

Newer Dental Teaching Methods: Paradigm Shift from Teacher-Centered to Student-Centered Learning. Review

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Abstract

Information and communication technologies are being rapidly incorporated into our culture and their effect on the lives of people is becoming more and more evident. Their presence has entered the education sector, where a transition to a modern way of understanding teaching and in the ways in which it is taught has been made by their inclusion. The use of assessment or adjunct instruments as part of teaching has become more common in medical and dental schools in recent years. In the dental curriculum, educators have tried distinct teaching approaches. The new curriculum has moved from teacher-centered approaches to more methods for student learners.

Various teaching techniques used in educational institutions are workshops, discussions, computer-assisted learning, audiovisual sources, video-based learning, presentation and role-playing. But for all of these new teaching methods, there is still no straightforward summary and no reference to the evidence for the most effective teaching form. Modern learning methods that are increasingly spreading around the world are not well-known in dentistry. Therefore, the purpose of this review was to focus on these modern teaching methodologies in order to attract the attention of dental staff to be more informed of these methods, particularly in the field of education. This helps dental institutions shift their model from one that focuses on teacher-led training to one that focuses on student-centered learning.

Keywords: Tutorial Lecture; Flipped Classroom; Rain Classroom; Evidence Based Dentistry; Problem Based Learning; Role Play; Computer Assisted Learning; Simulation Training

Introduction

Educators of learners at various educational levels have used learning style models in efforts to improve learning ability. Learning styles is defined as “the way in which people choose to approach a learning situation or are inclined to do so” [1]. Education is seen by humanity today as an important asset to excellence. In order to encourage the learner to access knowledge and use any facility to its fullest potential, education should face the vision of the ‘New World Order. Around the world many educational innovations have been made, attempted and progressed in order to make a difference. Teaching and learning have evolved from passive and didactic to active and enthusiastic [2].

The use of assessment or adjunct instruments as part of teaching has become more common in medical and dental schools in recent years. In the dental curriculum, educators have tried distinct teaching approaches. Actually, the curriculum has shifted from teacher-

centered methods to more methods for student learners. Different teaching techniques used in educational institutions are seminars, discussions, computer-assisted learning, audiovisual sources, video-based learning, presentation and role play [3].

Training is a learning process that deals with unpredictable consequences, with situations that involve a dynamic synthesis of information, skills and experience to find solutions [4]. The education method is driven by the theory of education [5]. There is a broad classification of educational theories into normative and descriptive theories. The normative theories concentrate on the principles, expectations and circumstances underlying the philosophy of education, and the descriptive theory explains teaching methods (pedagogy) and the effects of a program [6].

In dentistry, modern learning techniques that are quickly spreading across the world are not well known. Therefore, the purpose of this review was drawing the attention of dental workers especially in the field of education to be more aware of these modern teaching methods. This helps dental institutions to change their model from one focused on teacher-led instruction to one based on student-centered learning.

Teaching methods

As shifts in information and technology are so rapid, education also keeps up with it and continues its growth with creative approaches to learning. It is important to use creative approaches in education to compensate for the educational requirements of students of the 21st century [7]. The commonly used teaching techniques include:

Lecture tutorials

Lecturing is the most commonly used teaching technique at all levels of education. Lectures are one of the key forms of teaching and are the lecturer's formal presentation. In traditional teaching, teachers play a dominant role, with teachers lecturing and students listening [8]. Traditional pedagogy is focused on broad lecture classes as the method of transmitting teacher-to-student knowledge. They are also interactive and use a number of multimedia resources to make them engaging. Lectures are usually recorded so that, if you need to revision, you can access the material again. Pre-recorded lectures have become popular in medical education with the advent of technology. Similarly, the principal mode of instruction in dental education is lectures [9]. This method assumes that the lecture format allows for the most effective use of faculty time to present the greatest amount of information in the shortest period of time. While it is cost-effective to provide a single lecture to a wide group of students, this pedagogical approach is often inefficient because the concentration of students in passive listening environments is difficult to sustain for durations longer than ten minutes. Lectures have been confirmed to be effective but not more effective than other teaching methods [10].

Flipped classroom

The most common active-based approach is the Flipped classroom approach, which is a special form of blended learning. In 2007, with chemistry teachers Jonathan Bergmann and Aaron Sams from Woodland Park High School recording live lessons and broadcasting them online for students who skipped those lessons, this approach first attracted the attention of educators [11]. The key goal of this new approach to learning is to prepare students for the subject prior to the course and during the course, by introducing practices that improve the standard of face-to-face education [12].

