

VOL. 67, 519:530, JANUARY, 2021



PRINT ISSN 0070-9484 • ONLINE ISSN 2090-2360

FIXED PROSTHODONTICS AND DENTAL MATERIALS

www.eda-egypt.org • Codex : 20/21.01 • DOI : 10.21608/edj.2020.46192.1291

DEVELOPMENT AND IMPLEMENTATION OF AN EVIDENCE-BASED DENTISTRY TEACHING MODULE AT A SAUDI ARABIAN UNIVERSITY

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ABSTRACT

Aim: We describe a module designed to help undergraduate students apply evidence-based dentistry (EBD)-related skills and develop an evidence-based report at the Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia (KAUFD).

Method: This paper explains the procedures undertaken to teach students in the final year of the dental program at KAUFD. A brief description of the module was provided, starting with preparation and including all steps required to produce an evidence-based report to answer certain clinically relevant questions. At the end of the module, students were invited to anonymously fill out a questionnaire to evaluate the module. Responses to the questionnaire from 2015–2016 and 2019–2020 were summarized using descriptive statistics. Chi-square or Fisher's exact tests were used to compare the students' responses from the two academic years at a significance level of 0.05.

Results: The majority of students found the module objectives and expectations clear, were satisfied with the module organization, and felt that it was intellectually challenging. More than 80% of respondents stated that they felt confident in applying the EBD concept to answer any clinical question. Overall, the majority of students found the topics clinically relevant, the assignment useful, and the deadlines reasonable. Students were highly satisfied with their experiences with the assigned tutors regarding all evaluated aspects.

Conclusion: This study suggests that the EBD module incorporated into the undergraduate curriculum is effective for improving EBD-related knowledge and skills.

INTRODUCTION

Dentists are challenged with decision making in their daily practice. In the past, dental practitioners based their decisions mainly on expertise and interactions with colleagues and experts in the field. With the introduction of evidence-based approaches in medicine in the early 1990s and the movement toward implementing similar approaches in the dental field, dentists were expected to integrate the best available evidence, dentist expertise, and

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the values, needs, preferences, and expectations of patients to reach the best clinical decision. This approach is commonly known as evidence-based practice (EBP).^[1] Despite the fact that scientific evidence has become more readily available with rapid advancements in science and technology, dental practitioners frequently report difficulties in locating, obtaining, and/or interpreting the available evidence due to a lack of proper training in EBPrelated skills.^[2] Therefore, it is recommended to incorporate these skills in continuing education and dental curricula. Implementing evidence-based dentistry (EBD) within busy dental curricula, in which learning technical and procedural skills consumes most of the time, can be challenging. A recent review of EBP education literature suggested the introduction of basic EBP-related skills through didactic courses using a combination of lectures, small-group work, self-directed online courses, and mixed methods as an effective approach to improve knowledge (but not necessarily attitudes and behaviors), and that outcomes can be enhanced if EBP principles are applied to routine clinical settings or in simulated clinical scenarios.^[3] At the Faculty of Dentistry, King Abdulaziz University, Jeddah, Saudi Arabia (KAUFD), EBP-related skills are developed throughout the curriculum as part of courses in research methodology and biostatistics in the fourth year and in the community dental practice course in the sixth year. The school follows the course developed by the American Association of Public Health Dentistry to provide dental students with the basic knowledge and skills to practice EBD. ^[4] The course combines both didactic lectures with individual and/or group exercises that help students understand and apply different EBD-related skills. In 2015, KAUFD started an EBD module as part of its comprehensive care clinical course in the sixth year to help undergraduate students apply acquired EBD-related skills and develop an evidence-based report that answers clinical questions.

Objectives

This article describes the module that helps undergraduate students at KAUFD apply EBDrelated skills and develop an evidence-based report.

MATERIALS AND METHODS

The module was adapted from one developed by the Community Dentistry Department at the Faculty of Dentistry, University of Toronto, Canada.^[5] The original module was modified to fit the KAUFD undergraduate curriculum.

