The Effect of a Mobile-Based Application to Train Dental Students in the Field of Grinding and Preparing Decayed Teeth

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Abstract
Dental students face multiple challenges in mastering practical skills like cavity preparation for decayed teeth. This study, therefore, aimed to design, develop, and produce a mobile-based application for grinding and preparing decayed teeth. Executed via an applied-developmental approach across needs assessment, design/development, and evaluation phases, an Android application was created after confirming necessity with students and faculty. The final evaluation showed user acceptance regarding educational and graphical capabilities. Results indicate superior performance in graphics, with high satisfaction in image clarity (90.9%) and navigation ease (81.8%). Educationally, the application was highly successful in improving fundamental concepts like achieving clear gingival contours and controlling cavity width, though it showed less efficacy in complex skills like proximal box depth. Content-wise, 81.8% found the material adequate, but 54.6% called for more specialized content, and only 45.5% deemed it suitable for the general public. Overall, the mean score for Graphical Capabilities (41.18) was significantly higher than Educational Capabilities (30.27), indicating greater success in technical implementation than core content depth. The study concludes that the needs assessment identified five key educational priorities, and the application proved successful in enhancing foundational skills like clear gingival preparation and rounding line angles. This study is a software design and implementation that is innovative.

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Introduction

The most important duty of the medical sciences education system is to train human resources equipped with the necessary clinical competence required by society and to provide an optimal platform for the development of national health and treatment. Recently, the main focus of education and learning in the field of oral and dental health has shifted from the traditional model—which is often forgotten by graduates after some time—to a new approach [1, 2].

The field of dentistry is one of the most stressful professions, and consequently, dental schools are considered high-stress educational environments. These tensions and occupational hazards may stem from the educational processes during the study period or from the educational and professional pressures inherent in dentistry [3, 4]. Despite dentistry being a highly useful and applicable profession within medical sciences, it has various negative aspects, including occupational stress and educational environment stress, necessitating preventative measures to improve the educational stress associated with this field [5-7].

An ideal learning environment should enhance students' abilities in theoretical, practical, and personal domains, exposing them to clinical experiences equivalent to the setting they will work in after graduation [8]. Teaching methodology is not merely the transmission of information; its role in facilitating learning and interaction is very important [9]. Evaluation is an inseparable part of the teaching and learning process, determining the extent to which the objectives of formal curricula have been achieved [10]. Throughout their academic life, learners participate in various evaluation exams. Factors external to the formal curriculum also influence the quality of these evaluations [11]. Among the most significant of these factors are parental discipline and involvement, parental expectations, the supportive university environment, and the individual, knowledge-based, skill-based, and personality characteristics of the instructor, all of which affect students' academic success [12, 13].

To conduct appropriate evaluation, proper learning must first take place. Numerous factors, including the student, the instructor, clinical conditions, and the method of teaching, influence the outcome of learning, and necessary actions must be taken regarding the role of each of these elements [14]. One type of learning method is e-learning. This type of learning is a modern approach that has expanded in the age of information and the knowledge-based society. In education, technology-based methods are now seriously competing with traditional teaching methods [15-17].

New technologies have significant impacts on students' better learning, to the extent that the use of mobile phones can have important effects on student education [18]. One of the most critical technology-based teaching tools is the mobile phone, which leads to increased learning capability, self-management, and the creation of effective communication activities among individuals. In fact, the development of mobile phone-based software, or mobile applications, has led to the application of this software in various fields of health [19, 20].

Given the importance of education for dental students and their effective role in promoting community health, this study was conducted with the aim of designing, developing, and producing a mobile-based application for training dental students in the field of tooth preparation and restoration of decayed teeth.

Methods

This study was conducted using an applied and developmental approach on dental students. Using a simple random sampling method without replacement, 10 dental students and 10 individuals from a control group were selected to participate in the study.