The flipped classroom approach with its simplest meaning is expressed as "what is done at school at home, homework done at home completed in class" [11]. The students watch the theoretical part of the lesson in this method before the course through various devices such as online videos, presentations, learning management systems and take notes, prepare questions about the sections they do not un-

derstand [13]. They carry out supporting tasks during the course, such as finding joint answers to the questions they planned before the lecture, group work, problem solving, debate and inference [12]. Flipped Classroom is an approach that shifts teacher-to-student learning responsibility [14].

There are four different aspects to the Flipped classroom approach. It is mentioned that these four elements [15] must be taken into account in order for teachers to achieve this approach. The properties of this method, which is “Flip” in English, are explained in this way by referring to the first letters [15]:

- F (“F” flexible environment): This shows the versatility of learning in terms of time and place.
- L (“L” learning culture): The teacher is the source of expertise in the conventional teacher-centered approach. There is a transition from a teacher-centered approach to a student-centered approach in the flipped classroom process.
- I (“I” intentional content): Flipped educators in the classroom are both thinking about how education is?
- P (“P” trained educator): Flipped classroom educators are more accountable than conventional approaches. During the course, Flipped classroom educators constantly evaluate students, analyze their studies and provide feedback.

Rain class room

Rain classroom is a program for teaching and a small plug-in cut into a PPT. Tsinghua University’s Online Education Office and Xuetang Online have jointly developed this program. It recognizes the contact with students before, during and after class with the aid of WeChat, which boosts the interest of students in learning and livens up the atmosphere of the classroom. We can make single-choice questions, multiple-choice questions, voting questions, adding MOOCS, etc. in PPT using rain class, and we can also make preview courses, upload review materials and exercises to rain class after class. Exercises, voting, barrage and spontaneous roll call can be used in class to improve participation in the classroom and arouse the motivation of students. At the same time, for easy learning and analysis, class courseware is synchronized to the mobile phone of the learners. It is commonly used at present in colleges and universities [16].

The effect of rain classroom teaching and conventional teaching on nursing undergraduate self-directed learning capacity (SDLA) was investigated in recent research [17]. The conclusion was that the teaching method of the rain classroom is more effective than the conventional teaching method in promoting SDLA and teaching quality in stomatology for undergraduate nursing students. The reasons why nursing undergraduates prefer teaching in the classroom are as follows: First, with the help of rain classroom, students do not need to take notes in class and they can focus on learning. Second, materials for preview and analysis pushed before and after class may help students plan and review appropriately. Thirdly, activities are sent to the mobile phone of each student, so students can reply at the same time. The rain classroom random roll call feature makes students feel honored to be questioned. Finally, the rain classroom breaks the time and space constraint of learning, students could study using the phone and internet anywhere. To further explore the long-term impact and teaching effect of rain classroom teaching and traditional teaching on the self-directed learning capacity of students [17], multicenter, broad sample and mixed study method are needed.

Process oriented guide inquiry learning (POGIL)

A process-oriented directed inquiry learning classroom or laboratory consists of learners working on specially developed inquiry materials in small groups. These provide data to students followed by leading questions that are designed to direct teams to arrive at their own relevant conclusions. The teacher acts as a facilitator in POGIL to assist groups in the learning process and does not address

questions that should be answered on their own by students [18]. Although POGIL has been used most extensively in small classes, it has been adapted with great success for classes as wide as several hundred, POGIL has not been studied in dentistry. The curriculum based on POGIL, however, is currently being used in medical science subjects [19].

Peer review process oriented guide inquiry learning

Peer review is a conventional methodology in which one student reviews and reports on his or her peers' work [20]. The role of peer review in medical education has been assessed by several studies. Peer review has been reported to be a valuable replacement for traditional lectures [21]. Miligrom stated in dentistry that the peer review was relatively modest in enhancing performance in 1998, and Poorterman recommended the Dutch peer review approach to ensure consistency in the clinical cases handled by undergraduate students. American Dental Education Association recommended in 2003 that peer review should be used widely in the undergraduate curriculum [21].

Peer led team learning (PLTL)

This technique requires six to eight students led by a peer leader to learn all of the undergraduate disciples. Peer leads are extracted from the pool of students who have already performed well in the course. Students acquire leadership experience and eventually gain trust in this strategy. In medicine, PLTL has been stated to be more aligned with conventional instructions [22] compared with recent pedagogy such as process-oriented driven inquiry learning (POGIL) and problem-based learning (PBL). The social dimensions of learning developed by Vygotsky are emphasized by PLTL, where peers are often better catalysts for superior learning [23].

