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Online and on-site teaching in Pedodontology

Ji-Cheng Wu[1†], Zi-Xin Ye[1†] and Hua Wei[1,2*]

Abstract

Background In the teaching of Pedodontology, the combining of online and on-site teaching is becoming more and more widely used. This study aims to evaluate its impact on students' academic performance and satisfaction, attempting to discover potential teaching innovations.

Methods Undergraduate students majoring in Stomatology, a five-year program of Fujian Medical University, were selected as the research subjects. The 2021 cohort, serving as the experimental group, was taught using online and on-site methods during the pandemic, while the 2018 cohort, as the control group, received traditional teaching. Final exam results and satisfaction questionnaires from both groups were compared.

Results One hundred and twenty responses were received with a response rate of 100%(120/120). Compared with the control group, the experimental group's theory test scores increased by an average of 0.54 points and the practical skills test scores increased by an average of 2.11 points, but there was no significant difference ($P > 0.05$). The questionnaire suggested that the experimental group demonstrated significant improvements over the control group in stimulating learning enthusiasm, enhancing learning efficiency, promoting autonomous learning, problem induction, and problem-solving abilities ($P < 0.05$). In terms of satisfaction, students' satisfaction with this course has increased by 10% ($P < 0.05$).

Conclusion During the COVID-19 pandemic, the online and on-site teaching approach adopted in Pedodontology has been proved to be effective in improving student satisfaction.

Keywords Pedodontology, Online and on-site teaching, Blended teaching

Background

Pedodontology is a significant discipline within dentistry that centers around children's oral health. It is mainly involved in the diagnosis, therapeutics, pathogenesis, and prevention of children's oral diseases. This discipline attaches great importance to both theory and practices. It has a relatively broad scope, covering a considerable number of areas and incorporating a large portion of the medical knowledge related to oral health [1]. The aim of teaching Pedodontology is to endow students with the knowledge and capabilities required to comprehend the etiology, clinical manifestations, diagnosis, and treatment of common oral diseases in children by imparting theoretical and practical skills, thereby laying a firm foundation for their future clinical practice. This course mainly carries out basic theoretical teaching first, and carries out practical teaching after students have reached a certain theoretical foundation. Practical teaching mainly includes operating on a simulated head model and arranging students for clinical internships.

Before 2019, the Pedodontology courses generally adopted the traditional on-site teaching form. Teachers

†Ji-Cheng Wu and Zi-Xin Ye have contributed equally to this work.

*Correspondence:
Hua Wei
491150535@qq.com
[1]School of Stomatology, Fujian Medical University, Fuzhou, Fujian 350108, China
[2]Department of Pedodontology, School and Hospital of Stomatology, Fujian Medical University, Fuzhou, Fujian 350001, China

carry out face-to-face teaching activities in the classroom, mainly presenting the teaching content through PPT presentations, supplemented by blackboard writing. Although this traditional model can provide real-time feedback for teaching, its limitations are quite obvious. From the perspective of time and space, teaching hours are fixed and dependent on classroom space. In addition, during the teaching process, both teachers and students need to always maintain a high degree of concentration.

At that moment, a number of colleges and universities had come to recognize the limitations of on-site teaching and thus embarked on the exploration of the blended teaching mode in the new situation. Online teaching is a teaching mode that has emerged along with the development of the Internet and has been widely promoted on a global scale in recent years [2–3]. Memon I, et al. [4] expounded on the Blended teaching of anatomy and physiology.And Liang X, et al. [5] explored the blended teaching design and application of Pedodontology in Southern Medical University.

In 2019, the COVID-19 pandemic caused historic damage to the education system. During the outbreak of the pandemic, national policy is to avoid crowd gatherings, especially to avoid suspected patients coming into contact with student groups. On-site education was shifted to online learning, with classes being delivered through online platforms [6].

