



## Blended Learning in Undergraduate Dental Education

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### Reviews

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### ABSTRACT

The Dental education sector has witnessed a lot of innovations in the past decade. Technology has played an important role in achieving this revolution such that the student can pursue the learning process at any given time and place beyond the geographical limits. The most frequently used approach is the concept of blended learning, which is an amalgamation of face-to-face and online modes of education. Thus, its role in ensuring the learning process to students all over the world despite the COVID 19 pandemic is innumerable. Hence, this review was conducted to explore how different dentistry fields have adopted this approach as a useful tool to impart dental education. The PUBMED database was used to retrieve the articles about the same using the search terms "Blended Learning" AND "dental education". The majority of the studies showed a positive response and a higher level of satisfaction in comparison to conventional teaching. However, certain studies also indicated no significant improvement in knowledge compared to conventional methods. Conventional methods will definitely continue to be the mainstay as certain themes cannot be dealt with otherwise. In such cases, blending online as well as traditional methods would give beneficial results while preserving the feel of the live personal interaction.

**Keywords:** Dental Education, Graduate, Educational Technology, Curriculum Innovation.

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## Introduction

The scenario of dental education has witnessed numerous innovations incorporated to suit the requirements of a technological era. In the 21st century, the field of education demands that facilitators design diverse and novel approaches to stay akin to various pupils at any moment and at any place.<sup>1</sup> The most frequently used approach is the concept of blended learning (BL), which is an amalgamation of face-to-face and online modes of education.<sup>2</sup> It involves direct and indirect instruction, collaborative guidance and individualized computer-aided learning.<sup>3</sup>

The traditional system of education definitely has its perks as it involves the much-needed face-to-face sessions and human touch. Only the face-to-face approach meets the affective objectives along with psychomotor and cognitive.<sup>3</sup> The COVID - 19 pandemic gave way to abrupt closure of Universities. This brought the traditional education system to an unprecedented complete halt owing to the impositions of lockdowns and difficulties in maintaining social distancing at schools. This paved the way to creating blended learning techniques as a mainstay in order to avoid the discontinuation of the teaching-learning process. More and more innovative blended learning resources were created involving technology to capture the attention of the students.<sup>4</sup> Learning can be made more effective via

this approach by eliminating the obstacles of time and duration. It enables the use of innovative methods of teaching and student-centered education.<sup>5</sup> E- learning is on the rise and reinforces learning by students in distinct ways while enabling a flexible environment.<sup>6</sup>

The term E-learning is universal; and encloses electronically compatible learning and teaching, which may or may not be online. It can be delivered either in the classroom or out of the classroom. It accomplishes self-paced or instructor-led learning involving variety of media in diverse forms like images, text, animation, audio and video.<sup>7</sup> In this review, we explore about the different fields of dentistry and the way they have adopted the blended learning techniques as a useful tool to impart dental education. The PUBMED database was used to retrieve the articles pertaining to the same using the search terms "Blended Learning" AND "dental education". Full-text articles pertaining to undergraduate dental education were selected for the purpose of this review.

Blended learning has been defined by Rowe *et al.* as the systematic integration of online and face-to-face engagement to support and enhance meaningful interaction between students, teachers and resources.<sup>8</sup> It is context-dependent. A successful application of the approach in one domain may not be beneficial in another.<sup>9</sup> According to a meta-analysis conducted by Means *et al.* on

the effectiveness of online and blended learning, a course can be rendered “blended” when at least 25% of its content is made available online. In order to design a program, all the available media and technology should be considered, and their usage should be enhanced in order to meet the requirements of the learner.<sup>10</sup>

**Blended Learning Models**

A variety of blended learning models that are a combination of synchronous and asynchronous patterns are given below.

- Synchronous Physical Formats
- Synchronous Externally Directed Learning Formats
- Online Live e-learning formats that are Self-Paced and Asynchronous

Synchronous physical formats comprise of Instructor-led classrooms and lectures, Hands-on laboratory and workshop sessions, and Hands-on clinical training.