Problem based learning

Problem-based learning (PBL) in health professional schools worldwide is a common educational technique. In both medical and dental education, this approach strengthens problem-solving and clinical reasoning skills [24]. PBL tutorials allow students to combine clinical expertise and skills in preclinical and clinical areas. A case is used in PBL to enable students (as a group) to define and build new learning areas, whether or not the case is solved. PBL in medical curricula has been widely applied, but only to a small extent in dental education. PBL emerged in healthcare education at McMaster University in Canada in the 1960s, where it was added to the curriculum of medical sciences. A systematic analysis of the influence of problem-based medical school learning on the output of physicians after graduation found strong positive effects on the competence of physicians [25].

Constructive, collaborative, contextual, and self-directed learning (SDL) [26] are the four main learning concepts on which PBL is centered. In order to cope with PBL as well as other changes in the education climate, students in healthcare careers need to be self-directed learners (SDL). SDL is an important teaching concept advocated in the health professions and is an important skill for being a lifelong learner [26]. In 2000 Schmidt stated that "SDL is the preparedness of a student to engage in learning activities defined by him or herself, rather than by a teacher" [27].

Evidence from research indicates that certain features in PBL help SDL growth. Students begin to work on an issue in the PBL process before obtaining other curriculum inputs and creating their own learning challenges by recognizing their knowledge gaps. All main features that foster SDL are the contributions of new knowledge to the problem and learning to collectively represent as a group, and this, in turn, is positively linked to academic success in medical education [27]. PBL works better when students and faculty understand the factors that affect learning and are mindful of their positions, such as motivation, reflection and lifelong learning [28].

As students have different learning skills and are not homogeneous in their information, experience and learning styles, SDL meets the diverse learning needs of students as part of the PBL process [29]. In the process of students being self-directed learners, cooperation between students and faculty is therefore crucial [30]. From that of a guru (sage on the stage), the role of a faculty member has now changed

into a side guide. This shift in position is one of the significant contributors to SDL's success.

Self-directed learning versus self regulated learning (SRL) in problem based learning

Through the development of SDL as well as SRL skills, students learn to become independent and responsible learners in the PBL process and have control over their learning tasks. The self-directed learner initiates the task of learning, while the task can be set by the instructor in SRL [31]. SRL is an active learning process in which learners set goals, prepare, choose strategies, manage their resources, track themselves, and assess their learning for themselves [32]. Although SDL and SRL are both active learning methods, SDL is a broader term that includes SRL in the sense of PBL [27]. SDL refers to an internal shift of values and SRL refers to the real strategies required to move towards SD's objective [29]. Some scholars argue that SDL and SRL should be used synonymously in educational literature, having said that. In addition, self-motivation of the learner is a significant aspect of improving SDL and SRL skills in PBL and also central in health care education (HPE) for lifelong learning [32].

Implementation of PBL in eligible HPE would enable learners to become more active and help to enhance SDL abilities. SDL is important because it helps a student develop life-long learning skills that are an essential skill required of an HPE, particularly with the increasing use of online learning. An significant distinguishing feature of PBL is the focus on SDL, as learners explore and prepare ways to resolve their information gaps while focusing on their success as well as their group's progress. This makes them aware of their previous understanding and helps them to take care of it [33].

Evidence based dentistry

In dentistry, evidence-based dentistry (EBD) utilizes existing scientific evidence to inform decision-making. EBD is a method that conveys a clinical issue as a question, uses a structured structure to define and review relevant research and incorporates clinical experience training to direct clinical decision-making [33]. The principles of evidence-based health care include the basis and guidelines to promote patient care at the highest levels. Clinical research is the cornerstone of EBD. The fact that there is considerable inconsistency in both clinical decision-making and therapy outcomes has led to a significant movement to integrate the values of the evidence-based method into the mainstream of clinical practice [34].

The ground work for EBD was laid by Sackett, who described it as "integrating individual clinical expertise from systematic research with the best available external clinical evidence". EBD is the incorporation and analysis, combined with personal knowledge, of the latest research evidence available. This helps dentists and academic researchers to keep up-to-date with new technologies and to make recommendations that can strengthen their clinical practice [35].