The data collection tool was a researcher-developed questionnaire. This questionnaire consists of three parts: the first part covers demographic information; the second part contains 18 closed-ended questions on a 5-point Likert scale (ranging from "Strongly Agree" to "Strongly Disagree") regarding the educational capabilities of the software.

This study was implemented as an applied and developmental research, and the statistical population comprised dental students. The study was carried out in three stages:

1. **Stage One:** Needs Assessment for the software.
2. **Stage Two:** Design and Development of the mobile-based educational software.
3. **Stage Three:** Evaluation of the program in the target population.

In a need's assessment conducted before the software development, students deemed the existence of such software as an essential supplementary educational tool. Furthermore, faculty members held a positive view, considering the creation of this software necessary for enhancing students' educational levels.

The second stage involved the initial coding of the raw mobile application by a programming expert. The required sections of this application were approved by dentistry faculty members. The necessary information was extracted from reference textbooks and entered into the framework of an Android application, designed to be installable on mobile phones for student use, organized in separate, grouped sections. Following final approval, it was made available to the users.

The Third Stage is based on the available samples of the study population, which are the dental students. The evaluation procedure involved providing the developed software to the participating students for a one-week period, during which it was installed on their mobile phones. These students were asked to carefully examine the graphical and educational capabilities of the software.

The data collection instrument was the researcher-developed questionnaire, which, as mentioned, includes three parts: demographic information, and 18 closed-ended questions on a 5-point Likert scale concerning educational capabilities. For data analysis, the SPSS-21 software was utilized. The results of the evaluation section were presented descriptively in the format of frequency and percentage. To analyze the data, inferential statistical tests such as correlation tests were used.

Result

This needs assessment evaluated five educational strategies for better understanding challenging topics in the fundamentals of restorative dentistry. Below, each need is analyzed based on its actual priority (by percentage of agreement). Group problem-solving sessions (100% Agreement): This item received the maximum agreement, marking it as the strongest and most urgent student need. This indicates the presence of numerous shared ambiguities and questions among them. Use of virtual simulation (90% Agreement): The very high inclination toward virtual simulation reflects the recognition of the benefits of modern technologies and also the need for a stress-free and safe practice environment before entering the real clinical setting (Table 1).

Table 1: Conducting a needs assessment of students regarding more difficult topics in the Fundamentals of Restorative Dentistry course

Educational Needs	Percentage of agreement	%
Increase hands-on practice time	80	8
Use virtual simulation	90	9
Produce educational videos	70	7
Group troubleshooting sessions	100	10
Present more clinical cases	60	6

Increase practical training time (80% Agreement): The majority of students feel that the time allocated for practical training is insufficient to achieve mastery. Preparation of educational videos (70% Agreement): Significant agreement

on this item indicates a preference for flexible, review-based learning. Provision of more clinical cases (60% Agreement): Although this item has the lowest priority, it is still affirmed by the majority of students. This shows that students value the connection between theory and practice (Table 2).

Table 2: Conducting an application evaluation in a small group of students

Question		Master 2			Master 1			P
		Control	Post	Pre	Control	Post	Pre	
Presence of a distinct gingival floor	True	4	10	9	4	10	7	<0.001
	False	6	0	1	6	0	3	
Presence of an occlusal isthmus	True	4	4	7	7	7	0	0.008
	False	6	6	3	3	3	10	
Depth of the proximal box cavity	True	9	3	9	3	4	3	<0.001
	False	1	1	1	7	6	7	
Smoothness of the axial angle line	True	0	7	6	1	7	0	<0.001
	False	10	3	4	9	3	10	
Smoothness of the outer boundaries of the cavity	True	9	0	8	5	5	2	<0.001
	False	1	0	2	5	5	8	
Width of the cavity	True	4	9	10	8	10	5	0.002
	False	6	1	0	2	0	5	
Depth of the cavity planning in the occlusal part	True	5	10	10	7	9	8	0.028
	False	5	0	10	3	1	1	

