

# Efficacy of E-Learning via the Website of Tehran University of Medical Sciences for Diagnosing Tooth Discolorations and Treatment Planning by Senior Dental Students

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**Abstract-** The efficacy of methods like e-learning as a supplement to traditional face-to-face instruction needs to be evaluated in dental courses. This study aimed to assess the efficacy of posting case presentations on one of the educational websites of the virtual school of Tehran University of Medical Sciences called "SARMAD" to enhance the ability of senior dental students to diagnose tooth discolorations and offer treatment plans. This experimental study had a pre-test/post-test control group design and was conducted on 63 senior dental students. After filling out the primary questionnaire and obtaining a written informed consent, students participated in a pre-test and were then randomly divided into two groups of intervention and control. Fifteen case presentations were posted on the university website (SARMAD) during 6 weeks and discussed. Then, students participated in a post-test. Students' perspectives and their satisfaction with the website were assessed by a questionnaire. For ethical purposes, the same program was also offered to the controls. The post-test score was significantly higher than the pre-test score in the intervention group ( $P < 0.001$ ); but in the control group, the post-test score was only slightly higher than the pre-test score ( $P = 0.128$ ). In the intervention group, 70% stated that they would suggest this method as an efficient educational modality; 93.3% stated that this method would be beneficial as a supplement to conventional education; 16.7% ranked the SARMAD website excellent, 30% ranked it good, 33.3% acceptable, 16.7% moderate and 3.3 poor. It appears that this instructional modality may be efficiently used as a supplement to traditional instruction in undergraduate dental curricula.

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## Introduction

Medical instructors face new challenges every day in educating students (1). Considering the recent advances in medical sciences, it is difficult to instruct contemporary topics while the current curricula are still inefficient in covering the conventional topics (2). The traditional, instructor-centered education is evolving towards a learner-centered model, in which learners manage their own level of learning. Dental curricula are gradually shifting towards the competency-based

learning, which emphasizes on the outcome of learning rather than the process of instruction (3). On the other hand, the current dental education system is experiencing problems dealing with the growing demand for dental services, increasing the number of dental students and a limited number of instructors. The current concern is that these problems may affect the standards of instruction and compromise the clinical performance of graduates in the future (4). Thus, the efficacy of methods like e-learning must be evaluated as a supplement to traditional face-to-face instruction. E-

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learning, also known as web-based learning, online learning, distributed learning and internet-based learning, refers to providing students with the educational content via the Internet, intra/extranet (LAN/WAN), multimedia, etc. (2,5). Based on the previous qualitative studies, e-learning is a well-accepted method for medical education (6,7) and its application in dental education has also been increasing since its introduction in 1970 (8). After years of debate about its superior efficacy to lecture-based learning and other methods of instruction, researchers have reached a consensus that e-learning is efficient in conjunction with face-to-face instruction in which case the term blended learning is commonly used (9-11). Reaching a balance between the conventional and supplemental instruction techniques depends on the learning objectives, learners' characteristics, and accessibility of online educational resources and the experience of the instructors (12). Despite the previous studies on the topic of education, in general, available sources of dental instruction are rather limited. Previous studies on dental curricula have evaluated the efficacy of online and blended learning in different domains including dental terminology (13), operative dentistry (14), dental anatomy and radiology (15), fixed prosthodontics (16,17), removable prosthodontics (18), oral pathology (19), oral anatomy (20) and orthodontics (21). They have mainly focused on the students' perspectives and expectations, the efficacy of the course, design and presentation of the course and attitude of instructors. However, further studies are required to assess the efficacy of these techniques in dental education (12). Designing optimal e-learning tools is now the focus of attention of many researchers (22). However, the available literature in this respect suggests further investigation (4).

The virtual school of Tehran University of Medical Sciences (<http://etums.tums.ac.ir>) is the main e-learning center for medical education in Iran. This school has developed a software called SARMAD (a Persian abbreviation for "Software of virtual clinical rounds") based on constructivism learning theories (<https://sarmad.tums.ac.ir>) which attempt to enhance clinical decision-making and works under the supervision of the university. Educational topics and papers (including review cases, original research cases, etc.) are posted by the scientific faculty members on this website and discussed by the users .