EBD has been derived from the term "Evidence-Based Medicine" which is defined as "the integration of the best research evidence with clinical expertise and patient values". The concept was invented by the McMaster University clinical epidemiology community in Canada. American Dental Association has defined EBD as: "an approach to oral health care that requires the judicious integration of systematic assessments of clinically relevant scientific evidence, relating to the patients oral and medical condition and history, together with the dentist's clinical expertise and the patient's treatment needs and preferences" [36].

Systematic reviews and meta-analysis take the top position in the available hierarchy of evidence and lead to the highest standard of evidence, followed by randomized clinical trials (RCTs). These are followed by non-RCTs, cohort studies, case-control studies, cross-over studies, cross-sectional studies, case studies, and expert opinions [37]. EBD's ultimate winners are members of the public, who will receive the benefit of better treatment. Researchers would benefit from being called upon to carry out the requisite clinical tests before the marketing of new products [38]. EBD consists of five steps: i) transform the need for clinical data into an answerable query, ii) find and rate the best evidence for answering the question with, iii) test the proof for relevance, effect and applicability critically, iv) integrate this

proof with clinical experience and the particular circumstances and desires of the patient, and v) assess performance and efficiency in the execution of measures i-iv [38].

Need of evidence-based dentistry

In the current era, clinicians are expected to keep up with the advancements in dental therapies, materials, research, and clinical recommendations. There is an abundance of research-based and even anecdotal evidence supporting various aspects of dentistry. Both clinicians and patients have ready access to all kinds of online information using web browsers from the comfort of their offices or homes. Although online information is a great resource, it is often difficult for the clinicians and more so for the patients to evaluate the extensive literature available in terms of validity, quality of data, and reliability of information [39].

Method of practicing evidence-based dentistry

Define the question

The query formulation will help to concentrate not only on the search for literature, but also on the analysis of the information found. It is implied that a searcher may want either context or foreground information to be retrieved. Context information on a general understanding of a disease, testing, care, goods, and other matters. There are typically two components to these queries. They begin with who, what, where, where, why, or how, and with a verb connecting them to the object of interest [40]. On the other hand, foreground questions are more descriptive and apply to the patient's management. There are typically four components to these questions: 1) the patient problem or population (P), 2) the intervention (I), 3) the comparison (C), and 4) the outcome (O), referred to as PICO. The question focuses on the search terms and speeds up the selection of the best evidence from among the identified titles that answered the patient's issue directly. It offers strong (but not compelling) evidence for dentists to support the patient's response. It also offers a fresh piece of information to the dentist to use next time the issue arises [41].

Search for the information

It is now easy to search online for published papers in medical and dental journals, using electronic such databases as Medline. Organizations such as the National Center for Clinical Excellence provide summaries of evidence on various treatments and their usage guidelines [40].

Interpret the evidence

This is the most time-consuming phase and is also seen as the most frustrating part of research paper reading. Three factors that are important for the analysis of research outcomes are: i) The scale of the impact of a therapy (or exposure). In order to be clinically significant, is the effect large enough? ii) Do the findings observed reflect a real impact, or are they likely to be a finding of chance? and iii) The findings of the study are often focused on a sample of people (or objects); would we see similar results if we took another sample?. All study studies include outcome assessment. When our goal is to decide whether or not to use a new medication, the effect of the treatment on a particular outcome variable is analyzed. Therefore, we must always consider whether the measure used in a specific study is both meaningful and sufficient for answering the original question that prompted us to look for the data [41].

It is possible to define outcomes as real or surrogate endpoints. Those that have a strong and direct clinical significance to patients are real endpoints. True endpoints, for example, in dentistry, are pain, tooth loss, esthetics, and quality of life related to oral health, all of which

are tangible to the patient. Surrogate endpoints are interventions which do not have an apparent effect and can easily be recognized by patients. Periodontitis, for instance, may be measured in many ways, including assessing the width of the pocket or the extent of attachment. Such surrogate effects, while easy to calculate and objective, are not always tangible to the patient. It is commonly thought that a surrogate result is a precursor to the true result [42].

Act on the evidence

It is then appropriate to consider the information obtained from the evaluation of the evidence in relation to the question which prompted the dentist to undertake the search [43].

Clinical relevance

For both clinicians and the patient population, EBD is very significant. Its acceptance into dental practice, however, has been a fairly slow process. It is not possible to underestimate the value of having a balanced combination of research, clinical experience and patient needs to improve patient care in a practice [44].

