



Effect of Electronic and Lecture-Based Continuing Education Courses on Level of Knowledge of General Dentists on Dental Bleaching

Sedighe Sadat Hashemikamangar,¹ Mohammad Javad Kharazi Fard,² Nazanin Kiomarsi,³ Mitra Zolfaghari,⁴ Zahra Zinati,⁵ and Ladan Ranjbar Omrani^{6,*}

¹MSc of Operative Dentistry, Department of Operative Dentistry, Faculty of Dentistry, Tehran University of Medical Sciences, International Campus, Tehran, IR Iran

²PhD of Epidemiology, Dental Research Center Dental Research Institute, Faculty of Dentistry, Tehran University of Medical Sciences, Tehran, IR Iran

³MSc of Operative Dentistry, Department of Operative Dentistry, Faculty of Dentistry, Tehran University of Medical Sciences, International Campus, Tehran, IR Iran

⁴PhD of E-learning, Nursing and Midwifery Care Research Center, Department of E-learning in Medical Education, Virtual School, Tehran University of Medical Sciences, Tehran, IR Iran

⁵Dentist, Tehran University of Medical Sciences, Tehran, IR Iran

⁶MSc of Operative Dentistry, Department of Operative Dentistry, Faculty of Dentistry, Tehran University of Medical Sciences, Tehran, IR Iran

*Corresponding author: Ladan Ranjbar Omrani, MSc of Operative Dentistry, Department of Operative Dentistry, Faculty of Dentistry, Tehran University of Medical Sciences, Tehran, IR Iran. Tel: +98-9122132110, E-mail: ladanomrani@yahoo.com

Received 2017 March 02; Revised 2018 January 24; Accepted 2018 January 28.

Abstract

Background: The efficacy of electronic continuing education courses in comparison to lectured based methods requires further evaluation. This study aimed at comparing the effect of electronic (e-learning) and face-to-face conventional instruction on level of knowledge of general dentists on bleaching of discolored teeth.

Methods: In this quasi-experimental controlled trial study in 2017 (1396) with post-test and control group design, firstly, a lecture-based continuing education courses at Shahid Beheshti University on discoloration of a single tooth was carried out for general dentists (as the control group, N = 35). Then, a continuing education online course with the same topic was done for the second group (N = 35). Convenience sampling was used to select participants of each group. Data were collected by a researcher-made questionnaire, which consisted of 2 parts (post-test with 10 questions and a satisfaction questionnaire with 10 questions). Content validity and test-retest reliability ($r = 0.8$) of both was determined. Data analysis was performed using the t-test and Pearson's chi square test using the SPSS 23 software. The level of statistical significant was considered at $P = 0.05$.

Results: The mean knowledge score after education was 7.02 (2.87) in e-learning and 6.77 (1.23) in the conventional group. The difference between the 2 groups was not significant ($P = 0.63$). Overall, 91.4% in the e-learning and 91.5% in the conventional group believed that the educational course obviated their occupational needs.

Conclusions: E-learning was as effective as conventional instruction for bleaching of a single discolored tooth in terms of knowledge score (post-test score) and self-reported satisfaction and attitude of dentists.

Keywords: Education, Dentistry, E-learning, Tooth Discoloration, Knowledge

1. Background

The growing demand for dental education, an increased number of students, and limited number of instructors are challenges for dental education. These limitations may affect educational standards and clinical performance of dentists (1).

Continuing education is necessary for maintaining the professional skills of dental graduates. Even the most efficient dental curricula cannot guarantee adequate skills during the entire professional life of a clinician because by continuous advances in science, the learned knowledge soon becomes outdated and obsolete (2-4).

At present, dental education must be continued after graduation until the end of the clinical practice of clin-

icians. Dentists are obliged to participate in continuing education courses to promote their level of knowledge (5). However, the efficacy of continuing education courses must be evaluated (6, 7).

Instructor-centered education is gradually converted to learner-centered instruction, in which learners control the process of learning. Recently, curricula have been changed to competency-based curricula, which emphasize on the outcome of learning and not the method of instruction, and continuing education is no exception to this rule (8).

Computer-based learning is gaining increasing popularity in dental education (9) and has advantages, such as easy access, easy use, enabling instruction almost any-

where, high quality of images, and enabling repetition of instruction and exercises (10). Web-based instruction is an important tool in evidence-based medicine due to recent advances in science and technology (10). Thus, in addition to face-to-face instruction, alternatives, such as e-learning, can serve as adjunct tools.

