific content portals were subscribed and login credentials were populated for faculty and students.

The data for this study were based on the student's experiences with e-learning methodologies. Feedback forms constitute the following questions under students' demographics and background information, design of

online teaching and learning, assessment techniques, communication strategies, benefits, challenges, and technical support.

A total of 363 students participated in the study. Based on their academic year of Bachelor of Dental Surgery (BDS), 363 students were categorized into four groups: I BDS [93], II BDS [89], III BDS [93], and IV BDS [88] students.

#### **Inclusion criteria**

- (I) Undergraduate students from I<sup>st</sup> BDS to IV<sup>th</sup> BDS;
- (II) Students who had shown interest to continue their education during the COVID-19 lockdown.

#### **Exclusion criteria**

- (I) Participants who finished or not appearing for the university examination.
- (II) Those not willing to learn through advanced e-learning methodology during the COVID-19 lockdown due to health issues.
- (III) Those not able to use electronic databases or due to the lack of network connection in rural and semi-urban areas.

The questionnaire included the demographics information of the students, their health status, and their willingness of students to continue dental education during a pandemic and to know the availability of electronic databases usage in their region or location. We have conducted a pilot survey with the validation of questions from all the subject experts. Google forms were created based on the above-said aspects included for student feedback. Documents were circulated to all the BDS students through social media (WhatsApp groups) and informed to fill in the feedback about e-learning technology and its use.

#### **Statistical analysis**

The participants responded to the survey anonymously, and the data was stored in the hosted online survey service. Descriptive data analyses (such as frequencies) were conducted using the data analysis tool provided on the online survey site.

#### **Ethical statement**

The institutional review board of Vishnu Dental College approved this study (No. VDC/RP/2020/14). For all the participants, the study aims, objectives, information confidentiality, and their right to leave the survey at any

time were explained by the e-learning team. Oral consent was taken from all the participants to incorporate in the study. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013).

## **Results**

In total, 363 participants with 18.7% male and 81.3% female students with an age range of 16–21 years from 1<sup>st</sup> to 4<sup>th</sup> BDS students were included by e-team in the study. Among the participants, 24.2% of IV-year students, 25.6% of III-year students, 24.5% of II-year students, and 25.6% of I-year students were included in the study.

#### ***Participant's characteristics***

All the demographic characteristics with students' awareness of online teaching schedules and their knowledge of internet usage with their craving levels during the COVID lockdown period were summarized in *Table 1*.

#### ***Design characteristics of online teaching and learning***

All the faculty of our institute continuously worked hard on digitalizing the academics completely during the pandemic. We used learning aids like iPads for online teaching effectively. All the students were motivated for online teaching classes well in advance of the teaching schedule, and proper guidelines and instructions were given on how to use digital technology for online classes and what software programs and apps should be downloaded before introducing the e-learning methodology.

All the faculty effectively used their time and space for their classes, and they planned to reach the learning objectives. The faculty paid their effort and engaged the students with innovative methods of online teaching.

All the above design characteristics of online teaching and learning were rated by all the students of our institute and they were summarized in *Table 2*.

#### ***Assessment of online teaching and learning style***

Online teaching and learning methods were assessed by conducting online tests/assignments/multiple-choice questions and debates between small groups before starting the lecture for about 15 minutes. Immediate feedback forms assessed the performance of the students after online class through activities on each topic for about 15 minutes after

**Table 1** Characteristics of participants

Demographics and characteristics	Percentages of characteristics
<b>Academic year</b>	
I BDS	25.6% (n=93)
II BDS	24.5% (n=89)
III BDS	25.6% (n=93)
IV BDS	24.2% (n=88)
<b>Age</b>	
16–17 years	15.1%
18–19 years	14.9%
20–21 years	36.4%
>21 years	33.6%
<b>Gender</b>	
Female	81.3%
Male	18.7%
<b>Residence location</b>	
Urban area	39.4%
Semi-urban area	28.1%
Rural areas	32.5%
<b>Awareness of the online teaching schedule before the commencement of classes (4-point Likert scale was used when users' opinion is essential without giving a neutral score)</b>	
Excellent	15.2%
Good	73.8%
Fair	10.2%
Poor	0.8%
<b>Ranking the knowledge of Internet usage</b>	
Excellent	8.5%
Good	74.7%
Fair	15.4%
Poor	1.4%
<b>Craving levels of professional learning during lockdown</b>	
Excellent	5.1%
Good	70.8%
Fair	19%
Poor	5.1%

BDS, Bachelor of Dental Surgery.