The topic selected for e-learning in the current study was the diagnosis and treatment of tooth discolorations and bleaching treatment. Smile esthetics is highly influenced by the color, shape and position of teeth (23)

and correcting the discolored, mal-shaped and crowded teeth often improves self-confidence, self-esteem and social life of patients (24). There is currently a high demand for treatment of tooth discolorations and dental bleaching. This topic is instructed to undergraduate dental students only theoretically in didactic operative dentistry and endodontic courses in the current curricula. In the new curricula, treatment of tooth discolorations and dental bleaching will be offered as a voluntary course .

Considering all the above and the popularity of these treatments, it appears that inadequate instruction in this regard may lead to clinical malpractice by the graduates and force them to turn to unreliable sources of information.

The problem-based learning (PBL) approach is an educational, learner-centered modality that allows students to adjust their learning in a structured environment (25). This study aimed to determine the efficacy of posting case presentations on one of the educational websites of Tehran University of Medical Sciences called "SARMAD" to enhance the ability of senior dental students to diagnose tooth discolorations and offer treatment plans.

## Materials and Methods

This experimental study had a pre-test/post-test control group design and assessed the efficacy of case presentation in the virtual environment of the virtual school of Tehran University of Medical Sciences software, SARMAD, (<https://sarmad.tums.ac.ir>) to enhance the ability of senior dental students to diagnose tooth discolorations and suggest treatment plans. A total of 63 senior dental students from School of Dentistry, Tehran University of Medical Sciences were tested. Their level of satisfaction with the program and the academic achievement of learning were evaluated.

The preliminary phase: After necessary coordination with Department of Operative Dentistry and the managers of the SARMAD website, an informatory session was held for 63 students who took the course of "comprehensive treatment." After obtaining a written informed consent, a primary questionnaire was filled out for each student including demographic information, method, and duration of access to computer and The Internet, the level of interest in electronic instruction and the ability to diagnose of tooth discolorations. Students participated in a pre-test in the same session. Students were divided into two groups of intervention and control by systematic randomization using a list of student

names organized in order of their GPA (Grade Point Average). The intervention phase: Students were briefed about the website and provided with a username and a password. A total of 15 cases were presented by an instructor in the website during 6 weeks; 2-3 cases were uploaded on the website each week and were visible on the first day of the week. Students were allowed to log in to the website using their username and password from anywhere at anytime to review the uploaded materials and answer the questions. In the first 4 days of each week, students individually answered the questions; in the next 2 days, the topics were discussed in a group discussion under the supervision of the instructor and students could see the responses of their peers to the questions. In the final day of the week, students could view the final answer of the instructor.

Moreover, students were informed about the upload of new cases, the time limit for the responses to be posted and the time of group discussion via text messages. Students in the intervention group participated in a post-test at the end of 6 weeks. At the same session, students' perspectives and their level of satisfaction with this educational modality and the SARMAD website were assessed using a questionnaire.

To control for contamination, the post-test of the control group was held before the presentation of cases in the website (6 weeks after pre-test). For ethical purposes, the same program was provided for control students after holding the post-test for the intervention group (Figure 1).