E-learning, also known as web-based learning, online learning, distributed learning, computer-assisted instruction or internet-based learning, refers to educational content over the Internet, intra-extranet (LAN/WAN) or audio-video tools (11, 12). A qualitative study showed that e-learning is well-accepted in medical education (13). Since the first application of e-learning in dentistry in 1970s (14), its use has been increasing. After years of debate over its superiority to lecture-based and other instruction modalities, researchers unanimously believe that e-learning is effective, especially when blended with face-to-face learning (14-16).

Despite studies on education in general, studies on dental education are limited and further investigations are required on the efficacy of educational modalities in dentistry (17). Creating a balance between the conventional and electronic instructional modalities depends on educational goals, characteristics of learners, online sources, and experience of the instructors (18).

Tehran University of Medical Sciences has developed an electronic scientific learning center to provide e-learning courses and has launched a website offering online continuing education courses for dentists available at <http://cme.tums.ac.ir>.

A beautiful smile highly depends on correction of discolorations, malformed teeth, and dental crowding (19). A perfect smile increases self-esteem and promotes the personality and social life of individuals (20). Demand for correction of discolorations and tooth whitening is high. Considering the popularity of these treatments and their profitability for dentists, it appears that lack of electronic courses on this topic may result in malpractice or seeking knowledge from unreliable sources. Thus, one strategy to overcome this, is to design e-learning courses on this topic for general dentists as part of their continuing education program. This is currently implemented in Iran. However, the efficacy of e-learning for dental topics through the Website of Tehran University of Medical Sciences has not been evaluated. This study aimed at assessing the effect of e-learning regarding bleaching of a single discolored tooth through the <http://cme.tums.ac.ir> website on level of knowledge and satisfaction of general dentists.

2. Methods

This quasi-experimental, interventional study, performed during year 2017 (1396), had a post-test design with a control group. The study was approved by the ethics committee of Tehran University of Medical Sciences (IR.TUMS.VCR.REC.1395.248). Convenience sampling was used to select participants of each group. Firstly, a lecture-based continuing education course at Shahid Beheshti University on discoloration of a single tooth was performed (as control group) and then a continuing education online course with the same topic was done for the second group (N = 35). Continuing education online course was offered by the Tehran University of Medical Sciences website at <http://cme.tums.ac.ir> (as the experimental group). Sample size was calculated as 35, according to a study by Moazami et al. using the Minitab software, considering $\alpha = 0.05$, $\beta = 0.2$, standard deviation of 5.11, and minimum significant difference of 3.5 (21). A total of 70 general dentists were evaluated. Demographic variables are shown in Table 1. The license required to offer an online continuing education course on bleaching of a single discolored tooth was obtained from the Iranian general dental association (IGDA) (code: 39303011). The content of the course was approved and it was offered online at <http://www.ircme.ir> (code: 551129502).

Educational content was determined based on the objectives of the educational curriculum. Learners participated in the continuing education course held by the IGDA at Shahid Beheshti University. Conventional instruction included lectures, discussions, and question and answer panels on bleaching of a single discolored tooth for 1 hour and then a post-test was carried out.

The inclusion criterion for participation in this program was being a general dentists and signing up for the continuing education course on restorative dentistry. Those with a history of previous participation in the same course were excluded.

An Internet-based program on bleaching of a single discolored tooth was designed and offered through the following website, <http://cme.tums.ac.ir>. Post-test and a questionnaire were also offered electronically. The program included a study guide, to navigate the user throughout the course.

Data were collected by post-test (to prevent pre-test sensitivity bias) and satisfaction questionnaire. The post-test questions were designed based on the project objectives and previous relevant literature. Ten post-test questions were designed for the post-test, based on the educational content and goals. A satisfaction questionnaire was also designed, which included 10 questions. Two questions were asked about the inclusion criteria and 9 questions

about the satisfaction of participants with the Likert scale scoring system.

To assess the validity of the post-test and questionnaire, content validity was evaluated such that 10 restorative dentists (faculty members of Tehran University, school of dentistry) evaluated the questions and made revisions. To determine the reliability of the post-test and questionnaire, test-retest reliability was also used ($r = 0.8$).

Validity indicates the degree to which a measurement tool assesses the desired characteristic. Reliability indicates the degree to which a measurement tool yields similar results under the same conditions.

