

Original Article

Online and Offline Virtual Training Versus Traditional Training on Theoretical Knowledge of Dentistry Students in Primary Tooth Pulp Treatment

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Abstract

Background: Higher education faced difficult conditions caused by the coronavirus pandemic after January 2020. In such a situation, education through virtual space was one of the highly important and considerable proposed programs. So far, to our knowledge, no study has compared online and offline virtual education with traditional education in dentistry students. Accordingly, this study compared the efficacy of online and offline virtual training on theoretical knowledge of dentistry students in primary tooth pulp treatment with that of traditional training.

Methods: This semi-experimental study was conducted on dental students who have taken the theoretical pediatrics 2 course in the second half of the academic year 2020-2021. All students were randomly divided into three groups of 20 people, including online and offline virtual training and traditional training (control) groups. Educational contents were delivered to students in the form of an identical PowerPoint for all groups. The PowerPoint slides were prepared and virtual and face-to-face classes were held by the same person (Instructor). In addition, the pre-test and post-test were performed virtually with the same questions (20 questions designed by the instructor). Finally, SPSS-23 was used to describe and analyze the data.

Results: The participants were 60 students with an average age of 23 ± 0.48 years, including 42 males (70.0%). No significant difference was observed among groups in terms of gender, age, grade point average (GPA), and pre-test score ($P > 0.05$). The post-test score was significantly higher than the pre-test score ($P < 0.01$), but there was no significant difference in terms of post-test and "post-test-pre-test" scores among the groups ($P > 0.05$). GPA was significantly correlated with the post-test score ($P < 0.001$) and score changes (post-test-pre-test score) ($P < 0.001$).

Conclusions: It was found that online and offline virtual education are two suitable alternatives for the traditional education of dental students in the primary teeth pulp treatment course.

Keywords: Online virtual training, Offline virtual training, Traditional training, Dentistry students, Primary tooth, Pulp treatment



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Background

Medical sciences universities are responsible for the training of specialized and committed human resources required by the country's healthcare system. To achieve this goal, universities should take a step towards identifying problems and obstacles, designing and implementing written programs, and finally modifying and improving them. Undoubtedly, gaining experience through examining the quality of educational methods in students can be considered an important source for educational decisions (1).

Today, dentistry is considered a complex, challenging, and prominent medical profession. An efficient dentist

needs skills such as problem solving and clinical decision-making ability (2). In this regard, the education of students in the pediatric dentistry department is necessary for society in order to ensure and improve the oral health of children. Children's course 2 is one of the most important courses in the children's department of dental schools from the point of view of professors and students (3). In addition, students and professors believed in the importance of the educational topic of the pulp treatment of primary teeth (3). Although treatment of the primary teeth pulp is highly important, students usually do not reach the predetermined educational goals (4).



Therefore, to improve the quality of dental courses, an evaluation of the educational method is necessary (1). Currently, lecture-based learning is the main method of teaching in dentistry, where the lessons are presented in a theoretical-traditional course by a teacher (professor) (5). Virtual (electronic) education, which often refers to the use of computers and the internet and digital technologies in teaching and learning, is constantly being proposed as an alternative or a way to strengthen traditional approaches to education. Considering the advantages of electronic education, including centered learning, lifelong learning, active learning, interaction in learning, and multimedia-based learning, its integration into the current educational programs of universities seems to be inevitable (6). Virtual education is one of the new ways to develop educational justice in the contemporary world by taking advantage of the advances in information and communication technology and has opened a new horizon for educational institutions (6).

In online virtual education, a person can learn the educational content independently of the place of education. In online classes, the lessons are available live on the website of the training center, and the possibility of question and answer is also available. Moreover, the teaching content is normally available on the website after the completion of the online class. In offline virtual education, educational contents are given to students in the form of educational CDs. In this type of training, the teacher may be present in an environment such as a video conference to answer the questions of the learners (7).

Educational institutions welcome virtual education for reasons such as the growth of information technology, the possibility of accessing information resources at any time and place, the possibility of teaching all people (including disabled people), and the possibility of expanding education to a larger number of students (8).