Computer assisted learning (CAL)

The volume of medical knowledge has roughly doubled every second year since 1980. This means that, in order to learn how to make evidence-based decisions for diagnosis and care in a given patient situation, oral health students as well as practitioners need to address the flow of knowledge rationally. Current research suggests that computer-connected databases and computer-aided learning (CAL) can boost learning and provide decision-making knowledge to the clinician when treating patients. Multimedia for CAL, which interactively incorporates audio and visual data, has proven to be an effective educational tool [45].

CAL can complement and improve more formal learning and provide opportunities in an immersive way to explain clinical circumstances. CAL has the ability to help improve skills and awareness for students. Students, workers and clinicians consider CAL calming and inspiring.

Though their current computer literacy is still poor, students adapt easily to CAL. New authoring tools make the development of their own CAL applications easier for faculty. In the future, with virtual patients, we can see more advanced applications communicate and interact with the student in a very practical way. The program may also “step out” from the computer and assist the student with clinical procedures. Currently, however, CAL is not intended to replace conventional education, but to use it more as a complement and for self-directed studies [45].

Role play

Although the idea and development of the term role-play has recently gained ground due to its contributions to various fields of research, it was described several decades ago. It is a social and human activity in which users assume or adopt a role or function in most cases within a previously established contextual and social framework [46]. Therefore, role play is an instructional technique in which participants take on a certain role and carry out the role and improvise it. Typically, the rules of this game are defined with practical requirements that bring the participants as close to reality as possible. In recent years, however, with the emergence of active methodologies and the active involvement of students in their learning, role-play has been promoted as a very successful technique to be applied in any discipline, with particular focus on its application in education by different authors [47]. Research on the benefits and implications of incorporating this activity dates back to the 1970s.

In a familiar, supportive atmosphere, where he or she feels secure, this dynamic enables the learner to experience various learning styles. The key reason for choosing this method in different settings, especially in education, is that it enables teachers and researchers to deal with two aspects at the same time: on the one hand, to produce interpersonal behavior that approaches unprovoked interaction and, at the same time, to have control over this interaction [48].

The discrimination that occurs when it is applied is one of the drawbacks of this approach, since the participants, in this case the students, know each other beforehand, which allows the interaction to be conditioned. On the other hand, the flexibility to adapt it to any stage of education, to promote a rapid comprehension of the materials used in the teaching-learning process and to increase the sense of obligation and freedom of those participating in the dynamic is one of the benefits of applying this approach [49].

The possibility of integrating various resources is given by this form of methodology. Thus, one method that can be combined for educational purposes with roleplaying is film. Video is a virtual tool and a perfect example of multimedia learning, as it requires the integration of numerous elements that would be separate in conventional learning [50].

The advantages of using video in the classroom have been shown by several studies in recent years as the multimedia factor transforms every new feature in the learning process into long-term memory learning [51]. When used in the teaching-learning processes, this educational aspect and instrument for learning has clear advantages. It is a wireless and versatile resource that can be used in many locations, not strictly in the classroom, which allows the user an infinite number of views. Similarly, in comparison to other resources and materials [52], it is a reusable resource which does not require maintenance.

They must have a number of characteristics in order for videos to ensure that learning through them is genuine. The standard of the videos must therefore be monitored by teachers in terms of format and background, and the content must be up to date. It has been shown that the use of video improves student satisfaction with learning [53], as well as levels of memory and attention. A certain degree of active and experimental learning is implied by watching videos in the classroom, as students observe, evaluate and interpret the material, what they want to express, and from there react or carry out various activities [54].

It is concluded that the role-playing approach associated with the use of educational video in students of the Master's Degree of Teachers of Compulsory Secondary Education, Bachelor's Degree, Vocational Training and Language Teaching provides students with a better attitude and aptitude towards the teaching and learning process and has a positive effect on their academic growth. Moreover, thanks to the low use of consumable material resources, this teaching approach will encourage sustainable educational practices. In this way, as a potential line of study, we suggest that, through role-playing and educational video, we continue to establish examples of good practice in other educational groups in order to put together attitudes and expectations of different student samples and to be able to contrast the efficacy of the implementation of this method [55].