Independent sample t-test was applied to assess the effect of type of intervention on the outcome (knowledge) of learning in comparison with the post-test scores in the 2 groups. In order to evaluate the effect of intervention on level of satisfaction, the Pearson Chi-square method was used. The level of statistical significance was considered at 0.05.

3. Results

A total of 35 general dentists participated in the conventional instruction course, out of which, 18 were females and 17 were males (Table 1). Also, 35 participants participated in the e-learning course, out of which 14 were females and 21 were males. The mean knowledge score was 7.02 in the e-learning and 6.77 in the conventional group. The results of independent sample t-test showed that the mean knowledge score was not significantly different between the 2 groups ($P = 0.63$).

Table 1. Demographic Variables of Participants in the Two Groups in Number and Percentage

Variables	Lecture Based Course	On Line Course
Gender		
Male	17 (48.5)	21 (60)
Female	18 (51.5)	14 (40)
City of employment		
Tehran	15 (42.8)	18 (51.5)
Country	20 (57.2)	17 (48.5)
Employment status		
Governmental	10 (28.5)	6 (17.2)
Private	19 (54.3)	20 (57.2)
Other	6 (17.2)	9 (25.6)

Also the results of Pearson Chi-square showed that the 2 groups were not significantly different regarding the re-

sults of each question except for, the appropriateness of using images or films, for which there was a significant difference between the 2 groups ($P = 0.03$) (Table 2).

4. Discussion and Conclusion

Our results showed that e-learning was as effective as lecture-based instruction in improving the level of knowledge and self-reported satisfaction of learners in terms of bleaching of a single discolored tooth. This finding was in line with the results of Hugenholtz et al. (22). They compared the efficacy of e-learning and conventional instruction for continuing education and found that e-learning was as effective as lecture-based instruction for specialists (22). In this study, the mean knowledge score of participants in e-learning group was slightly higher than that of the conventional education group. However, this difference was not significant. In the e-learning group, participants had to acquire the minimum acceptable score to pass the course and receive the required continuing education score (which is mandatory for their practice). For this reason, they were allowed to take the exam several times and this may explain their slightly higher score compared to the conventional group. This finding highlights the advantage of repeatability of practice in e-learning, which eventually resulted in greater learning.

Nourian et al. (23) compared the efficacy of electronic and traditional instruction of community dentistry for undergraduate dental students and reported that the 2 groups acquired similar mean knowledge scores with no significant difference; this finding was in agreement with the current results.

Moreover, Chumley et al. (24) in their review study on 76 medical, nursing, and dental studies showed that one-third of studies considered the knowledge acquired by students as the index for efficacy of electronic instruction. They mostly asked multiple-choice questions in a written exam. In one study, a standard patient was used. These studies showed that e-learning was as effective as traditional instruction for acquiring knowledge. However, in most studies, the score obtained in the written exam served as the index of learning. However, in e-learning, since the learner takes responsibility for the process of learning, deeper learning occurs. In e-learning, instruction, the emphasis is on generating knowledge and not necessarily acquiring it. In other words, learners in this method learn how to learn (25-27).

Considering the current results, high efficacy of e-learning (similar to that of conventional instruction) was mainly due to the optimal efficiency of the CME system. This system is efficient and easy to use since it does not require any proficiency or software (such as PowerPoint, Mi-

Table 2. The Present of Answering Each Question in the Questionnaire in the Two Groups