To meet the requirements of pandemic prevention and control, universities have begun to widely adopt the new teaching model of online teaching [7]. This new approach overcomes time and space constraints, avoids crowd gathering, and offers advantages in resources integration [8–10]. Some students said that the shift to online education was the right decision in the context of the outbreak of the pandemic [11]. However, compared to on-site teaching, many students rate online teaching negatively. Respondents said the pandemic has adversely affected their clinical skills learning [12].

Online teaching offers flexible schedule and location, and students can review materials repeatedly. However, Pedodontology is a discipline requires substantial hands-on practice, and some concepts are difficult to fully grasp through online teaching alone. Therefore, our teaching team has optimized and upgraded the approach, integrating both online and on-site methods for teaching pedodontics to fully leverage the advantages of each. Online teaching and on-site teaching have their own advantages and disadvantages. How to combine the advantages of these two methods into a new teaching model so as to maximize the teaching results of Pedodontology is a topic that has been rarely covered before, and this is exactly what we are exploring.

Student satisfaction can cause students to generate positive emotions and make them more inclined to adopt positive learning methods, thereby achieving academic success [13]. Therefore, we also surveyed students' satisfaction with traditional teaching models and blended teaching.

This study aims to explore and evaluate the impact of traditional on-site teaching models and online and on-site blended teaching models on student performance and satisfaction in Pedodontology, and attempts to discover potential teaching innovations in this field.

Methods

Participants

The participants were full-time undergraduate students in Stomatology at Fujian Medical University, enrolled in 2018 and 2021. The experimental group included 60 students from the 2021 enrollment, and the control group included 60 students from the 2018 enrollment. Informed consent to participate was obtained from all of the participants in the study. All participants were admitted through the national college entrance exam, with no significant differences in entrance scores, age, and gender ($P > 0.05$), ensuring comparability between the groups. The inclusion criteria for the study were as follows: completion of the Pedodontology courses and obtaining credits for all courses in Pedodontology. The exclusion criteria for the study were as follows: absence from classes for more than one week due to various reasons.

Study design

The teaching for both the experimental group and the control group is based on the syllabus, with "Pediatric Dentistry" textbooks (version: People's Health Publishing House "Thirteenth Five-Year Plan") as teaching materials. The control group consists of 60 randomly selected students enrolled in 2018 who received traditional on-site, face-to-face teaching, in which teacher used a combination of board writing and slide presentation for lectures. The experimental group includes 60 randomly selected students enrolled in 2021, taught through a combination of online and in-person didactical approaches. For online theoretical classes, teachers and students log into the Tencent conference and other teaching platforms, where teachers combine slides, MOOCs [14–15] and other forms of demonstration for the instruction of basic theories, supplemented with analysis of clinical cases and videos of clinical operations for the understanding of the practical part. To enhance their learning, students are encouraged and directed to group discussion of the questions raised either by the instructor or students during the class. Students are required to complete, in a given period of time, the exercises or quizzes for the corresponding chapters post class, and afterwards teachers will schedule a Q&A session interpreting those exercises/quizzes and answering other student-raised questions.

For in-person practical learning, when conditions (quarantine policies) permit, training for laboratory operations, preclinical practice and outpatient clinical practice are conducted in batches over a concentrated period.

Assessment system

A combination of blind scoring final exam scores and anonymous questionnaires was used to evaluate teaching effectiveness. Collect the test scores at the end of the semester (including the theoretical test portion and the practical skills test portion) of two groups of students. The full score of theoretical and practical operation tests is 100 points each, and the teacher will blindly evaluate them within a uniformly arranged time. The results of the assessment will be used to measure the teaching effect, where a higher score indicates a better teaching result. The questions of the final exam are designed in accordance with the teaching syllabus and curriculum standards. They have been calibrated with reference to the data of previous exams to ensure their validity and reliability, so that they can truly reflect students' learning levels.