**Table 2** Design characteristics of online teaching and learning

Characteristic feature	Percentages
<b>Level of motivation obtained from academic scheduling, online training sessions, and learning objectives (4-point Likert scale was used when users' opinion is essential without giving a neutral score)</b>	
Excellent	13.2%
Good	71.3%
Fair	15.2%
Poor	0.3%
<b>Students' rating of usage of learning aids (iPads) effectively during online classes</b>	
Excellent	41.6%
Good	51%
Fair	5.6%
Poor	1.8%
<b>Rating of faculty class time and space during an online education system</b>	
Excellent	30.3%
Good	66.7%
Fair	2.7%
Poor	0.3%
<b>Rating of online classes that engaged the students</b>	
Excellent	12.9%
Good	77.1%
Fair	9.6%
Poor	0.4%
<b>The effort put by the faculty into the online classes</b>	
Excellent	56.2%
Good	41.6%
Fair	2.2%

the lecture.

About 13.6% of students rated excellent on time given to complete online tests or assignments, etc. Of the students, 72.7% gave good grades, 9.9% gave fair grades, and 3.8% gave low grades. And 27% of students rated excellent, 69.1% rated good, and 3.9% rated fair on the instant feedback to know their performance in the activity.

### *Communication between the students and teachers*

The communication between the students and faculty for conducting online classes is essential, and it consists of providing timetables and teaching schedules before the lessons and clarifying doubts post-lecture. Of the students 40.8% rated excellent, 55.6% ranked good, and 3.6% of students rated fair on students' and teachers' communication skills.

Of the students, 33.3% rated excellent, 62.3% ranked good, 4% rated fair, and 0.4% rated low on the teacher's availability to respond to their queries after class hours via social media platforms. Of the students, 22.3% rated excellent, 69.1% ranked good, 8% rated fair, and 0.6% rated poor on faculty solving their problems during online teaching.

### *Benefits, challenges, and technical support*

Students benefited much through online classes and also faced a few challenges with technology. Of the students, 15.2% rated excellent, 69.1% ranked good, 14% rated fair, and 1.7% rated low on the benefit of the online academic activity during the COVID-19 lockdown. Of the students, 36.9% rated excellent, 59.8% ranked good, and 3.3% rated fair on the support, and prompt response of the e-learning team to the technical issue during or after the commencement of online classes.

## **Discussion**

This study helped explain the transformation of traditional classroom teaching and the significance of e-learning methods for dental education during this pandemic. The constant change in learning mindsets across generations demands alteration in teaching methodologies, including individual student focus, updated industrial orientation, technology adoption, evidence-based training, and multitasking ability building (13).

The e-learning team of this institute is continuously evolving to cater learning community. We have designed a curriculum based on the Dental Council of India (DCI) and NTR University of Health Sciences (NTRUHS) and the regular curriculum, and the institution has included ethical and value-added courses. Since 2017, we have implemented technology in the teaching and learning process to increase millennial' student engagement. We conduct online tests designed to improve students' cognitive abilities, attitudes,

critical thinking, and logical reasoning. Virtual learning is safe and satisfactory in engaging dental students during this pandemic and helps fulfill the student's knowledge on par with the traditional teaching methods (14,15).

We are fully digital chartless and paperless; this institute is committed to utilizing computerized patient record systems, digital X-rays, and intraoral cameras that allow you to see everything the doctor sees, and we also use patient education videos.