Preparation for the module

At the beginning of each academic year, departments at KAUFD are invited to participate in the EBD module and asked to provide names of potential tutors. Nominated tutors are invited to participate in a two-day workshop given by the module developers (authors) and asked to prepare potential clinically relevant questions for the module. During the first day of the workshop, which lasts about 6 hours, participants are introduced to the module and the steps that are required to produce the evidence-based report. The first day of the workshop contains multiple individual exercises and demonstrations that focus on different EBDrelated skills, including formulating a question in Population, Intervention, Comparison (control) and Outcome (PICO) format, searching PubMed, and identifying different types of studies. In addition, all participants discuss the questions provided previously to select the ones that suit the module best. Then, each participant is asked to rephrase the question in PICO format and present it to the group for approval. At the end of the first day, participants are tasked with performing a PubMed search for their questions and filtering the results, which are presented on the second day of the workshop. During the second day, which lasts about 3 hours, participants are asked to present their search strategy and outcomes to all participants for feedback.

Module description

For the module, students are divided into groups of 8–10 and are mentored by the trained tutors. Tutors are assigned to groups randomly and act as facilitators. Each group works independently throughout the module. In the introductory session, each group elects a team leader who organizes and distributes the work among the team members and acts as a point of communication with the tutor. The module consists of seven sessions (Table 1). Different teaching strategies, including lectures and small group discussions, are used during these sessions to teach students how to produce an evidence-based report following seven steps:

1. Define and analyze the problem and formulate a research question.

During their first meeting, team members should

Session	Lecture	Tasks to be completed during the session	Tasks to be completed between the sessions
1. Week 9 – 1 st semester	The session consists of a 2-hour introductory lecture to introduce the student to the evidence- evidence based module.		
2. Week 10 – 1 st semester	Demonstration of how to conduct a search using the PICO format (30 min). Examples of the module outcome (presentation and report) (30 min).	Students should (in 2h):Analyze the topicFormulate the PICODevelop the search strategy.	Students should perform a systematic search on PubMed.
3. Week 12 – 1 st semester	Introduction to the bibliography management software (1h).	 Students should (in 2h): Discuss their search results Develop the inclusion and exclusion criteria for filtering the articles. 	Students should exclude articles at title, abstract, and full article levels based on the selected inclusion and exclusion criteria.
4. Week 3 – 2 nd semester		 Students should (in 3h): Discuss their data filtered results. Design their evidence table and data extraction sheet. Decide which checklist will be used for assessing the quality of the selected articles. 	Students should read the selected articles and extract the data to the data extraction sheet and fill out the evidence-based table.
5. Week 5 – 2 nd semester		 Students should (3h): Finalize the evidence tables. Assess the quality of the article using the selected checklist. Synthesize the conclusion. 	Students should start preparing their presentation and writing-up the report.
6. Week 8 – 2 nd semester		Students should: Be ready with their final presentation and discuss it with the supervisor.	Students should finalize their presentation and report.
7. Week 11 – 2 nd semester		Final presentation	Finalize the report and submit it.

TABLE (1) EBD module sessions

discuss and analyze their assigned questions by answering the following questions: What is the problem? What is the clinical significance of answering the question? What type of question is being asked (i.e., prevalence, causality, diagnosis, prevention, therapy, or cost-effectiveness)? What is the best study design to answer this question?

Assigned questions are usually phrased broadly to facilitate discussion. Team members are encouraged to identify all embedded questions and discuss them with the tutor to develop a searchable, well-focused question using the PICO format and record it in a special form. It should be noted that the PICO components may be modified based on the type of question being asked.

2. Acquire and search for evidence.

Based on the identified PICO components, students should choose appropriate medical subject heading (Mesh) terms and/or keywords that describe each of the PICO components and record them in a designated form. Students are required to develop a search strategy using the identified search terms and search at least the Medline database using the PubMed search engine. A live demonstration is given at the introductory session to show students how to perform searches on PubMed using the keywords and Mesh terms for each of the PICO components and combining their search terms using Boolean expressions. During the demonstration, instructions are given to students to record their search strategies, which students are to include in their final reports and presentations. Furthermore, students are encouraged to search other electronic databases (e.g., EMBASE and Cochrane Library), use Google Scholar, find references cited by articles identified through the search, and manually search journals known to publish in the field. Students are asked to import their search results into online bibliography management tools to help them organize and share their search results and detect duplicates. As part of the module, students

are introduced to the bibliography management software (Mendeley) (<u>www.mendeley.com</u>).