In addition, the anonymous questionnaires of the two groups of students mainly include: inspiring students 'thinking, teaching according to their aptitude, learning methods guidance, the hands-on ability of the students, teaching methods guidance, and improving problems solving [16]. The wording of the question does not affect the positive or negative bias of the response. The questionnaire ensures that students' feedback can be collected effectively. The questionnaire is provided in supplemental materials. Each problem will be divided into four levels: satisfied, relatively satisfied, relatively unsatisfied, and unsatisfied. Students who considered the teaching to be satisfied rated it 8 points and above, those who were relatively satisfied gave 6 and 7 points, those who were relatively unsatisfied scored 4 and 5 points, and those who were unsatisfied rated it 3 points and below. The formula for calculating the satisfaction rate is: **satisfaction rate = (number of satisfied + number of relatively satisfied)/ total number of people**.

Data evaluation and statistical analysis

SPSS 17.0 was used for statistical analysis, independent samples t-test was used to compare the mean values between groups, count data were expressed as percentage n (%), and $\chi 2$ test was used to compare the differences between different groups, with the test level $\alpha = 0.05$.

Results

Comparison of test scores between the two groups

Results of the experiment are summarized as follows: the experimental group scored slightly higher than the control group in theory exams and laboratory operation.

Table 1 Pedodontology exam results of control and experimental group students

Groups	Theory test score	Practical skills test scores
Control Group	67.63 ± 10.31 [95%CI: 65.02,70.24]	86.43 ± 3.61 [95%CI: 85.51,87.35]
Experimental Group	68.17 ± 10.37 [95%CI: 65.54,70.80]	88.54 ± 5.42 [95%CI: 87.17,89.91]
t-value	0.647	0.752
P-value	> 0.05	> 0.05

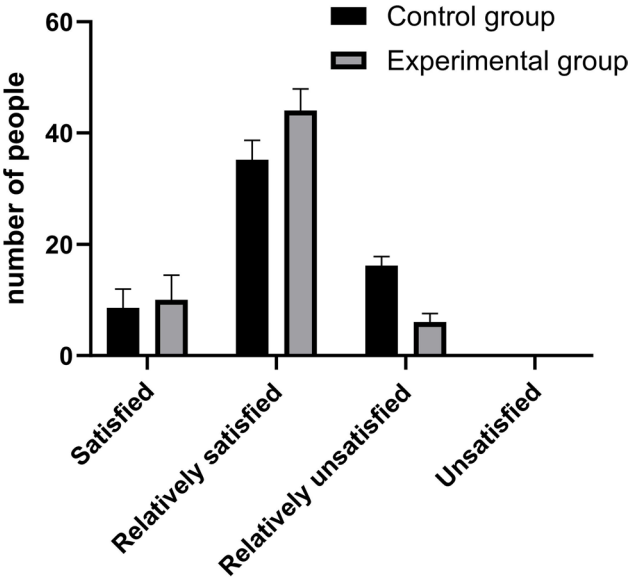

Fig. 1 Comparison of satisfaction with teaching modes between two Groups (n, %)

However, these differences were not statistically significant ($P > 0.05$) as shown in Table 1, suggesting that online and on-site teaching may not differ significantly in terms of their impact on students' test scores.

Comparison of satisfaction of students in the two groups

The experimental group outperformed the control group in the following aspects: improving independent learning ability, enhancing learning efficiency, stimulating learning initiative, and improving the ability to summarize problems, with statistical significance ($P < 0.05$) as shown in Fig. 1 ang Table 2.

Comparison of the overall acceptance of the two groups

Students who consider the teaching mode of this group as "highly satisfied" or "satisfied" are defined as having a high level of acceptance. The acceptance of teaching by students in the experimental group is higher than that of the control group, and the difference is statistically significant. ($\chi 2$-value is 5.326, $P < 0.05$), as shown in Fig. 2; Table 3.