On the other hand, after January 2020, higher education faced difficult conditions caused by the corona virus pandemic (9,10). The Ministry of Science, the Ministry of Health, and the Ministry of Education successively ordered the closure of universities and schools since the end of February in Iran. After the closure of schools and universities, the concern of continuing education at home became the most serious challenge of educational systems. One of the highly important and considerable proposed programs was education through virtual space (11). The World Health Organization announced in a statement that distance education using radio, podcast, television, and online methods is the best way to continue education in the conditions of the Corona pandemic (12). Therefore, the effect of virtual versus traditional education on the theoretical knowledge of dental students in the course of primary tooth pulp treatment was compared in this study.

Materials and Methods

Study Design and Participants

This semi-experimental study was conducted on

intervention and control groups using pre-test and post-test (13) at Dental School of Hamadan, a western province in Iran in 2020-2022. All dental students who have taken the theoretical pediatrics 2 course in the second half of the academic year 2020-2021 were included in the study (n=60), while those who were absent from training sessions or tests were excluded from the study. The studied samples were randomly divided into three groups of 20 people, including two intervention groups (online and offline virtual training) and one control (traditional training) group using a table of random numbers.

Interventions

The resources used to prepare the educational content included chapter 23 of pediatric dentistry, infancy through adolescence 6th edition 2019 book, and chapter 13 of the Dentistry for the Child and Adolescent, McDonald, 2016. Educational contents were delivered to students in the form of an identical PowerPoint for all groups. All training was performed in one day. In intervention group 1 (online virtual training), educational materials (PowerPoints) were provided by the instructor using a 1-hour (10 to 11 AM) online class on Skype, and an opportunity was provided for students to practice answering questions. In the intervention group 2 (offline virtual training), educational materials (PowerPoints and lecturer's audio file) were uploaded on the virtual education system of Hamadan University of Medical Sciences, and only offline virtual training group members were allowed to access the uploaded contents at the designated time (11 to 12 AM). In the control (traditional training) group, educational materials (PowerPoints) were presented to the students within an hour (11 to 12 AM) with the face-to-face training method in the classroom, and an opportunity was provided for the students to practice answering questions. PowerPoint and audio files were prepared and virtual and face-to-face classes were held by one person. The students were reassured that the test results would not be used in their evaluations.

Pre-test and Post-test

Twenty multiple-choice questions were designed by the instructor. The content validity of the questions was qualitatively assessed based on the opinions of experienced professors of pediatric dentistry. In this method, the researcher asked the experts to provide the necessary feedback after the qualitative review of the questions so that the items can be revised if necessary. The reliability of the questions was checked and confirmed by Cronbach's alpha method ($\alpha=0.897$). A score of 1 or 0 was allocated to a correct or wrong/no answer to each question, respectively. Therefore, the overall score range of test questions varied from 0 to 20. Before starting the training, a pre-test was taken from all groups on the same day (9 to 9:50 AM). After the training, a post-test was taken from all groups (00:30 to 01:20 PM). The pre-test and post-test were performed virtually with the same questions. Ninety

seconds were allocated to answering each question, and it was impossible to return to the previous question.

Statistical Analysis

Data are expressed as means \pm standard deviations (SD) or frequencies (percentage). Data were analyzed using one-way ANOVA, paired *t* test, independent *t* test, chi-square test, and Pearson correlation test. $P < 0.05$ was considered the significant level, and SPSS (version 23) was employed to describe and analyze the data.

Results

The participants included 42 males (70.0%) and 18 females (30.0%) with an average age of 23 ± 0.48 years. The grade point average (GPA) of the students was 15.46 ± 0.91 . Table 1 compares the gender, age, and GPA of the students among the groups. Based on the results, no significant difference was observed among groups in terms of gender, age, and GPA ($P > 0.05$).