3. Select the best evidence.

Students are taught to establish inclusion/ exclusion criteria for filtering their search results and record them in a designated form. The form divides the inclusion and exclusion criteria based on the PICO components. In addition, a category was added for miscellaneous criteria (e.g., language, species, and study design). Students are asked to filter their search results at the title, abstract, and fulltext levels using the predefined inclusion/exclusion criteria. Filtering the results using filters available in PubMed is discouraged, except for language and species. Each group member is required to filter the search results independently. Disagreements are resolved by consensus-based discussion or a third party (i.e., the tutor). Details for the excluded results at various levels, including the number of excluded articles at each level and reasons for exclusion at the full-text level, should be recorded and presented in a Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.[6]

4. Extract data from the included studies.

In the next step, students are taught how to design a table of evidence to summarize the articles remaining after excluding articles at all levels. This table may include the author and year, aim of the study, study design, population demographics, sample type (random or convenient), number of subjects in treatment and control groups, any other characteristics related to the topic, information about the intervention and control (if applicable), and the outcome. A data extraction form is then created based on this table for collecting data from each article. A separate form should be filled out for each article. Each article is assigned to at least two students, who fill out the data extraction form independently, and any disagreements are resolved by consensus-based discussion or a third-party (i.e., the tutor). Each student is required to extract data from at least one article independently.

5. Assess the quality of the included studies.

Using one of the available tools, the included studies are assessed in terms of methodological quality and applicability. The students are encouraged to use the checklists suggested by Azarpazhooh et al.^[5] Several checklists are available based on the type of question being asked. Each included study should be assigned to at least two reviewers, who work through the checklist independently. Any disagreements are resolved by consensus-based discussion or a third party (i.e., the tutor). Reviewers are instructed to give scores of 0 = no, 1 = yes, or NA = not applicable. The quality score for each article is calculated by summing all the scores and dividing the total score by the number of items in the list after subtracting items marked as NA. Higher scores indicate higher-quality articles. The decision to reject articles with low scores based on a cut-off threshold is left to each group and their assigned tutor.

6. Analyze and summarize the findings to draw conclusions.

7. Present the findings and write the report.

Each group has to present their findings orally (10 minutes for the presentation and 10 minutes for the discussion). The choice between a presentation by a single presenter or more than one presenter (maximum 3) is left to the group. All students have to be present during the discussion and participate in answering questions. Three to four independent evaluators from the Dental Public Health Department are invited every year to evaluate the presentations based on a specially designed rubric (Appendix I). The final written report is expected to be submitted 2 weeks after the presentation. A list of suggestions related to the content of the presentation and the final report is given to the students (Appendix II).

Student evaluation

Each group is evaluated for the content and quality of the presentation and report. In addition, each student is evaluated by the tutor for attendance and participation in each session (Appendix III). The scoring rubric of the module is presented in Table 2. The presentation evaluation scores for the academic years 2015–2016 and 2019–2020 are presented in Table 3.

TABLE (2) Mark Distribution

Item	Percentage
Attendance	10%
Participation in sessions	25%
Group presentation*	45%
Written report *	20%

*Generally, all members of a group will receive the same mark for the presentation and the written report. (The exception would be if it is obvious that a member or members of the group did not participate in the presentation and/or report preparation.)

TABLE (3) Presentation evaluation scores (%) for the academic years of 2015-2016 and 2019-2020

YEAR	2015-16	2019-20
Mean	73.1	85.3
SD	6.8	3.7
Min	60	76.6
Max	85	91.5

Module evaluation:

At the end of the module, students are asked to anonymously fill out a questionnaire to evaluate their experiences with the course. The questionnaire consists of three sections regarding the module in general, the assignment, and the tutor. Students are asked to provide their answers for closed-ended questions on a Likert scale of strongly agree, agree, neither agree nor disagree, and strongly disagree. In addition, three open-ended questions are asked about skills, knowledge, and/or abilities gained in the module, things students liked about the module, and suggestions for improvements. The responses of the students to the questionnaire for the academic years of 2015–2016 and 2019–2020 were compared in this paper.