In addition to the conventional dental teaching strategies like lectures, demonstrations, and performing clinical procedures, digitalization is important and impacts dental students learning methods in the pandemic. Digital learning and teaching methods followed in the institute are summarized in *Figure 2* (16,17).

Evaluation of students was done in this study by conducting online tests or assignments or by conducting formative assessments to check the knowledge students have gained during the learning process by digitalized dental education. These assessment results were by Cheng *et al.* in their study in which they conducted online assessments by digital technology (18).

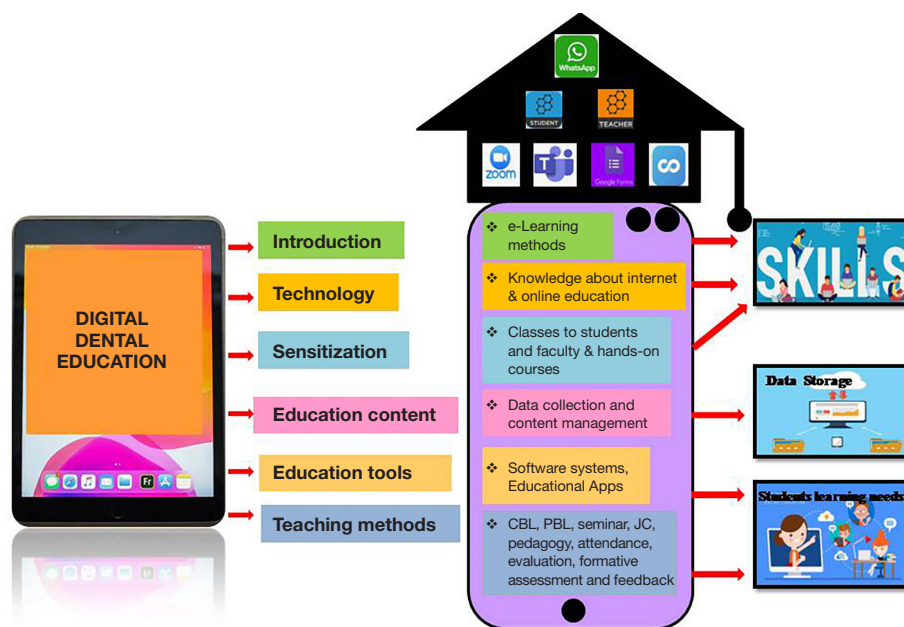
Very few students experienced inconvenience with the online education system because of internet usage efficiency and due to the rural residence or location where they had difficulty joining online classes. Very few students also experienced trouble with online exams because this technology was used for the first time in their profession.

Cheng *et al.* 2020 conducted a case study on the Application of DenTeach in Remote Dentistry Teaching and Learning During the COVID-19 Pandemic and the trials have shown significant improvement in terms of tool handling, smoothness of motion, and steadiness of the operation (18).

We have conducted student assessments through feedback forms to know their performance to know and overcome the deficiencies in virtual teaching. These assessment results were also in accordance with Zitzmann *et al.* 2020 in which students felt that online assessments or education systems showed a great way for them to practice in the future and to reach the greatest levels in academics (19).

In many educational institutes and professions, flipped learning has grown as a very common education system as the main principle in this system is enabling active learning.

Su *et al.* in 2018 conducted a structural model and investigated the effects of flipped classroom learning, student question generation, and instant response



**Figure 2** Digitalized dental learning and teaching methods followed in our institute. CBL, Case Based Learning; PBL, Problem Based Learning; JC, Journal Club.

technologies on students' learning motivation, attitudes, and engagement. Though the students showed a positive impact on learning motivation, attitudes, and engagement, they had contrasting opinions on the motivation or attitudes of students (20).