In all three groups, the score obtained from the post-test was significantly higher than the pre-test ($P < 0.01$, Table 2). The amount of score changes in the online virtual training group was higher than that of offline virtual training and traditional training groups (Table 2). However, there was no significant difference in terms of pre-test, post-test, and "post-test-pre-test" scores among the groups ($P > 0.05$, Table 3).

Based on the data in Table 4, no significant correlation was found between age and test scores ($P > 0.05$). However, GPA was significantly correlated ($P < 0.001$) with the post-test score ($P < 0.001$) and score changes (post-test-pre-test score). Eventually, there was no significant difference between males and females in terms of test scores ($P > 0.05$) (Table 5).

Discussion

The present study was designed and implemented to compare online and offline virtual training methods with traditional training methods. The virtual education method in the era of COVID-19 made it possible to continue education through distance education (14). In dental education, especially in theory courses, virtual learning has increased during the COVID-19 pandemic (15). Previous studies suggested that virtual learning or e-learning has been successful and satisfactory in teaching medical and dental courses (16-20). One study concluded that online learning attained better outcomes and reported

that it is more satisfying than the face-to-face traditional learning method (21), while the other one found no significant difference between such learning methods (22). However, studies comparing offline and online virtual education methods are highly limited and most of them compare online virtual education and traditional education methods.

In the present study, three traditional, online virtual, and offline virtual training groups were taken into consideration. There were no significant differences between the three groups in terms of gender distribution, average age, GPA, and pre-test score. This indicates that the distribution of students among the groups occurred randomly, and the results are not affected by confounding factors as much as possible.

The results demonstrated that the score obtained from the post-test was significantly higher than the pre-test in all three groups, but there was no significant difference in terms of post-test scores and "post-test-pre-test" scores among the groups. These findings revealed that virtual education (especially online virtual) is a suitable alternative to face-to-face traditional learning. The findings of many previous studies confirm those of our study. Bartok-Nicolae et al concluded that virtual education can serve as an effective alternative to traditional education for learning orthodontics, pedodontics, and oral rehabilitation knowledge for dental students (23). Aljarbou and Riyahi (24) and Pei and Wu (25) obtained similar findings in this regard. Hakami found that virtual learning can be a suitable alternative to face-to-face education for teaching dental students (26). Kouhpaiezadeh et al reported that they could gain similar success to the traditional face-to-face learning method in teaching dentistry students using the virtual learning approach (27). Hugenholtz et al confirmed that both traditional and virtual education methods similarly enhanced the physicians' knowledge score with no significant difference (28).

Table 2. Comparing the Test Scores of the Groups Before and After the Training

Variables	Groups		
	Traditional Training	Online Virtual Training	Offline Virtual Training
Pre-test score	11.95 \pm 2.06	12.25 \pm 2.46	11.45 \pm 3.03
Post-test score	15.00 \pm 3.06	16.90 \pm 2.77	15.20 \pm 2.58
<i>P</i> value	0.000 ^a	0.000 ^a	0.002 ^a

Note. ^a Paired *t* test.

Table 1. Comparison of Gender, Age, and GPA of Study Groups

Variables		Groups			<i>P</i> Value
		Traditional Training	Online Virtual Training	Offline Virtual Training	
Gender	Male, n (%)	14 (70.0%)	13 (65.0%)	15 (75.0%)	0.788 ^a
	Female, n (%)	6 (30.0%)	7 (35.0%)	5 (25.0%)	
Age (Mean \pm SD)		23.0 \pm 0.45	22.90 \pm 0.44	23.10 \pm 0.55	0.438 ^b
GPA (Mean \pm SD)		15.45 \pm 1.07	15.60 \pm 0.89	15.34 \pm 0.77	0.670 ^b

Note. GPA: Grade point average; SD: Standard deviation; ANOVA: Analysis of variance;

^a Chi-squared test; ^b One-way ANOVA test.