Statistical analysis:

Descriptive statistics (frequencies and percentages) were used to summarize the students' responses. The chi-square or Fisher's exact test was used to compare the responses to questions from 2015–2016 and 2019–2020. All statistical analyses were conducted using SPSS for Windows (version 25; IBM Corp., Armonk, NY, USA) at a significance level of 0.05.

RESULTS

A total of 80 out of 123 students (65%) and 94 out of 152 students (61%) completed the questionnaire for 2015–2016 and 2019–2020, respectively. More than 80% of respondents stated that they strongly agreed or agreed that the module objectives and expectations were clear and that it was well prepared, well organized, and intellectually challenging. The percentage of students who strongly agreed that the module was well organized and intellectually challenging was significantly higher in 2019–2020 than in 2015–2016. At the end of the module, more than 80% of the students thought that they were capable of applying EBD concepts to answer any future questions. This percentage was higher in 2019–2020 than in 2015–2016. Students' evaluations of the module are shown in Table 4.

In the majority of responses, students strongly agreed or agreed that the project was useful, topics were clinically relevant, the number of meetings with the tutor was adequate, and deadlines were reasonable. The percentage of students who strongly agreed that topics were clinically relevant and the number of meetings adequate was significantly higher in 2019–2020 than in 2015–2016. Students' evaluations of the assignments are shown in Table 5.

When asked about their experience with the assigned tutor, more than 80% of students strongly agreed or agreed that the tutor was available all or most of the time (even outside the assigned sessions), made effective use of the session time, answered the questions in a helpful way, and increased their understanding of the topic. Collectively, the majority of students strongly agreed or agreed that the tutor provided direct support to them in their project. A significantly higher percentage of students agreed that they had a positive experience with their tutor in all evaluated aspects. Responses to questions about the module, assignment, and tutor are shown in Table 6.

			Module Objectives Were Clearly Presented	Module Expectations or Requirements Were Clearly Stated	Module Materials Were Well- Prepared	The Module Was Well- Organized	The Module Was Intellectually Challenging	The Module Made Me Capable of Applying The EBD Concept to Answer any Clinical Question.
			%	%	%	%	%	%
		Strongly disagree	0.0%	1.2%	1.2%	1.2%	0.0%	0.0%
)16	Disagree	2.4%	4.8%	3.6%	0.0%	3.6%	3.6%
	2015-20	Neither agree nor disagree	13.3%	13.3%	15.7%	24.1%	20.5%	15.7%
		Agree	45.8%	41.0%	43.4%	38.6%	39.8%	38.6%
ar		Strongly agree	38.6%	39.8%	36.1%	36.1%	36.1%	42.2%
Ye		Strongly disagree	0.0%	0.0%	0.0%	2.1%	2.1%	0.0%
)20	Disagree	3.2%	5.3%	0.0%	0.0%	1.1%	1.1%
	2019-20	Neither agree nor disagree	4.3%	8.5%	16.0%	6.4%	18.1%	4.3%
		Agree	38.3%	36.2%	30.9%	43.6%	23.4%	35.1%
		Strongly agree	54.3%	50.0%	53.2%	47.9%	55.3%	59.6%
		P-value *	0.061	0.504	0.036	0.023	0.015	0.006

TABLE (4) Student	evaluation of the	module in	academic years	of 2015-2016 a	and 2019-2020
			-		

Using chi-square or (Fisher's exact) test to compare the student responses in the two academic years.

TABLE (5) Student evaluation of the assignment in academic years of 2015-2016 and 2019-2020

			This assignment was useful for me.	The selected topics were relevant.	Number of meeting with the supervisor were adequate.	Deadlines were reasonable.
			%	%	%	%
		Strongly disagree	0.0%	0.0%	1.2%	1.2%
	9	Disagree	3.6%	2.4%	13.3%	2.4%
	15-201	Neither agree nor disagree	8.4%	16.9%	14.5%	8.4%
	50	Agree	45.8%	44.6%	43.4%	45.8%
ar		Strongly agree	42.2%	36.1%	27.7%	42.2%
Ye		Strongly disagree	1.1%	1.1%	1.1%	0.0%
	0	Disagree	3.2%	3.2%	4.3%	2.1%
)19-202	Neither agree nor disagree	10.6%	23.4%	7.4%	6.4%
	5(Agree	26.6%	22.3%	31.9%	31.9%
		Strongly agree	58.5%	50.0%	55.3%	59.6%
		P-value *	0.067	0.019	0.002	0.141

Using chi-square or (Fisher's exact) test to compare the student responses in the two academic years.