No.	Questions	Group	Answer, %					Analysis P Value	
			Completely Agree	Agree	No Opinion	Disagree	Completely Disagree		No Answer
1	This program obviated your occupational needs.	Conventional	10 (28.6)	22 (62.9)	2 (5.7)	1 (2.9)	0 (00)	0 (00)	0.62
		E-learning	13 (37.1)	19 (54.3)	2 (5.7)	0 (00)	1 (2.9)	0 (00)	
2	The program's goals were clear and compliant with your occupational needs.	Conventional	9 (25.7)	25 (71.4)	1 (2.9)	0 (00)	0 (00)	0 (00)	0.33
		E-learning	10 (28.6)	21 (60.0)	4 (11.4)	0 (00)	0 (00)	0 (00)	
3	The program contents complied with the goals.	Conventional	7 (20.0)	24 (68.6)	1 (2.9)	3 (8.6)	0 (00)	0 (00)	0.23
		E-learning	9 (25.7)	20 (57.1)	5 (14.3)	1 (2.9)	0 (00)	0 (00)	
4	The program contents were Up-to-date	Conventional	23 (65.7)	10 (28.6)	1 (2.9)	1 (2.9)	0 (00)	0 (00)	0.18
		E-learning	20 (57.1)	9 (25.7)	6 (17.1)	0 (00)	0 (00)	0 (00)	
5	The program flow of the course was logical and had a proper sequence.	Conventional	13 (37.1)	18 (51.4)	2 (5.7)	2 (5.7)	0 (00)	0 (00)	0.51
		E-learning	11 (31.4)	45.7	6 (17.1)	2 (5.7)	0 (00)	0 (00)	
6	The content of this program was clear and eloquent.	Conventional	12 (34.5)	62.9	1 (2.9)	0.0 (00)	0 (00)	0 (00)	0.09
		E-learning	9 (25.7)	18 (51.4)	6 (17.1)	2 (5.7)	0 (00)	0 (00)	
7	The films or images had the required quality.	Conventional	10 (28.6)	16 (45.7)	4 (11.4)	5 (14.3)	0 (00)	0 (00)	0.38
		E-learning	5 (14.3)	17 (48.6)	8 (22.9)	5 (14.3)	0 (00)	0 (00)	
8	The images and films were used appropriately.	Conventional	13 (37.1)	19 (54.3)	2 (5.7)	1 (2.9)	0 (00)	0 (00)	0.03
		E-learning	4 (11.4)	19 (54.3)	9 (25.7)	3 (8.6)	0 (00)	0 (00)	
9	The theme of the program was attractive and interesting.	Conventional	10 (28.6)	22 (62.9)	3 (8.6)	0 (00)	0 (00)	0 (00)	0.87
		E-learning	12 (34.3)	20 (57.1)	3 (8.6)	0 (00)	0 (00)	0 (00)	
10	The program was efficient to increase proficiency.	Conventional	11 (31.4)	22 (62.9)	1 (2.9)	1 (2.9)	0 (00)	0 (00)	0.56
		E-learning	10 (28.6)	22 (62.9)	3 (8.6)	0 (00)	0 (00)	0 (00)	

crosoft Word or Excel) and every one with a slight familiarity with the Internet can use it.

Buckley (28) believed that easy access to educational content via the Internet is an important factor enhancing learning ability. Woelber et al. reported that using an easy software increased the test score of learners about aggressive periodontitis compared to the use of the complex software.

Also, independence in use of this modality results in increasing popularity and positive feedbacks. Billings et al. (29) reported a significant association between satisfaction with instruction and easy use.

In use of the CME system, learning occurs independently. Although some believe that the process of e-learning is mechanical and senseless and lacks efficient interaction between students and instructors (30), the high satisfaction rate obtained in this study contradicted this belief. Assessment of the satisfaction of learners is another method to evaluate the efficacy of online educational courses (20). The current results indicated that 91.4% of cases in the e-learning and 91.5% in the conventional education group believed that these programs obviated their occupational needs; 88.6% in the e-learning and 97.1% in the conventional group believed that the objectives of the programs were compatible with their occupational needs. Over 91.5% in the e-learning and 94.3% in the con-

ventional instruction group believed that their proficiency improved after their participation in the course. The current results also showed that 91.4% of the e-learning and 91.5% of the conventional instruction group believed that content of the program was appealing to them. Evidence showed that electronic learning is enjoyable and motivating for learners (30, 31). McDonald (32), De Muth and Bruskiwitz (33), and Mathur and Stanto (34) compared e-learning, traditional instruction, and other educational methods (audio-conference) and concluded that participants were more interested in computer-based learning.

In the current study, satisfaction rate of the e-learning group was similar to that of the conventional group for all questions except for clarity of topics (satisfaction rate on this topic was higher in the conventional group). This difference may be due to the greater familiarity of learners with the lecture-based method of instruction. On the other hand, despite the fact that educational content of the system was peer reviewed by experts, some modifications may still be required for further clarity of the topics.