The results indicate that the application was highly effective in teaching the skill of "Establishing a clear gingival floor," which is fundamental to cavity preparation. A significant increase was observed post-intervention, with the intervention group outperforming the control group. Regarding the "Presence of occlusal isthmus," the application's effect on this criterion is less clear and may be dependent on the instructor's teaching style. A notable improvement from zero was achieved, where the performance of the intervention group was comparable to the control group. For the "Depth of proximal box cavity," the results suggest that the application failed to be effective in teaching this specific criterion. The improvement was very slight and negligible, with the performance of the intervention and control groups being similar.

In "Rounding of the axiogingival line angle," the application performed very successfully in teaching this technical point. The improvement was very significant, and the intervention group's performance was clearly superior to the control group. Concerning "Cavity width," the results show significant progress and the achievement of full performance, which was better than the control group, demonstrating the application's effectiveness in teaching cavity width control. For the "Depth of occlusal cavity preparation," there was a slight improvement, and the performance of the intervention and control groups was relatively similar. The effect of the application on this criterion is moderate, especially for students who already possessed relative prior knowledge (Table 3).

Table 3: Number and frequency percentage of evaluation responses regarding software graphics capabilities

Question	I agree very much	I agree	To some extent	I disagree	I strongly disagree
Installation on a mobile phone is simple.	5(%45.5)	6(%54.5)	1(%9.1)	0	0
The amount of memory used by the software is appropriate.	0	5(%45.5)	4(%36.4)	2(%18.2)	0
The software is easy to use.	7(%63.6)	4(%36.4)	0	0	0
The graphic elements, buttons, and colors used in the software are appropriate.	4(%36.4)	6(%54.5)	1(%9.1)	0	0
Is it easy to go to the next pages or return to the previous pages in the designed software?	6(%54.5)	3(%27.3)	2(%18.2)	0	0
The different pages and the quality of the images in the software are designed very clearly and transparently.	4(%36.4)	6(%54.5)	1(%9.1)	0	0
The fonts used in the software are appropriate and legible.	7(%63.6)	4(%36.4)	0	0	0
The software information is categorized in an appropriate way.	3(%27.3)	6(%54.5)	1(%9.1)	1(%9.1)	0
It is easy to receive user comments through the communication channels defined in the software.	0	6(%54.5)	1(%9.1)	4(%36.4)	0
The amount of internet consumption by the software during use is appropriate.	4(%36.4)	3(%27.3)	4(%36.4)	0	0

This evaluation was conducted on 10 users. In the detailed component analysis, indicators related to User Interface (UI) Design, including the appropriateness of graphical components and image clarity, achieved a 90.9% satisfaction rate. Ease of navigation received an 81.8% satisfaction rate. In the area of Technical Optimization, the satisfaction rate for memory consumption was recorded at 81.8%, and for internet consumption, it was 63.7%. Regarding Interactive Capabilities, information categorization received the highest satisfaction rate at 81.8%, while the feedback receipt system scored the lowest at 54.5% satisfaction. Overall, the evaluated software received very positive feedback regarding its user-friendliness and graphical capabilities. In most criteria, the overwhelming majority of users expressed a positive opinion using the "Agree" and "Strongly Agree" options.

Table 4: Number and frequency percentage of evaluation responses regarding software educational capabilities