Table 2 Comparison of satisfaction with teaching modes between two groups (n, %)

Investigation	Control group ($n=60$)					Experimental group($n=60$)					χ2-value	*P*-value
	1	2	3	4	5	1	2	3	4	5		
Stimulating learning enthusiasm	9	37	14	0	76.67%	11	42	7	0	88.33%	3.521	< 0.05
Enhancing effectiveness	14	29	17	0	72.31%	17	38	5	0	91.67%	3.711	< 0.05
Enhancing autonomy	5	37	18	0	70.00%	9	47	4	0	93.33%	9.632	< 0.05
Generalizing competence	7	36	17	0	71.66%	8	46	6	0	90.00%	8.586	< 0.05
Problem handling	8	37	15	0	75.47%	5	47	8	0	86.66%	2.189	< 0.05

Notes 1, Satisfied; 2, Relatively satisfied; 3, Relatively unsatisfied; 4, Unsatisfied; 5, Satisfaction rate

Content of survey Control group ($n=60$) Experimental group ($n=60$) χ2 -value P -value\

Fig. 2 Comparison of acceptance of respective teaching modes (n, %)

Table 3 Comparison of acceptance of respective teaching modes between two groups (n, %)

Groups	Satisfied	Relatively satisfied	Relatively unsatisfied	Satisfaction
Control group	17(28.3)	31(51.7)	12(20.0)	48(80.0)
Experimental group	7(11.7)	47(78.3)	6(10.0)	54(90.0)

Discussion

No significant difference in exam results improvement

In this study, we found that there was no significant difference in the improvement of students' academic performance, which might be the result of the combined effects of multiple factors.

First of all, in terms of the connection of teaching content, online and on-site teaching content may not be closely integrated enough. The added part of online teaching that is not integrated with offline may hinder the continuity of knowledge absorption and affect the final learning effect.

Secondly, students' study habits and adaptability are also key factors. Online learning requires students to have stronger autonomous learning capabilities, and some students may need a relatively long time to adapt to changes in teaching models. Some students with poor self-discipline may instead be distracted or delayed during the learning process, which further affects the improvement of academic performance. In addition, teaching management also faces challenges. In the blended teaching model, teachers need to balance both online and on-site teaching links, which makes quality control more difficult. It is not easy to control student participation in the online teaching part, which also affects the teaching

effect to a certain extent, making the improvement of academic performance not obvious.

Finally, the quality of teaching resources also has an impact. Online teaching resources are rich and diverse, but they may not all accurately match our teaching goals and the actual needs of students. If the online resources do not serve teaching well, it will be difficult to promote significant improvement in academic performance.

Blended teaching enhances student satisfaction

In this study, we also found that the combination of online and on-site teaching approaches led to an increase in students' satisfaction and acceptance of teaching, which is conducive to inspiring students' thinking, tailoring teaching to students' needs, guiding learning methods, cultivating students' hands-on ability, guiding power of the teaching method, and improving problem-solving ability.

Blended teaching can increase student satisfaction for a variety of reasons. First of all, the resources of blended teaching are diversified. Online platforms can provide students with multiform learning materials, such as video tutorials, e-books, academic papers, animation demonstrations, etc., which can meet the needs of different learning styles.

Secondly, blended teaching has better flexibility and autonomy. This teaching method can give students more rights to independently arrange study time and progress. This flexibility allows students to better balance study and life, thereby improving their satisfaction.

Finally, in terms of teaching support, good technical support allows students to focus on learning content, thereby increasing their satisfaction. Teachers' guidance and timely feedback in blended teaching also have a great impact on student satisfaction. Using online devices to focus on teaching progress can make students feel valued, thereby enhancing their satisfaction.

Linkages of the research results

We found that in this study, students' satisfaction and acceptance of teaching increased, but there was no significant difference in the improvement of students' academic performance. The possible reasons are as follows.

First of all, evaluation methods have limitations. Traditional evaluation may not match newer teaching methods, and the effect of blended teaching in cultivating autonomous learning may not be fully reflected in existing short-term assessments. Blended teaching is a gradual process of building a knowledge system and capabilities. This process is reflected to a certain extent in the improvement of teaching satisfaction and acceptance, but the effect of improving performance may only be reflected in long-term assessment.

The second is the factor of individual differences. Students' motivation for learning may not be just to improve their grades, but to enjoy a more flexible learning process and gain rich knowledge resources. These students are very satisfied with the convenient online resources, but the knowledge they acquire may not be closely related to the current examination system, so their satisfaction is not in sync with the improvement of their scores.