Zolfagahry et al. stated that combining traditional instruction and e-learning would result in higher satisfaction of students and teachers (35). Ruiz et al. emphasized that electronic instruction should not replace classroom teaching and should only be used as a supplement to other conventional instructions (12). Hashemi Kaman-

gar et al. in 2016 suggested e-learning as an adjunct tool for instruction of general dental curricula since this modality resulted in relative satisfaction of students, changed their attitude, enhanced their diagnostic ability and resulted in efficient treatment planning for dental discolorations (36). Considering the limitations of educational research, this study had a quasi-experimental design. Since we could not randomly assign learners to the 2 groups, for making the groups more homogenous, those reporting a history of previous participation in the same course were not included. On the other hand, due to pre-test sensitivity bias, the study was performed with an interventional design with a control group and only compared the post-test score and satisfaction rate of the 2 groups. For this reason, in short duration educational programs, holding pre-test creates pre-test sensitivity, therefore in this semi-experimental study, only a post-test was designed (37).

Since traditional lecture-based continuing education courses require allocation of time, a specific location for holding classes and physical participation of learners, designing electronic courses for dentists, and evaluation of their efficacy seem necessary. Since the current results indicated similar efficacy of e-learning and conventional instruction and considering the costly and time consuming nature of class-room-based instruction, authorities of medical universities, especially dental schools, must be encouraged to offer these courses online. The current results provided some information about the pitfalls and perspectives of e-learning and its application for continuing education.

According to the limitations of this study, it could be concluded that electronic instruction can be as effective as traditional lecture-based instruction for dental continuing education at least for the topic of a single discolored tooth.

To benefit from the advantages of e-learning, such as saving time, cost and educational environment and also to benefit from expert instructors, e-learning can be used as an adjunct to class-room teaching and its efficacy must be evaluated in future studies for use in other medical fields.

Acknowledgments

The authors thank the virtual school of Tehran University of Medical Sciences for making this online course.

Footnotes

Authors' Contribution: All authors contributed towards the data analysis, drafting, and critical review of the paper and agreed to be accountable for all aspects of the work.

Conflict of Interest: None declared.