Simulation method

In dentistry, COVID-19 has had several immediate risks, some of which may have additional long-term effects on clinical practice, dental education and dental science. Incorporating new IT-based and online ways of teaching and evaluation into dental education, which can also benefit the environment and minimize emissions, is crucial to note. Further investment in related fields of dental science is needed [56]. A recent article in the British Dental Journal illustrated the views of the dean of the dental school at London's Queen Mary University on the outbreak of COVID-19 and its crisis management strategy. It was noted that the moral decision initiative was taken to stop all patient treatment for undergraduate and postgraduate clinics in order to save the lives of students, staff and patients, which in turn encouraged further debate on this subject and changed the situation during the crucial period of the pandemic [57]. The role of simula-

tion in dental education in dental clinics and hospitals, alternative modes of teaching have been explored due to the high risk of COVID-19 transmission. Without the need for physical interaction in the clinical setting and direct communication with patients, simulation activities are one of the best types of clinical skills instruction [57].

Training independent dentists who are able to treat their patients properly and safely is the main goal of dental education. Therefore, with fine motor skills, learners must have outstanding physical dexterity. During undergraduate study, these qualities can be developed and learned in simulation settings. It is a real challenge to teach these skills to the necessary level, given the fact that allocated time and resources are not unlimited [58]. Simulation was also used to promote the transition to the dental clinic and boost the preclinical experience of a student by integrating a wide variety of simulated patient scenarios and exercises. Simulation technology offers a host of dental school education opportunities. It offers continuous, seamless on-screen feedback on the trainee's results to both students and the tutor [59].

The recent advancement in virtual reality (VR)

The VR simulators have been fitted with the capability of tactile feedback through the combination of recent haptic technology that enables the trainee to feel and touch the virtual tooth tissue. There is evidence suggesting that the use of VR technology increased the rate of learning of skills in modules of operative dentistry taught in dental undergraduate programs [60]. Research has shown that the most effective form of teaching in a simulation environment is a VR simulation facility alongside an experienced teacher offering real-time input. It improves the hand-eye coordination, fine motor skills and reflection skills of students and becomes particularly successful in the very early stages of skill development, leading to a cautious approach to training and improved retention of skills [61]. It can therefore be suggested that VR simulation technology is a valuable additional tool for traditional dental training approaches, and during the COVID-19 pandemic, its efficient and safe use can be considered with some modifications to enable distance learning [61].

Conclusion

In order to train prospective dentists for their everyday work-life, the movement towards digitization and continuing advances in teaching methods must be recognized in dental curricula. To better train future dentists for their everyday practice, digitalization provides tremendous potential to revolutionize dental education. To stimulate an enjoyable and meaningful educational experience with 24/7 services, more immersive and intuitive e-learning possibilities will emerge. In the future of dental education, augmented and virtual reality technologies will definitely play a dominant role [62].

In dentistry, COVID-19 has had several immediate risks, some of which may have additional long-term effects on clinical practice, dental education and dental science. A host of dental school education opportunities are provided through simulation technology. It provides both students and the tutor with ongoing, seamless on-screen input on the trainee's results [59].

Not only did the students achieve improved scholastic success after the reformed teaching approach was adopted, but they also showed greater precision in diagnosing medical problems and formulating treatment plans. They were also more appreciated by patients, suggesting that this strategy is effective for dental students [63].

Conflicts of Interest

The authors declare no conflict of interest.