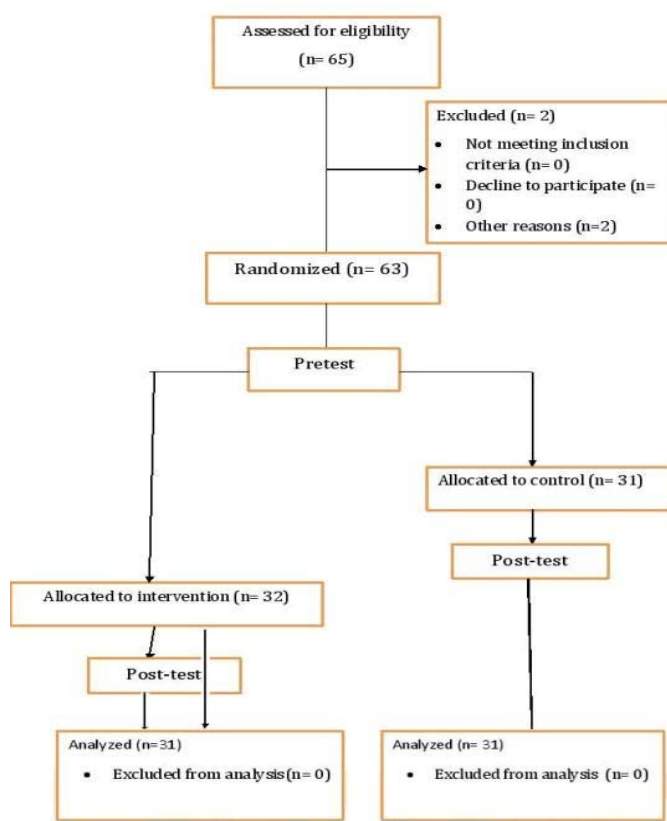


Figure 1. Participant and intervention flow chart

To access the educational content of each course and some basic information about tooth discolorations and their treatments, students in both groups were provided with a lecture note at the onset of the study. In order to encourage the students to participate in this study, 10% of the final score of comprehensive treatment course (comprising of 7 didactic and practical credits instructed by 5 educational faculties of operative dentistry,

endodontics, prosthodontics, radiology and oral medicine offered to senior dental students) was allocated to the post-test score. So, the post-test score of the control group was matched with that of the intervention group using statistical methods to have a fair final score.

**Designing the tests and the questionnaires**

This course was offered to senior dental students as

an extra-curricular course based on the “needs assessment” conducted by the authors. At the onset of the study and after designing the course, a test consisting of 15 questions were designed based on the educational goals, blueprints, and review of the previous literature including 5 basic questions and 10 case scenarios. To determine the validity of the test, 10 specialists in aesthetic and operative dentistry were requested to review and comment on the test, and the necessary corrections were made. Since designing parallel tests with the same level of difficulty is extremely difficult if not impossible, the pre-test and post-test questions were almost similar. But, at the same time, we slightly changed the appearance and order of questions in the post-test to relatively control for the pre-test sensitivity. The authors also designed the primary and final questionnaires, and their validity was ensured by content validity assessment. The questionnaires were designed according to several previous studies and related literature. Necessary modifications were made according to the perspectives of 10 scientific faculty members of Tehran University who were familiar with SARMAD website as well as the operative dentistry faculty members. To determine the reliability of the questionnaires, the Cronbach’s alpha method was applied, and the reliability of the questions was approved by a Cronbach’s alpha coefficient of 83%.

### Data analysis

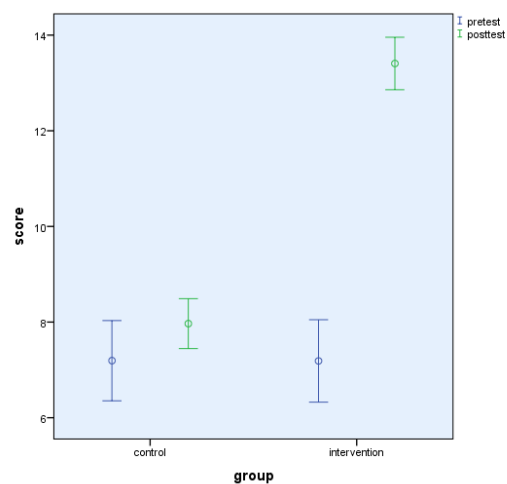
Repeated measures ANOVA was used to determine the effect of type of intervention on the outcome of learning. In the case of significance, independent sample t-test was applied to compare groups. Paired sample t-test was used for the comparison of pre-test and post-test scores in each group.

### Results

Of 63 students participating in this study, 28 were females, and 35 were males; 19% were married, and 81% were single. The mean age of participants was 23.49 years and 100% of students stated in the questionnaire that they had access to a computer and The Internet; 63.6% had experienced e-learning for at least one topic, and 74.4% were familiar with SARMAD website.