			Was available in (all/most) of the sessions	Made effective use of session time	Answered questions in helpful ways	Increased my understanding of the project	Was available to talk with students out of class (in person or e-mail)	Was helpful and supportive as a direct supervisor on your group
			%	%	%	%	%	%
		Strongly disagree	3.6%	2.4%	0.0%	0.0%	0.0%	1.2%
	9	Disagree	13.3%	4.8%	3.6%	3.6%	4.8%	3.6%
	015-201	Neither agree nor disagree	14.5%	16.9%	10.8%	21.7%	10.8%	16.9%
	5	Agree	26.5%	34.9%	38.6%	30.1%	34.9%	34.9%
ar		Strongly agree	42.2%	41.0%	47.0%	44.6%	49.4%	43.4%
Ke		Strongly disagree	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	0	Disagree	0.0%	0.0%	2.1%	1.1%	0.0%	0.0%
	019-202	Neither agree nor disagree	0.0%	9.6%	4.3%	11.7%	8.5%	6.4%
	5	Agree	27.7%	17.0%	23.4%	18.1%	19.1%	22.3%
		Strongly agree	72.3%	73.4%	70.2%	69.1%	72.3%	71.3%
		P-value *	<0.001	<0.001	0.012	0.008	0.004	0.001

TABLE (6) Student evaluation of the tutors in academic years of 2015-2016 and 2019-2020

Using chi-square or (Fisher's exact) test to compare the student responses in the two academic years.

TABLE (7) Examples of the selected topics for the two academic years of 2015-2016 and 2019-2020

2015-16	2019-20
What is the effectiveness of systemic antibiotics as an adjunctive to non-surgical periodontal therapy?	What is the incidence of lingual nerve injury following lower third molar extraction?
Which bleaching technique (In-office or at-home bleaching) causes more post-operative sensitivity?	Is botulinum toxin injections effective in treating patients with gummy smile?
Which direct pulp capping material is better?	What is the survival rate of dental implants placed in diabetic patients?
What is the efficacy of oxalate as a treatment for dentin hypersensitivity?	Is cone beam computed tomography (CBCT) useful in endodontic treatment planning?
Which is more effective implant-retained mandibular overdenture with a single or two implants?	What is the efficacy of home irrigation devices in improving plaque control and clinical parameters of periodontal inflammation?
Which has better survival endodontically-treated teeth restored with prefabricated or custom-made posts?	Is there a relationship between recurrent aphthous stomatitis and helicobacter pylori?
Which has better survival endodontically-treated teeth restored with post or without post?	Is there association between vitamin D deficiency and sunscreen usage?
Which local anesthetic solution provide profound pulpal anesthesia through inferior alveolar nerve block (IANB) in cases with symptomatic irreversible pulpits?	Is a mixture of three antibiotics as effective as zinc oxide eugenol as root filling materials for pulpectomy in primary teeth?
	What is the clinical performance of bulk fill resin composite in comparison to the incrementally applied ones?

DISCUSSION

This paper described the EBD module taught in the final year of the Bachelor of Dental Surgery Program at KAUFD. The results of the questionnaire showed that the majority of students were satisfied with the module, assignment, and tutors. Additionally, the questionnaire indicated that the module evolved over the last 5 years, which was reflected in improvements in the students' evaluations of the module in 2019–2020 compared with those in the first year. In addition, the selected topics became more clinically relevant and intellectually challenging. Examples of selected topics are shown in Table 7.