Bibliography

1. Cassidy S. "Learning styles: an overview of theories, models, and measures". *International Journal of Experimental Educational Psychology* 24.4 (2004): 419-444.
2. Parameswaran A. "Problem based learning....Need for the hour". *Journal of Conservative Dentistry: JCD* 11.2 (2008): 49-50.
3. Gopinath V and Nallaswamy D. "A Systematic Review on the Most Effective Method Teaching Dentistry to Dental Students Compared to Video Based Learning". *American Journal of Educational Research* 5.1 (2017): 63-68.
4. Playdon M. "Promoting Health in Hospitals". *Australian Nursing Journal* 4.7 (1993): 18-19.
5. Kneller GF. "Education, Knowledge, and the Problem of Existence". *Harvard Educational Review* (1961).
6. Basal A. "The Implementation of a Flipped Classroom in Foreign Language Teaching". *Turkish Online Journal of Distance Education* 16.4 (2015): 28-37.
7. Ozdamli F and Asiksoy G. "Flipped classroom approach". *World Journal on Educational Technology: Current Issues* 8.2 (2016): 98-105.
8. Bi M., et al. "Comparison of case-based learning and traditional method in teaching postgraduate students of medical oncology". *Medical Teacher* 41.10 (2019): 1124-1128.
9. Plasschaert AJM., et al. "Curriculum content, structure, and ECTS for European dental schools. Part II: methods of learning and teaching, assessment procedures, and performance criteria". *European Journal of Dental Education* 11.3 (2007): 125-136.
10. Davis BG. "Tools for teaching". New York: John Wiley and Sons (2009).
11. Bergmann J and Sams A. "Flipping for mastery". *Educational Leadership* 71.4 (2014): 24-29.
12. Formica SP., et al. "Transforming common-sense beliefs into Newtonian thinking through just-in-time teaching". *Physics Education Research* 6 (2010): 1-7.
13. Kim MK., et al. "The experience of three flipped classrooms in an urban university: An exploration of design principles". *Internet and Higher Education* 22 (2014): 37-50.
14. Bergmann J., et al. "The Flipped Class: Myths vs. Reality" (2011).
15. Flipped Learning Network (FLN) (2014).
16. Premkumar K., et al. "Self-directed learning readiness of Indian medical students: a mixed method study". *BMC Medical Education* 18 (2018): 1341-1310.
17. Wang Y., et al. "Comparison of Rain Classroom Teaching and Traditional Teaching Methods in Teaching Undergraduate Nursing Students of Stomatology" (2020).
18. Farrell JJ., et al. "A Guided-Inquiry General Chemistry Course". *Journal of Chemical Education* 76.4 (1999): 570.
19. Spraggs G., et al. "Re-Construction of Historic Drought in the Anglian Region (UK) Over the Period 1798-2010 and the Implications for Water Resources and Drought Management". *Journal of Hydrology* 526 (2015): 231-252.
20. Ruth L. "Documenting the Scholarship of Clinical Teaching Through Peer Review". *Nurse Educator* 23.6 (1998): 17.
21. Cowen D L., et al. "Peer Review in Medical Education". *Academic Medicine* 51.2 (1976): 130.

22. Prince M., *et al.* "The Many Faces of Inductive Teaching and Learning". *Journal of College Science Teaching* 36.5 (2007): 13-20.
23. Abney JR and Scalettar BA. "Saving Your Students' Skin. Undergraduate Experiments That Probe UV Protection by Sunscreens and Sunglasses". *Journal of Chemical Education* 75.6 (1998): 757-760.
24. Khatami S., *et al.* "Evolution of Clinical Reasoning in Dental Education". *Journal of Dental Education* (2011): 321-328.
25. Koh GCH., *et al.* "The Effects of Problem-Based Learning During Medical School on Physician Competency: a Systematic Review". *Canadian Medical Association Journal* 178.1 (2008): 34-41.
26. Telang A. "Problem-based learning in health professions education: An overview". *Archives of Medicine and Health Sciences* 2 (2014): 243-246.
27. Loyens SM., *et al.* "Self-directed learning in problem-based learning and its relationships with self-regulated learning". *Educational Psychology Review* 20 (2008): 411-427.
28. Bate E., *et al.* "Problem-based learning (PBL): Getting the most out of your students - their roles and responsibilities: AMEE Guide No 84". *Medical Teacher* 36 (2014): 1-12.
29. Malan SB., *et al.* "Introducing problem-based learning (PBL) into a foundation programme to develop self-directed learning skills". *South African Journal of Education* 34 (2014): 1-16.
30. Silen C and Uhlén L. "Self-directed learning – A learning issue for students and faculty!" *Teaching in Higher Education* 13 (2008): 461-475.
31. Robertson J. "The educational affordances of blogs for self-directed learning". *Computers and Education* 57 (2011): 1628-1644.
32. Demirören M., *et al.* "Medical students' self-efficacy in problem-based learning and its relationship with self-regulated learning". *Medical Education Online* 21 (2016): 30049.
33. Nerali JT., *et al.* "The role of self-directed learning in problem-based learning: Health professions education". *Archives of Medicine and Health Sciences* 4 (2016): 125-126.
34. Celi R and Sutherland SE. "Evidence-Based dentistry: Do we know what it means?". *Acta Stomatologica Croatica* 37 (2003): 195-198.
35. Gillette J., *et al.* "The benefits of evidence-based dentistry for the private dental office". *Dental Clinics of North America* 53 (2009): 33-45.
36. American Dental Association. ADA Policy on Evidence-Based Dentistry, Professional Issue and Research, ADA Guidelines, Positions and Statements". *American Dental Association* (2002).
37. Ismail AI., *et al.* "Evidence-based dentistry in clinical practice". *Journal of the American Dental Association* 135 (2004): 78-83.
38. Goldstein GR. "What is evidence-based dentistry?". *Dental Clinics of North America* 46 (2002): 1-9.
39. Dhar V. "Evidence-based dentistry: An overview". *Contemporary Clinical Dentistry* 7 (2016): 293-294.
40. Sackett DL., *et al.* "Evidence Based Medicine: How to Practice and Teach EBM". London: Churchill Livingstone (2000).
41. Anderson JD. "Applying evidence-based dentistry to your patients". *Dental Clinics of North America* 46 (2002): 157-164.
42. Hujoel PP. "Endpoints in periodontal trials: The need for an evidence-based research approach". *Periodontology 2000* 36 (2004): 196-204.