Finally, there are some problems in the teaching implementation process. The blended teaching model is not yet mature, and the teaching team may have differences in its understanding and implementation. These teachers may not have invested enough energy in teaching strategies related to performance improvement, resulting in no significant change in students 'performance.

Advantages and disadvantages of online teaching

Its biggest feature is to break the limitation of time and space, under the premise of network and equipment, students can study anytime and anywhere, and independently grasp the learning pace [17]. In addition, online teaching has greatly reduced the cost of education, so that some children in remote mountainous areas have the opportunity to access more and better teaching resources, and even attend lectures by famous tutors.

However, online teaching also has certain limitations [18].On one hand, compared with traditional teaching, the content and courseware of online teaching is not very rich, and there is still a lot of room for progress and to be supplemented.On the other hand, due to the reduced opportunities for face-to-face communication between teachers and students, it is impossible to grasp the dynamics of students in real time, and it becomes more difficult to supervise and guide students, and the quality of teaching may be affected [19], which further aggravates the phenomenon of bifurcation: self-disciplined students are steadily improving their learning performance; students with poor self-consciousness may lag behind. The development of online education in China and abroad is also unbalanced. Online education in China has many shortcomings and needs to be improved urgently. In contrast, foreign online education platforms currently have stronger teachers, richer course categories, and quite complete platform structures [20, 21].

In addition, the change in teaching methods puts higher demands on teachers. If some teachers are not familiar enough with new media devices and are reluctant to utilize and adapt online platforms, the quality of teaching may be greatly affected.The shift to online teaching presents teachers with unique pedagogical, technological, and psychological challenges [22]. Some teachers are unfamiliar with the new media equipment and thereby resistant to online teaching, which may negatively affect teaching quality.

Advantages and disadvantages of on-site teaching

On-site teaching follows a three-centered teaching model of "teacher, textbook and classroom", in which students are educated in-person through lectures and hands-on practice in the classroom, laboratory and teaching hospital. Teachers and students communicate face-to-face in offline teaching, and they can assist in explaining and transferring knowledge through gestures, movements and other body language, so as to enhance the attractiveness and participation of the classroom, thus enhancing students' comprehension. Moreover, in offline teaching, teachers can play a role of supervising students in an invisible way. In addition, teachers can adjust the teaching progress and methods in real time according to the students' mastery of knowledge, focus on teaching difficult-to-understand concepts, and answer students' questions in the classroom in a timely and accurate manner, all of which are more challenging and may not be accomplished equivalently when teaching online.

Nevertheless, the traditional mode of teaching also has its drawbacks. Confined to the fixed time and place, students won't be able to schedule their study time flexibly and control their learning content and progress independently. Online teaching, regarding those respects, outperforms on-site approach [23].

Advantages of the combination of online and on-site teaching

We have optimized and integrated on-site teaching and online teaching to achieve better blended teaching results. The combination of the two has the advantages of integrating teaching resources, improving learning flexibility, and optimizing teaching effect evaluation.

Blended teaching can integrate high-quality resources. Online teaching platforms can integrate a large number of open course videos from top Stomatology universities at home and abroad, such as the excellent courses of Hospital of Stomatology Sichuan University and The University of Pennsylvania. These courses expose students to the most cutting-edge theoretical knowledge and clinical techniques in Pedodontology. At the same time, the online platform also has a variety of digital resources such as three-dimensional animation models and virtual operating software related to Pedodontology, which can help students better understand complex text steps. On-site teaching can make full use of the school's physical teaching facilities, such as human tooth specimens, simulated dental treatment chair equipment, etc. Under the on-site guidance of teachers, students practice the knowledge they have learned online by hand in a real environment, realizing the organic combination of online resources and on-site resources.

Blended teaching makes scheduling more flexible. For students of Pedodontology, who need to study a large amount of theoretical knowledge while conducting clinical practice, the online teaching section allows students to study according to their own schedule and is not limited by traditional class hours.