According to the results of repeated measures ANOVA, the effect of the intervention on the academic achievement of learning was significant ( $P<0.001$ ). Independent sample t-test showed that the pre-test scores of the intervention and control groups were not

significantly different ( $P=0.992$ ); but, a significant difference was noted between their post-test scores ( $P<0.001$ ). Paired sample t-test revealed that the post-test score was significantly higher than the pre-test score in the intervention group ( $P<0.001$ ); but in the control group, the post-test score was only slightly higher than the pre-test score ( $P=0.128$ ) (Figure 2).



**Figure 2.** The error bar of mean and 95% confidence interval of mean of the pre-test and post-test scores of control and intervention groups

In the final poll, 63.3% of students in the intervention group ranked this educational modality “good” while 16.7% ranked it “very good”; 63.3% agreed and 20% totally agreed with the statement that “this method can better cover the educational content”; 70% stated that they would recommend this method as an educational modality. In the intervention group, 43% of students agreed and 26.7% totally agreed with the statement that “this method of instruction further encourages students to study the respective topics”; 93.3% stated that this method would be useful as a supplement to face-to-face instruction; 46.7% agreed and 20% totally agreed that this method of learning is fun for students; 16.7% ranked the SARMAD website excellent, 30% good, 33.3% acceptable, 16.7% moderate and 3.3% poor.

### Discussion

The results showed that e-learning improved both the academic achievement (post-test score) and attitude of learners towards the diagnosis and treatment planning of tooth discolorations. The post-test score was significantly higher than the pre-test score in the intervention group.

The results of previous studies have been controversial based on their design. Preston *et al.*, (26) reported that Internet instruction was more efficient than conventional education for improving physiotherapy skills; which is in accord with our findings. However, Ramseier *et al.*, (17) demonstrated that web-based instruction was as effective as the lecture notes for enhancing the knowledge of undergraduate dental students about fixed prosthodontics.

In the majority of previous studies, the post-test score has been the criterion of the level of learning. However, in e-learning approach, the learners are responsible for their own level of learning and thus, the learning would be deeper since e-learning emphasizes on the production of knowledge rather than necessarily acquiring it. In other words, via e-learning, students actually learn how to acquire knowledge or skills (27-29). Clinical cases are uploaded by the instructors on the SARMAD website, and students read them and answer the quiz questions. Learning via this website does not require any specific computer skills (like PowerPoint, Microsoft Word, Microsoft Excel, etc.) and only a slight acquaintance with the Internet would suffice. Buckley (30) stated that easy access to educational content via a computer is effective in enhancing the process of learning. Woelber *et al.*, (22) reported that using easy-software resulted in an increase in the students' score in the topic of aggressive periodontitis compared to the use of complex-software. In our study, 80% of students ranked SARMAD acceptable, good and excellent.

Independence in choosing the method of instruction can lead to high level of satisfaction and have positive outcomes. Billings *et al.*, (31) also confirmed that a positive correlation exists between satisfaction with instruction and its easy accessibility.

With all that said and based on the study results and relative satisfaction of learners with this instructional modality, e-learning via the SARMAD website might have been responsible for the improvement observed in the ability of students to diagnose tooth discolorations and offer a treatment plan.

However, critics believe that computer-based learning is dull, mechanical and inhumane and there is no live and thriving interaction between the instructor and students or even among the learners themselves. But, in the current study, this problem was somehow non-existent since there was an interaction between the students and the instructors and 70% of learners in the intervention group stated that this instructional modality was fun. Another aspect of this study was instruction with the PBL approach in the SARMAD website. PBL

is learner-centered and allows the students to adjust their learning in a structured environment (25) and improves their problem-solving ability (25). Literature indicates that this method of instruction is enjoyable and motivating for learners (32,33). In the current study, educational topics were taught to students via clinical case presentations and at a specific time, students were requested to diagnose the problem and offer a treatment plan or comment on the complications and limitations of treatment plans and discuss the case with other students and the instructor. In fact, when learners are expected to use their knowledge for solving the problem, they are given a chance to practice this skill (25). There is a possibility that this issue has significantly contributed to improving the ability of students to diagnose tooth discolorations and offer treatment plans considering their post-test score.

E-learning via SARMAD website significantly enhanced the ability of senior dental students to diagnose tooth discolorations and offer a treatment plan.

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