References

- Bains M, Reynolds PA, McDonald F, Sherriff M. Effectiveness and acceptability of face-to-face, blended and e-learning: a randomised trial of orthodontic undergraduates. *Eur J Dent Educ.* 2011;**15**(2):110-7. doi: [10.1111/j.1600-0579.2010.00651.x](https://doi.org/10.1111/j.1600-0579.2010.00651.x). [PubMed: [21492347](https://pubmed.ncbi.nlm.nih.gov/21492347/)].
- Bordji A, Imani M, Moradi A. The study of general practitioners' views on the content of composed programs in Zahedan. *Tabibe Shargh.* 2004;**6**(2):145-51.
- Moattari M, Azizi F. Continuing medical education. *J Shaheed Beheshti Univ Med Sci Health Serv.* 1998;**1**(22):106-18. [in Persian].
- Zahed PY, Kanani JG. A survey on tile opinions of participators about cme in babol university of medical sciences 2000. *Teb va Tazkieh J.* 2001;**11**(42):18-23.
- Mersel A. Continuing education: obligation or duty? The European dilemma. *Int Dent J.* 2007;**57**(2):109-12. [PubMed: [17506470](https://pubmed.ncbi.nlm.nih.gov/17506470/)].
- Hosseini JSN. Revision in continuing medical education programm. Suppl 4th National Congress on Medical Education. *J Tehran Faculty Med.* 2000:153-4.
- Zolfaghari B, Yousefi AR, Adibi P. A look to five-year program of continuing medical education of physicians: teachers' and doctors' viewpoint. *J Isfahan Med School.* 1998;**50**(16):1-5.
- Leung WC. Competency based medical training: review. *BMJ.* 2002;**325**(7366):693-6. [PubMed: [12351364](https://pubmed.ncbi.nlm.nih.gov/12351364/)].
- Schleyer TK, Thyvalikakath TP, Spallek H, Dziabiak MP, Johnson LA. From information technology to informatics: the information revolution in dental education. *J Dent Educ.* 2012;**76**(1):142-53. [PubMed: [22262557](https://pubmed.ncbi.nlm.nih.gov/22262557/)].
- Potomkova J, Mihal V, Cihalik C. Web-based instruction and its impact on the learning activity of medical students: a review. *Biomed Papers.* 2006;**150**(2):357-61. doi: [10.5507/bp.2006.055](https://doi.org/10.5507/bp.2006.055).
- Hillenburg KL, Cederberg RA, Gray SA, Hurst CL, Johnson GK, Potter BJ. E-learning and the future of dental education: opinions of administrators and information technology specialists. *Eur J Dent Educ.* 2006;**10**(3):169-77. doi: [10.1111/j.1600-0579.2006.00413.x](https://doi.org/10.1111/j.1600-0579.2006.00413.x). [PubMed: [16842592](https://pubmed.ncbi.nlm.nih.gov/16842592/)].
- Ruiz JG, Mintzer MJ, Leipzig RM. The impact of E-learning in medical education. *Acad Med.* 2006;**81**(3):207-12. [PubMed: [16501260](https://pubmed.ncbi.nlm.nih.gov/16501260/)].
- Gormley GJ, Collins K, Booohan M, Bickle IC, Stevenson M. Is there a place for e-learning in clinical skills? A survey of undergraduate medical students' experiences and attitudes. *Med Teach.* 2009;**31**(1):e6-12. doi: [10.1080/01421590802334317](https://doi.org/10.1080/01421590802334317). [PubMed: [19253150](https://pubmed.ncbi.nlm.nih.gov/19253150/)].
- Mullaney TP, Duell RC, Smith TA, Blair HA. Programmed simulation of clinical endodontic problems. *J Dent Educ.* 1972;**36**(11):37-9. [PubMed: [4117493](https://pubmed.ncbi.nlm.nih.gov/4117493/)].
- Mattheos N, Schoonheim-Klein M, Walmsley AD, Chapple IL. Innovative educational methods and technologies applicable to continuing professional development in periodontology. *Eur J Dent Educ.* 2010;**14** Suppl 1:43-52. doi: [10.1111/j.1600-0579.2010.00624.x](https://doi.org/10.1111/j.1600-0579.2010.00624.x). [PubMed: [20415976](https://pubmed.ncbi.nlm.nih.gov/20415976/)].
- Pereira JA, Pleguezuelos E, Meri A, Molina-Ros A, Molina-Tomas MC, Masdeu C. Effectiveness of using blended learning strategies for teaching and learning human anatomy. *Med Educ.* 2007;**41**(2):189-95. doi: [10.1111/j.1365-2929.2006.02672.x](https://doi.org/10.1111/j.1365-2929.2006.02672.x). [PubMed: [17269953](https://pubmed.ncbi.nlm.nih.gov/17269953/)].
- Levinson AJ, Weaver B, Garside S, McGinn H, Norman GR. Virtual reality and brain anatomy: a randomised trial of e-learning instructional designs. *Med Educ.* 2007;**41**(5):495-501. doi: [10.1111/j.1365-2929.2006.02694.x](https://doi.org/10.1111/j.1365-2929.2006.02694.x). [PubMed: [17470079](https://pubmed.ncbi.nlm.nih.gov/17470079/)].
- Kavadella A, Tsiklakis K, Vougiouklakis G, Lionarakis A. Evaluation of a blended learning course for teaching oral radiology to undergraduate dental students. *Eur J Dent Educ.* 2012;**16**(1):e88-95. doi: [10.1111/j.1600-0579.2011.00680.x](https://doi.org/10.1111/j.1600-0579.2011.00680.x). [PubMed: [22251359](https://pubmed.ncbi.nlm.nih.gov/22251359/)].