Table 3. Comparison of Pre- and Post-test Scores Among Groups

Variables	Groups			P Value
	Traditional Training	Online Virtual Training	Offline Virtual Training	
Pre-test score	11.95 ± 2.06	12.25 ± 2.46	11.45 ± 3.03	0.609 ^a
Post-test score	15.00 ± 3.06	16.90 ± 2.77	15.20 ± 2.58	0.072 ^a
Post-test-pre-test score	3.05 ± 3.06	4.65 ± 3.73	3.75 ± 4.74	0.425 ^a

Note. ANOVA: Analysis of variance; ^a One-way ANOVA test.

Table 4. Relationship Between Students' Age and GPA With Test Scores

Variables	Pre-test Score	Post-test Score	Post-test-pre-test Score
Age	r=0.179 P=0.172 ^a	r=0.144 P=0.272 ^a	r=-0.009 P=0.945 ^a
GPA	r=-0.069 P=0.599 ^a	r=0.606 P<0.001 ^a	r=0.503 P<0.001 ^a

Note. GPA: Grade point average; r: Pearson correlation coefficient; ^a Pearson correlation test.

Table 5. Relationship Between Student's Gender With Test Scores

Variables	Gender		P Value
	Male	Female	
Pre-test score	11.80 ± 2.66	12.05 ± 2.26	0.733 ^a
Post-test score	16.14 ± 2.78	14.66 ± 2.97	0.070 ^a
Post-test-pre-test score	4.33 ± 3.89	2.61 ± 3.51	0.112 ^a

Note. ^a Independent t test.

However, some other studies represented the superiority of virtual learning over traditional learning or the superiority of online virtual learning over offline virtual education. Gao et al stated that online learning could lead to higher knowledge and skill scores in medical education when compared with offline learning (14). Moazami et al reported that virtual education is more effective than lecture-based training (29). Soltanimehr et al concluded that virtual learning is more effective than traditional learning for the education course of the radiographic interpretation of jaw bony lesions (30). Belcher and Vonderhaar also commented that virtual education enables easy access to educational content, resulting in higher satisfaction of students and consequently enhanced learning (31). According to previous studies, online teaching is appreciated by students because of availability at any time and place and the possibility of better learning of complex concepts. This implies that students may learn skills and knowledge that cannot be easily acquired through traditional face-to-face education (32). However, the absence of physical communication is the main limitation of distance learning (33). Dental students need to learn clinical skills in addition to theoretical lessons. In a study, most students agreed that virtual learning was not effective enough for developing clinical skills (34). Therefore, organized technique and planning may be required for the dental curriculum to increase the efficiency of virtual learning (35,36).

Further, some studies showed that traditional face-to-face education is more effective than virtual learning (37,38). This finding contradicts that of our study and may be

attributed to the lack of facilities, unavailability of required infrastructures, different interests of students to educational content, or absence of some helpful actions such as group discussions, which may reduce the student's motivation.

The positive relationship between GPA and post-test and "post-test-pre-test" scores demonstrated that students with higher GPA obtained higher grades in the course in all three groups. The results of Hakami (26) and González-Gómez et al (39) reported that female students gain higher scores than male students in online courses. However, in our study, there was no significant difference in terms of test scores between males and females.

It should be noted that the participants' interest and satisfaction were not evaluated in the present study. The evaluation of students' interest and satisfaction is a complementary method to measure the success of an educational program (29). Another limitation of the current study was a relatively small number of samples. Thus, it is recommended that a multicenter study should be conducted with a high number of participants.

Conclusions

Our findings revealed that online and offline virtual education are two suitable alternatives for the traditional education of dental students in the primary teeth pulp treatment course. Organized planning will help improve the quality of virtual education for use in situations such as the Corona pandemic. However, the clinical skill of dental students is also important, thus the impact of virtual education on students' clinical skills should also be measured, which was not investigated in the present study. Moreover, it is suggested that similar studies with a larger sample size should be conducted to confirm the findings of this study.

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Competing Interests

The authors have no conflict of interests to declare.

Ethical Approval

This research project was approved by the Ethics Committee of Hamadan University of Medical Sciences (IR.UMSHA. REC.1400.540). Participation in the study was voluntary. Oral consent was obtained from the participants, and their information was kept confidential with the research group.

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