43. Hackshaw A., *et al.* "Evidence-Based Dentistry – An Introduction". *The British Dental Journal* 201 (2006): 543.
44. Tandon C., *et al.* "Evidence-based dentistry: Effectual tool in decision-making". *Indian Journal of Dental Sciences* 11 (2019): 180-184.
45. Schitteck M., *et al.* "Computer assisted learning. A Review". *European Journal of Dental Education* 5 (2001): 93-100.
46. Simoes D and Faustino P. "The role of ICT in enhancing the autonomy of higher education students: Teachers' insights". *Education Policy Analysis Archives* 27 (2019): 1-26.
47. Romero-Hall E., *et al.* "Examining the Effectiveness, Efficiency, and Usability of aWeb-Based Experiential Role-Playing Aging Simulation Using Formative Assessment". *Journal Forms and Documents Learn.* 3 (2019): 123-132.
48. Scharfenberg FJ and Bogner FX. "A Role-Play-Based Tutor Training in Preservice Teacher Education for Developing Procedural Pedagogical Content Knowledge by Optimizing Tutor–Student Interactions in the Context of an Outreach Lab". *Journal of Science Teacher Education* 30 (2019): 461-482.
49. Hidayati L and Pardjono P. "The implementation of role-play in education of pre-service vocational teacher". In IOP Conference Series: Materials Science and Engineering; IOP Publishing: Bristol, UK 296 (2018): 012016.
50. Chien SY., *et al.* "Effects of peer assessment within the context of spherical video-based virtual reality on EFL students' English-Speaking performance and learning perceptions". *Computers and Education* 146 (2020): 1-20.
51. Zhang C., *et al.* "Toward Edge-Assisted Video Content Intelligent Caching with Long Short-Term Memory Learning". *IEEE Access* 7 (2019): 152832-152846.
52. Orús C., *et al.* "The effects of learner-generated videos for YouTube on learning outcomes and satisfaction". *Computers and Education* 95 (2016): 254-269.
53. Torres-Ramírez M., *et al.* "Video-sharing educational tool applied to the teaching in renewable energy subjects". *Computers and Education* 73 (2014): 160-177.
54. Liu S., *et al.* "Human Pose Estimation in Video via Structured Space Learning and Halfway Temporal Evaluation". *IEEE Transactions on Circuits and Systems for Video Technology* 29 (2019): 2029-2038.
55. Moreno-Guerrero AJ., *et al.* "Educational Innovation in Higher Education: Use of Role Playing and Educational Video in Future". *Sustainability* 12.2558 (2020): 1-14.
56. Barabari P and Moharamzadeh K. "Novel Coronavirus (COVID-19) and Dentistry–A Comprehensive Review of Literature". *Journal of Dentistry* 8.53 (2020): 1-18.
57. Coulthard P. "Dentistry and coronavirus (COVID-19) - moral decision-making". *The British Dental Journal* 228 (2020): 503-505.
58. Plasschaert AJM., *et al.* "Curriculum content, structure and ECTS for European dental schools. Part II: Methods of learning and teaching, assessment procedures and performance criteria". *European Journal of Dental Education* 11 (2007): 125-136.
59. Scalese RJ., *et al.* "Simulation technology for skills training and competency assessment in medical education". *Journal of General Internal Medicine* 23 (2008): 46-49.
60. Buchanan JA. "Use of simulation technology in dental education". *European Journal of Dental Education* 65 (2001): 1225-1231.
61. Al-Saud LM., *et al.* "Feedback and motor skill acquisition using a haptic dental simulator". *European Journal of Dental Education* 21 (2017): 240-247.

62. Zitzmann NU., *et al.* "Digital Undergraduate Education in Dentistry: A Systematic Review". *International Journal of Environmental Research and Public Health* 17.9 (2020): 1-23.
63. Wang W., *et al.* "Reforming teaching methods by integrating dental theory with clinical practice for dental students". *Peer Journal* 8 (2020): e8477.

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