Synchronous Externally Directed Learning formats include virtual classrooms, webinars, broadcasts/podcasts, instant messaging, and e-meetings while self-paced online live e-learning formats include Documents and web pages, Web/computer-based training modules, Assessments/tests/surveys, Recorded live events, Online streaming and discussion fora, Simulated experiences, Job aids, and electronic performance support systems.<sup>10</sup> (Figure 1)

Blended learning provides the feel of a traditional classroom where there can also be scope for face to face interaction in the case of virtual live classes. The benefits of the virtual classroom are incomparable as the learning process can happen at any given time and place. The cyberspace is a forum where meetings happen with co-students and teachers beyond the geographical

boundaries. Online audios and videos are available which utilise the latest means of technology and explain variety of concepts in a manner appealing to students and are simple to understand. A webinar is an important tool which is an ICT supported format. It facilitates student participation in topics of their choice virtually. Various softwares are available which enable them to present their academic paper online and simultaneously participate in discussion via video conferencing. Online assessments are a vital part of the blended concept and are very useful in the transition of the evaluation system which is more formative, transparent, and quick. Hence all the above features blended together form the basis of blended learning.<sup>3</sup>

**Blended Learning for Undergraduate Teaching in Various Branches of Dentistry**

In dentistry, virtual learning and blended approach have been specifically reviewed in radiology as it involves working with digital images, and is quite apt for virtual viewing. It can also be utilized to assess the learners understanding of the subject, especially the anatomy of the oral structures and differentiating their appearance in a normal and a pathologic phenomenon, thus aiding to arrive at a diagnosis.<sup>11</sup>

A study conducted by Pacheco-Pereira C *et al.* on assessing the confidence of students in the interpretation of dental images subsequent to a blended learning approach revealed that the module had a positive impact. The students also mentioned the significance of including the detailed history of the patient along with findings of clinical examination as part of their image interpretation exercise.<sup>12</sup>

<b>SYNCHRONOUS PHYSICAL FORMATS</b>	<b>Instructor-led classrooms and lectures, Hands-on laboratory and workshop sessions and Hands-on clinical training.</b>
<b>SYNCHRONOUS EXTERNALLY DIRECTED LEARNING FORMATS</b>	<b>Virtual classrooms, webinars, broadcasts/podcasts, instant messaging and e-meetings</b>
<b>ONLINE LIVE E-LEARNING FORMATS THAT ARE SELF-PACED AND ASYNCHRONOUS</b>	<b>Documents and web pages, Web/computer-based training modules, Assessments/tests/surveys, Recorded live events, Online streaming and discussion fora, Simulated experiences, Job aids and electronic performance support systems</b>

Figure 1. Showing the Variety of Blended Learning Models.

Kavadella A *et al.* performed a study to evaluate the effectiveness of blended learning module for imparting oral radiology to undergraduate dental students as compared with that of a conventional method. They found that students' attitude towards the blended approach was positive, and they performed better than their counterparts in the traditional group in the evaluation test post the course. The authors also concluded that it could be included in the curriculum of undergraduate teaching of dental students for oral radiology.<sup>13</sup> Eachempati *et al.* conducted a study to analyze the impact of blended education in order to reinforce dental pharmacology during clinical years. Online sessions and face to face discussions replaced the traditional teaching hours in this study. Each session had a quiz, MCQ, or case scenario which addressed themes from dental pharmacology associated with orofacial pain and oral lesions. Their findings suggested that blended education can be effectively amalgamated into the undergraduate curriculum, and would also be agreeable when they move from preclinical to clinical years. The researchers also felt that the process was flexible and time-efficient.<sup>14</sup>

Nijakowski K *et al.* conducted a study to check the efficacy of blended learning in Conservative Dentistry and Endodontics amongst the undergraduate students (4th year) during the COVID 19 pandemic. The theory classes were conducted using online learning portals. And the practicals were performed with patient involvement following appropriate protocol. The students were very optimistic about the blended learning method and wanted the same to continue even after the pandemic.<sup>15</sup> Similar positive attitudes of the students was observed in a study conducted by Maresca C *et al.* where students learned and demonstrated the skills better than that of the traditional group.<sup>16</sup>

Bock *et al.* devised blended education units for lectures of oral and maxillofacial surgery. The students were pleased with the method and were specifically impressed with the operative videos displayed in the course of the lectures, which were a part of the module. A survey conducted by them post the module revealed that the majority of the students use online learning tools and actually preferred learning this particular way. They also concluded that integrating a blended approach with curriculum could meet the demands of the students of the present era, and thus help in the transition of long lectures into interesting and impactful ones.<sup>17</sup>