One obstacle encountered during the planning of the module was the lack of trained tutors. Thus, a training program was designed and implemented to prepare a core of tutors to start the module. A similar approach was found to be effective in improving the evidence-based medicine knowledge and skills of postgraduate physicians in a 3-day intensive workshop. In addition, the American Dental Association's Center for Evidence-Based Dentistry adopted a similar approach and offered on-site training for the dental school faculty. In 2015, 16 tutors were trained; every year since, an additional 6-8 tutors have been trained and added to the group. The new tutors are assigned to shadow a tutor who spent at least one year in the module. This shadowing improves outcomes and is reflected in the improvement in students' evaluations of tutors in 2019-2020 compared with those in the first year.

In the present paper, more than 80% of students agreed or strongly agreed that they can apply the EBD concept to answer any clinical question. We hope that this confidence will be reflected in their future behavior as young general practitioners.

Mean scores on independent evaluations of the presentations were 73% during 2015–2016, which indicates that most presentations met standard expectations (Table 3). The mean improved to 85% during 2019–2020, indicating that most presentations exceeded the standard expectations.

Responses to the open-ended questions in the stu-

dents' evaluations of the module revealed some interesting findings. Many responses emphasized the opportunity to work with classmates as a team and the ability to search PubMed efficiently as advantages of this module. Some students suggested starting this module earlier in the academic program and introducing more exercises throughout the curriculum that focus on applying EBD skills to make decisions in clinically relevant scenarios.

CONCLUSION

This study supports the effectiveness of the EBD module incorporated in the undergraduate curriculum. The module was effective at improving EBDrelated knowledge and skills, which was reflected in the independent evaluation scores of the oral presentations and in the student evaluations of the module. However, future prospective studies are required to assess the long-term impact of the module on the future behavior of the participating students.

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APPENDIX I

CONTENTS OF THE PRESENTATION AND WRITTEN REPORT

The following are the suggested contents for the presentation and the written report:

- 1. Define the problem?
 - What is the problem?
 - How common is it?
 - Why are we doing this search?)
- 2. State the PICO question and its components.
- 3. Identify the method that you have used to search for the evidence.
 - Identify the database used to search the evidence (e.g. Medline).
 - Identify your search strategy.
- 4. How did you select the best evidence?
- Identify the inclusion and exclusion criteria that were used to select the article.
- Explain how you excluded the articles (at title, abstract and full text levels).

- Please mention how many evaluators selected the articles at each level and how did you reach consensus in case of disagreement?

5. Present your results in a table.

The table should contains the following items (you might add more columns if you found it necessary):

- Author and year.
- Aim of the study.
- Study design.
- Population studied. (Sample type (random or convenient); number of subjects in treatment and control groups; any other characteristic of the population that you found it to be of an interest).
- Intervention (What was the intervention?).
- Control (if applicable, what was the control?).
- Outcome/s.
- 6. Conclusion on your own words.

APPENDIX II

Торіс:			Group:	
Evaluator Name:				
	Below standard <60% (1)	Meets standard 60%-75% (2)	Exceeds standard 75%-85% (3)	Exceptional performance 85%-95% (4)
Presentation's content (information):				
Introduction and background				
Identifying the problem				
Study question				
• PICO				
Inclusion/Exclusion criteria				
Keywords & search strategy				
Evidence based tables				
Conclusion/ recommendations				
Overall mark (A)				
Presentation's appearance:				
Organization				
• Readability of the font				
• Use of pictures/diagrams appropriately				
Overall mark (B)				
Presenter and the group:				
• Presentation skills of the presenter				
• Participation of all members of the group				
• Knowledge "of the group" about the subject				
Overall mark (C)				
Fina	l Mark = (A+B+	C)		

EVALUATION FORM FOR THE PRESENTATION SESSION

II
IX
R
PPE
7

STUDENT EVALUATION (EBD MODULE)

Group No:				Supervis	or Name:				
Student Name	General				Student Particij	pation			
	Team Skills *	During the project meetings	In PICO development	In search strategy development	In the search for evidence	In filtering the evidence	In the construction of evidence table	In the Presentation preparation	In the final report writing
* Showing po	sitive attitude, e	ncourages and	motivates team, si	upports team decisions, h	ielps team reach	consensus, hei	lps resolve conflict	ts in the group	

Each student should be given a mark between 1 (Low participation or ability)- 5 (High participation or ability)