Blended teaching can optimize the evaluation of teaching effectiveness. The online teaching platform can record students' learning data, and teachers can use the online platform to understand students' mastery of various knowledge points by analyzing the data. Similarly, teachers evaluate students through traditional examinations, practical operation assessments and other methods in the on-site teaching process. Through this method, teachers can more comprehensively and accurately evaluate students' comprehensive learning effects, thereby better guiding students' learning and improving teaching quality.

Challenges and limitations of the blended teaching

The implementation cost of blended teaching is high and requires a large number of teachers, equipment and funds, including the purchase of technical equipment, the construction of network platforms, and the development of teaching resources. This is an unbearable burden for some schools with limited resources.

Blended teaching has technical dependence and stability problems, and requires stable technical support, including network platforms and learning management systems. If the technology is faulty or unstable, it will greatly affect the teaching effectiveness and learning experience.

Blended teaching places high requirements on teachers' information-based teaching level. Teachers need to be proficient in online teaching technology and require teachers to constantly learn new knowledge and adapt to new teaching models.

Optimizing pedodontology teaching with blended teaching

We have given full play to the respective advantages of online teaching and on-site teaching. Specific implementation suggestions are as follows. For theoretical courses, the proportion of online teaching should be appropriately increased, and videos on key points and difficulties should be recorded as supplementary materials for on-site teaching.

Regularly conduct online special question and answer activities and publish corresponding practice questions. For courses with high practical requirements, the time and proportion of on-site teaching and experimental training should be increased. Carry out special practical training, and teachers provide face-to-face guidance. In addition, some video content related to the operation should be uploaded online for students to review repeatedly.

During the pandemic, students showed varying degrees of acceptance of online teaching due to personal differences or objective conditions [24]. After normal return to school, teachers should distinguish and guide students according to different situations and strive to make them establish a positive view of learning.

Pedodontology is an applied discipline, which not only requires us dentists to have a solid theoretical foundation, but also requires us to be proficient in various clinical operation skills, such as effective communication with children, clinical risk management, etc., which are all gathered and developed through solid practical operations. To ensure the good learning outcome of practical operations, we concentrate on on-site internship operations, including preclinical training and outpatient training as far as the condition permits. Therefore, at this stage, we combine online theoretical classes with in-person practical sessions, trying to make better use of the combined-mode of teaching, in the meantime avoiding their drawbacks, so as to guarantee the quality and quantity of "stopping classes without stopping learning" in the general environment [12, 25, 26].

Conclusion

In conclusion, through the reasonable arrangement of online and on-site blended teaching, the teaching effect of Pedodontology has been significantly improved, which helps students to more effectively learn and master relevant basic theoretical knowledge and basic practical skills of it. The limitation of this study is that the slightly higher score difference in the experimental group is not statistically significant, and how to effectively improve students' academic performance is still worth further exploration. A series of experimental studies will be carried out in the future to explore how to better combine online teaching models and on-site teaching models on the basis of improving student satisfaction and overall acceptance, thereby improving students' academic performance.

Abbreviations

COVID – 19	Corona Virus Disease 2019
PPT	PowerPoint
MOOCs	Massive Open Online Course
Q&A	Questions and Answers

Supplementary Information

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Supplementary Material 1

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Author contributions

Concept and design: Hua Wei. Experiments and procedure: Jicheng Wu, Zixin Ye. Data analysis: Zixin Ye, Hua Wei.Writing and editing the article: Zixin Ye, Hua Wei. All authors read and approved the final manuscript. All authors have made a sufficient contribution to the work.

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Data availability

All data generated or analyzed in the course of this study are included in this published article and its supplementary information file.

Declarations

Ethics approval and consent to participate

The study followed the Helsinki Declaration for ethical research standards. The study was approved by the institutional review board of Fujian Medical University. Informed consent to participate was obtained from all of the participants in the study. This article pertains to a teaching research, with its data being collected by means of questionnaires. This study does not involve issues such as clinical samples, and we confirm that no clinical samples were used.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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