Retrouvey *et al.* were one of the earliest with a blended learning module in Orthodontics way back in 2008 with methodologies comparable to this day. Their main objective was bridging differences amidst theoretic information and clinical competencies using interventional multimedia programs. They also highlighted that these could be useful learning tools within and beyond the confines of the classroom. This was very well accepted by the students who could bring about the learning process at their own pace as well as knowledge application by indulging in various exercises of the program.<sup>18</sup>

A randomized trial was conducted by Bains *et al.* comparing parallel groups of electronic learning, face-to-face, and blended training among orthodontic undergraduates to evaluate the efficacy as well as student attitudes towards the approach. They inferred that Blended learning was more effectual when compared to other modes in delivering cephalometric education to undergraduates.<sup>19</sup>

Jeganathan S *et al.* conducted a randomized control trial on using blended modules supplementing instructor-guided seminars for undergraduate teaching in orthodontics. Though the method was successful and the students accepted it, they did not find any significant improvement in knowledge in the blended approach as compared to the traditional approach. And the level of satisfaction was similar for both approaches.<sup>20</sup> This meant that the blending approach could be as efficacious as traditional education and could be a good option to be slowly introduced as a mainstay into the current curriculum, especially in topics where the traditional approach cannot be used. Also, a study conducted on varying attitudes towards disabled people in undergraduate Special care dentistry program using blended approach stated that it did not cause a significant improvement in the attitudes of students.<sup>21</sup> This could be due to the simple reason that blended learning may not be beneficial in some domains.<sup>9</sup>

Ariana *et al.* conducted a study to compare the scores of dental students in histopathology after teaching the students using blended learning and compared them with those who received traditional methods of training. The students who have had exposure to blended methods scored considerably better than those who had traditional methods alone. Their findings concluded that online tools for learning namely virtual microscopy and other innovative and interactive sources utilized for imparting pathology can be used to improve the performance, confidence, competence level and satisfaction among students.<sup>22</sup> A Blended learning approach utilized by Park *et al.*<sup>23</sup> in Dental Anatomy was well accepted by the students.

Reissmann *et al.* conducted a study evaluating the blended learning concept for a preclinical course of prosthodontics. The module is composed of three major components-key principles, additive information, and training outcome tests. Footages of the practical demonstration were uploaded online for the students to view. Also learning objective tests along with learning content were incorporated too. The evaluation of the students post this exercise was highly satisfactory.<sup>24</sup> Faraone *et al.* conducted a study using the blending techniques as a part of teaching pre-clinical prosthodontics. They wanted to test the hypothesis that this kind of approach would help establish competence in both pre-clinical as well as didactic learning. And that it required less supervision in comparison to the traditional approach.

Table 1. Showing the blended learning approaches followed in various programs of under graduation

Author	Year	Program	Method	Result
Retrouvey et al. <sup>(18)</sup>	2008	Orthodontics	Bridging differences amidst theoretic information and clinical competencies using interactional multimedia programmes	Positive Well accepted by the students who could bring about the learning process at their own pace Efficient tool beyond the confines of the classroom
Bains et al. <sup>(19)</sup>	2011	Orthodontics	Comparing electronic learning, face-to-face and blended training among undergraduates	Effectual when compared to other modes in delivering cephalometric education
Kavadella A et al. <sup>(13)</sup>	2012	Oral Radiology	Effectiveness of blended learning module for imparting oral radiology to undergraduate dental students as compared with that of a conventional method.	Positive On evaluation, students performed better than conventional counterparts
Faraone et al. <sup>(25)</sup>	2013	Preclinical Prosthodontics	Test the hypothesis that BL would help establish competence in both pre-clinical as well as didactic learning	Positive Students performance was good and they were satisfied too.
Maresca C et al. <sup>(16)</sup>	2014	Preclinical Endodontics	Check if students who experienced BL demonstrated better manual skills & knowledge in comparison to traditional approach	Students learnt and demonstrated the skills better than that of traditional group
Phdraig et al. <sup>(21)</sup>	2015	Special care dentistry	Assessing changing attitudes towards disabled people using BL	No significant improvement in the attitudes of students
Park et al. <sup>(23)</sup>	2015	Dental Anatomy	Promotion of student centered learning with flipped classroom	Positive with respect to the synergistic and innovative mode of BL
Reissmann et al. <sup>(24)</sup>	2015	Preclinical Prosthodontics	Evaluating the blended learning concept	Positive Student evaluation post the feedback was highly satisfactory
Eachempati et al. <sup>(14)</sup>	2016	Dental Pharmacology	Analyse the impact of blended education in order to reinforce dental pharmacology during clinical years	Positive Can be effectively amalgamated into the undergraduate curriculum, agreeable when they move from preclinical to clinical years. Flexible and Time efficient
Ariana et al. <sup>(22)</sup>	2016	General Pathology	Compare the scores after teaching the students using BL with those who received traditional methods of training.	Positive Virtual microscopy can be used to improve the performance, confidence, competence level and satisfaction among students
Bock et al. <sup>(17)</sup>	2018	Oral and Maxillofacial Surgery	Implement students' requests for new teaching methods	Positive Aid in transition of long lectures into interesting and impactful ones
Pacheco-Pereira C et al. <sup>(12)</sup>	2019	Oral Radiology	Assessed the confidence of students in interpretation of dental images subsequent to a blended learning approach	Positive
Jeganathan S et al. <sup>(20)</sup>	2020	Orthodontics	Randomised control trial on using blended modules supplementing instructor guided seminars	Positive Accepted by students No significant improvement in knowledge in blended approach as compared to the traditional approach
Nijakowski K et al. <sup>(15)</sup>	2021	Conservative Dentistry and Endodontics	Check the efficacy of blended learning amongst final year students during the COVID 19 pandemic.	Positive The students wanted the same approach to continue even after the pandemic