19. Polydorou O, Hellwig E, Auschill TM. The effect of different bleaching agents on the surface texture of restorative materials. *Oper Dent*. 2006;**31**(4):473-80. doi: [10.2341/05-75](https://doi.org/10.2341/05-75). [PubMed: [16924988](https://pubmed.ncbi.nlm.nih.gov/16924988/)].
20. Heymann HO, Swift Jr EJ, Ritter AV. *Sturdevant's Art Science of Operative Dentistry-E-Book*. Elsevier Health Sciences; 2014.
21. Moazami F, Bahrampour E, Azar MR, Jahedi F, Moattari M. Comparing two methods of education (virtual versus traditional) on learning of Iranian dental students: a post-test only design study. *BMC Med Educ*. 2014;**14**:45. doi: [10.1186/1472-6920-14-45](https://doi.org/10.1186/1472-6920-14-45). [PubMed: [24597923](https://pubmed.ncbi.nlm.nih.gov/24597923/)].
22. Hugenholtz NI, de Croon EM, Smits PB, van Dijk FJ, Nieuwenhuijsen K. Effectiveness of e-learning in continuing medical education for occupational physicians. *Occup Med (Lond)*. 2008;**58**(5):370-2. doi: [10.1093/occmed/kqn053](https://doi.org/10.1093/occmed/kqn053). [PubMed: [18495676](https://pubmed.ncbi.nlm.nih.gov/18495676/)].
23. Nourian A, Nourian A, Ebnahmadi A, Akbarzadeh Bagheban A, Khoshnevisan MH. Comparison of E-learning and Traditional Classroom Instruction of Dental Public Health for Dental Students of Shahid Beheshti Dental School during 2010-2011. *Shahid Beheshti Univ Dent J*. 2012;**30**(3):174-83.
24. Chumley JHS, Dobbie A, Cynthia A. *Sound educational method or hype? a review of the evaluation professional dental education amongst general dental practitioners who attended the 26th Asia Pacific Dental Congress*. 2006.
25. Hewitt-Taylor J. Facilitating distance learning in nurse education. *Nurse Educ Pract*. 2003;**3**(1):23-9. [PubMed: [19036314](https://pubmed.ncbi.nlm.nih.gov/19036314/)].
26. Choi H. A problem-based learning trial on the Internet involving undergraduate nursing students. *J Nurs Educ*. 2003;**42**(8):359-63. [PubMed: [12938898](https://pubmed.ncbi.nlm.nih.gov/12938898/)].
27. Twomey A. Web-based teaching in nursing: lessons from the literature. *Nurse Educ Today*. 2004;**24**(6):452-8. doi: [10.1016/j.nedt.2004.04.010](https://doi.org/10.1016/j.nedt.2004.04.010). [PubMed: [15312954](https://pubmed.ncbi.nlm.nih.gov/15312954/)].
28. Buckley KM. Evaluation of classroom-based, Web-enhanced, and Web-based distance learning nutrition courses for undergraduate nursing. *J Nurs Educ*. 2003;**42**(8):367-70. [PubMed: [12938900](https://pubmed.ncbi.nlm.nih.gov/12938900/)].
29. Billings DM, Connors HR, Skiba DJ. Benchmarking best practices in Web-based nursing courses. *ANS Adv Nurs Sci*. 2001;**23**(3):41-52. [PubMed: [11225049](https://pubmed.ncbi.nlm.nih.gov/11225049/)].
30. Lycke KH, Grottum P, Stromso HI. Student learning strategies, mental models and learning outcomes in problem-based and traditional curricula in medicine. *Med Teach*. 2006;**28**(8):717-22. doi: [10.1080/01421590601105645](https://doi.org/10.1080/01421590601105645). [PubMed: [17594584](https://pubmed.ncbi.nlm.nih.gov/17594584/)].
31. Winning T, Townsend G. Problem-based learning in dental education: what's the evidence for and against...and is it worth the effort?. *Aust Dent J*. 2007;**52**(1):2-9. [PubMed: [17500157](https://pubmed.ncbi.nlm.nih.gov/17500157/)].
32. MacDonald PJ. *Integrating multimedia technology into continuing nursing education examining the effectiveness*. 2011. Available from: <http://www.collectionscanada.gc.ca/obj/s4/f2/dsk3/ftp04/MQ57438.pdf>.
33. De Muth JE, Bruskiwitz RH. A comparison of the acceptability and effectiveness of two methods of distance education: CD-ROM and audio conferencing. *Am J Pharm Educ*. 2006;**70**(1):11. [PubMed: [17136154](https://pubmed.ncbi.nlm.nih.gov/17136154/)].
34. Mathur S, Stanton S, Reid WD. Canadian physical therapists' interest in web-based and computer-assisted continuing education. *Phys Ther*. 2005;**85**(3):226-37. [PubMed: [15733047](https://pubmed.ncbi.nlm.nih.gov/15733047/)].
35. Zolfaghari M, Sarmadi MR, Negarandeh R, Zandi B, Ahmadi F. Attitudes of Nursing and Midwifery School's Faculty toward Blended E-learning at Tehran University of Medical Sciences. *Hayat*. 2009;**15**(1).
36. Hashemikamangar SS, Yazdanpanah F, Mirzaii M, Yazdani R, Karazifard MJ, Yasini E. Efficacy of E-Learning via the Website of Tehran University of Medical Sciences for Diagnosing Tooth Discolorations and Treatment Planning by Senior Dental Students. *Acta Medica Iranica*. 2016;**54**(8):536-41.
37. Delavar A. *Research methodology in psychology and education*. Tehran: Virayesh Publication Institute; 2005.