In our study, we introduced e-learning technology before the pandemic, and we keep on transforming at a faster pace from a traditional system to e-learning and used many applications for interactive sessions or activities and at last, we created a single platform like Moodle where we have the content available for all the students for learning purpose and even the applications for activities in between teaching classes are integrated into Moodle learning system. So, no students found it difficult to search for different applications for activities. All the activities under one platform helped in engaging and motivating the students all the time. It seemed that students followed the online education system very easily after the pandemic due to the continuous online education during the pandemic. Designing an e-learning course is an important aspect of e-learning, whereas creating interactive content and evaluating the learning activities were the most satisfied components by students.

To ascertain the frequency of various teaching approaches, technologies, and platforms used in dentistry education during the COVID-19 pandemic, Di Carvalho

Melo *et al.* undertook a scoping review in 2023. The scoping analysis of the dental education profile revealed promising blended teaching approaches, technologies, and platforms. According to the available data, e-learning technologies can significantly advance dentistry education during the COVID-19 pandemic. As we started and experienced e-learning methodology for five years, we have created and designed the e-learning system which is standardized with content by day-to-day updates for the faculty in training them in all aspects of advanced e-learning methodology (21).

Asiry [2017] in a study on dental students' perceptions of online learning concluded that the students viewed e-learning as a supplement than a replacement for conventional teaching methods. Whereas in this present study, students revealed that e-learning is the best alternative education system before and during pandemics because of both offline and online communication platforms created by our e-learning system (22).

These are the following innovative methods followed in our institute for effective teaching and learning process. Problem-based learning, case-based team-based learning, microteaching, and flipped classroom are some of the innovations we followed and the methods and design of the system we followed are in accordance with the education system followed by Bhat *et al.* in 2021 (23).



The strengths of blended learning are promoting lecturer-student interactions, the focus on students' learning needs and self-learning, and problem-solving skills. All these objectives were reached by following the blended learning methods while implementing the e-learning methodologies in our institute. The student's perception of e-learning methodology is in accordance with Jebraeily *et al.* 2020 (24).

Alkadi in 2021 used the technology to ensure the continuity of education. COVID-19 is associated with many changes in the continuity of education and it is also accompanied by many challenges in continuing education. This made every professional update in technology and served the students by providing education throughout the pandemic also. The steps and challenges faced and solving the same problems by training among the faculty made this study peculiar to other studies during a pandemic (25).

### **Recommendations for digitalization during COVID-19**

- ❖ Both faculty and the students benefitted during these tried and testing times.
- ❖ Faculty had enhanced their innovative skills and thought processes for effective teaching and student engagement.
- ❖ Students learned the subject efficiently by active participation in an online lecture.
- ❖ Apart from all these, regular online meetings with the parents who are primary stakeholders of our institute appreciated the efforts put forth by the e-learning team during the crisis time.

### **Limitations of the study**

For some areas of education, especially theoretical components, e-learning is fine. However, it is not appropriate for situations that call for a far more delicate, individualized approach, such as when healthcare experts must see the patient in-person, identify the issue through discussion, and address concerns with individual suffering.

### **Conclusions**

This study elaborated on the digital dental education methods and the challenges of the shift from traditional classroom teaching to e-learning education methods. The dental students of our institute appreciated this shift. Our institute recommended developing a blended learning methodology and the most innovative approaches to

promote a technologically based e-learning education system in the coming years. Hence, our motto is leadership in education, patient care, advanced oral care, and commitment to cultivating exceptional graduating doctors with excellent skills for their future achievements.