The course material was made available online. Thus, it was possible to blend the conventional delivery of teaching material with an asynchronous method involving virtual lecture presentations and online demonstrations. Students were satisfied with blended learning and they concluded that with the help of a technological environment, this approach facilitated student- focused learning with the enhancement of didactic and laboratory skills.<sup>25</sup>

### Advantages of Blended Learning

As the mode of instruction is online and is technology based, teachers have the creative freedom to use various strategies to explain a concept. The learning process of the students is unhindered while maintaining social interaction and the feel of traditional learning. Students become technologically sound and gain confidence which strengthens their professionalism. It also provides ample scope for communication.<sup>3</sup> It is possible to incorporate the benefits of personal communication in an offline classroom along with electronic learning. Thus, novel methods of instruction can be used to reach all potential learners regardless of the location and at any given time.<sup>5</sup>

### Limitations

The main limitation is that no matter how realistic, simulating an environment created by traditional learning, especially face-to-face interaction will be challenging. Training of practical skills cannot be undertaken online. Technical obstacles can also be another limitation especially in case of an unstable internet connection or poor connectivity. Since students are learning from home, there will be higher chances of distraction, which can be a hindrance to the learning process.<sup>26</sup>

### Future Perspective

The advancements in e-learning and technology have paved the way for an innovation in education enabling it to be individualized (adaptive learning), reinforcing interaction between the learners (collaborative learning) and revolutionizing the part of teacher from disseminator to facilitator.<sup>27</sup> The forthcoming e-learning packages may have scenario-based content and the difficulty level of the modules will be more as learners develop proficiency. Thus, the experience is personalized for every learner and will be more fascinating. The Face-to-face approach will continue by interactive lectures and networking events. Hence the blended approach will help us establish professionals in health care with the perfect harmony between knowledge, behaviour, and skills.<sup>28</sup> Predicting the future is not easy but the current trends may continue for a period of time and it is our duty as healthcare professionals to ensure that it is used wisely to avail the maximum benefits.<sup>29</sup>

### Conclusions

The field of education is changing at a faster pace and we often need to make the changes in our system of instruction in order to suit the requirements of the current generation of students. From the above review, it is clear that this approach has been accepted by the students as they found it innovative and highly satisfactory in comparison to traditional learning. However, certain studies also indicated that there was no significant improvement in knowledge in comparison to conventional methods. Conventional methods will definitely continue to be the mainstay as certain themes cannot be dealt otherwise. In such cases, blending online as well as traditional methods would give beneficial results, while preserving the feel of the live personal interaction. Undergraduate dental training also requires considerable interaction with the patient, which can only be possible by interaction but some amount of the training pertaining to the same could be imparted in a blended manner. In cases where blended learning gives a better edge over the conventional, it should be definitely implemented. Implementing this process is not an easy task as well. It needs a substantial amount of time and enormous efforts to design and create the modules, and also to capture the interest of the students. The transition should be gradual and with more and more methods incorporated and timely feedback by the learners would definitely help in establishing the foothold of blending concepts in the annals of the education sector.

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