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## References

- Barteit S, Guzek D, Jahn A, et al. Evaluation of e-learning for medical education in low- and middle-income countries: A systematic review. *Comput Educ* 2020;145:103726.
- Oetter N, Möst T, Weber M, et al. COVID-19 pandemic and its impact on dental education: digitalization - progress or regress? Example of an online hands-on course. *BMC Med Educ* 2022;22:591.
- Jiang Z, Zhu D, Li J, et al. Online dental teaching practices during the COVID-19 pandemic: a cross-sectional online survey from China. *BMC Oral Health* 2021;21:189.
- Stevens NT, Holmes K, Grainger RJ, et al. Can e-learning improve the performance of undergraduate medical students in Clinical Microbiology examinations? *BMC Med Educ* 2019;19:408.
- Al Shorbaji N, Atun R, Car J, et al. eLearning for undergraduate health professional education: a systematic review informing a radical transformation of health workforce development. World Health Organization; 2015.
- Nicoll P, MacRury S, van Woerden HC, et al. Evaluation of Technology-Enhanced Learning Programs for Health Care Professionals: Systematic Review. *J Med Internet Res* 2018;20:e131.
- Trivandrum Anandapadmanabhan L, Ramani P, Ramadoss R, et al. Effect of COVID-19 on Dental Education: A Review. *Cureus* 2022;14:e24455.
- Yu-Fong Chang J, Wang LH, Lin TC, et al. Comparison of learning effectiveness between physical classroom and online learning for dental education during the COVID-19 pandemic. *J Dent Sci* 2021;16:1281-9.
- Varoni EM, Sardella A, Lodi G, et al. COVID-19 and Dental Education: the Experience of the Dental School from the University of Milan. *Med Sci Educ* 2022;32:539-44.
- Farrokhi F, Mohebbi SZ, Farrokhi F, et al. Impact of COVID-19 on dental education- a scoping review. *BMC Med Educ* 2021;21:587.
- Dastnaei PH, Moallemi ZS, Najimi A. Quality of training in oral health educational programs: What do primary healthcare providers think? *J Educ Health Promot* 2020;9:60.
- Newman T, Beetham H. Student digital experience tracker 2017: The voice of 22,000 UK learners. Bristol: Jisc. 2017 Jun 26.
- Li B, Cheng L, Wang H. Challenges and Opportunities for Dental Education from COVID-19. *Dent J (Basel)* 2022;10:188.
- Nasseripour M, Turner J, Rajadurai S, 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;8:2382120521999667.
- Hernández-Crespo AM, Fernández-Riveiro P, Rapado-González Ó, et al. Students' Perceptions of Educational Climate in a Spanish School of Dentistry Using the Dundee Ready Education Environment Measure: A Longitudinal Study. *Dentistry Journal* 2020;8:133.
- Colomo-Magaña E, Soto-Varela R, Ruiz-Palmero J, et al. University students' perception of the usefulness of the flipped classroom methodology. *Education Sciences* 2020;10:275.
- Kerkstra RL, Rustagi KA, Grimshaw AA, et al. Dental education practices during COVID-19: A scoping review. *J Dent Educ* 2022;86:546-73.
- Cheng L, Kalvandi M, McKinstry S, et al. Application of DenTeach in Remote Dentistry Teaching and Learning During the COVID-19 Pandemic: A Case Study. *Front Robot AI* 2020;7:611424.
- Zitzmann NU, Matthisson L, Ohla H, et al. Digital Undergraduate Education in Dentistry: A Systematic Review. *Int J Environ Res Public Health* 2020;17:3269.
- Su CY, Chen CH. Investigating the effects of flipped learning, student question generation, and instant response technologies on students' learning motivation, attitudes, and engagement: A structural equation modeling. *EURASIA Journal of Mathematics, Science and Technology Education* 2018;14:2453-66.
- Di Carvalho Melo L, Bastos Silveira B, Amorim Dos Santos J, et al. Dental education profile in COVID-19 pandemic: A scoping review. *Eur J Dent Educ* 2023;27:252-61.
- Asiry MA. Dental students' perceptions of an online learning. *The Saudi Dental Journal* 2017;29:167-70.
- Bhat S, Madiyal A, Babu GS. Innovative teaching methods in dental education. *Gulhane Medical Journal* 2021;63:8-12.

24. Jebraeily M, Pirnejad H, Feizi A, et al. Evaluation of blended medical education from lecturers' and students' viewpoint: a qualitative study in a developing country. *BMC Medical Education* 2020;20:1.
25. Alkadi L. Dental Education in the COVID-19 Era: Challenges, Solutions and Opportunities. *The Open Dentistry Journal* 2021;15:17-24.

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