Question	I agree very much	I agree	To some extent	I disagree	I strongly disagree
The software provides the information users need in the field of grinding and preparing decayed teeth	2(%18.2)	7(%63.6)	2(%18.2)	0	0
Due to the use of various images, it is easier to understand the content.	1(%9.1)	6(%54.5)	4(%36.4)	0	0
Using the software makes learning and teaching the content easier.	2(%18.2)	7(%63.6)	2(%18.2)	0	0
The information in the software is usable and practical for the general public.	3(%27.3)	2(%18.2)	5(%45.5)	1(%9.1)	0
The designed software increases the knowledge, attitude, and performance of users in the field of grinding and preparing decayed teeth.	4(%36.4)	4(%36.4)	3(%27.3)	0	0
The scientific content of the designed software is up-to-date.	0	9(%81.8)	1(%9.1)	1(%9.1)	0
The content of the designed software needs to increase more and more specialized information.	1(%9.1)	5(%45.5)	4(%36.4)	1(%9.1)	0
When I need to obtain information in the field of grinding and preparing decayed teeth, I prefer this software to books.	2(%18.2)	5(%45.5)	1(%9.1)	3(%27.3)	0

Educational Evaluation of the Application

Overall, the software received highly positive feedback from an educational perspective. Regarding the core criteria—effectiveness in content delivery and ease of learning—a substantial majority of users (mainly those selecting "Agree" and "Strongly Agree") expressed favorable opinions. This indicates the software's success as a supportive educational tool.

Concerning the provision of essential information for tooth preparation and restoration, 81.8% of users (7 "Agree" + 2 "Strongly Agree") responded positively, suggesting the application effectively conveyed the fundamental concepts.

Content up-to-dateness was also recognized as one of the strongest aspects of the program, with 81.8% agreement (9 users). The up-to-date nature of the scientific material was regarded as highly valuable by users, reflecting the application's success in maintaining current and relevant educational content.

In terms of facilitating the learning process, 81.8% of respondents (7 "Agree" + 2 "Strongly Agree") confirmed that the app made learning easier and more efficient, highlighting the effectiveness of its pedagogical design.

However, when assessing usability for the general public, only 45.5% of users (2 "Agree" + 3 "Strongly Agree") found the app applicable for non-specialist audiences. This suggests that the program is primarily suitable for dental students and professional learners, and may have limited relevance for the general population (Table 4).

Regarding the need for more specialized content, 54.6% (5 "Agree" + 1 "Strongly Agree") believed that the app would benefit from additional advanced-level materials, indicating that while the foundational content is adequate, further expansion is needed to meet the expectations of advanced users.

When compared with traditional textbooks, 63.7% of participants (5 "Agree" + 2 "Strongly Agree") preferred the application, signifying general acceptance, though a portion of learners still viewed printed educational materials as superior resources.

Statistical analysis revealed that the mean score for graphical capabilities (41.18) was significantly higher than that for educational capabilities (30.27), with a highly significant difference ($P < 0.001$). This underscores the software's strength in terms of visual and aesthetic quality compared with its educational performance.

Discussion

The aim of this study was to design, develop, and implement a mobile-based application to train dental students in tooth preparation and cavity restoration procedures, conducted at the Faculty of Dentistry, Ilam University of Medical Sciences.

In the study by Navabi *et al*., an educational software program on the Android platform was developed to teach oral and dental hygiene to children and adolescents aged 3 to 18 years. According to their findings, the software demonstrated favorable characteristics regarding ease of use, practicality, and educational impact. Specifically, ease of use scored 86.3% (good), user-friendliness 100% (good), and educational effectiveness 100% (good), indicating an overall positive learning impact [21].

Similarly, in the study by Talebi *et al*., virtual education methods were employed to teach proper oral hygiene techniques to students, and the dental plaque index was assessed. In the virtual reality group, each participant used a VR headset and watched two 3D videos demonstrating the Modified Bass toothbrushing technique. The results showed a statistically significant reduction in the mean plaque index compared with baseline levels [22].

In another study by Naderi *et al*., which aimed to determine the effect of mobile-based education on paramedical students, an electronic microbiology textbook was made available on their smartphones. The findings revealed that mobile-based learning positively influenced students' metacognitive self-regulation and attitudes toward learning [23]. Likewise, Ravanbakhsh *et al*. examined the effect of mobile-app-based education on public health internship training for medical students and found that this approach enhanced their learning outcomes—consistent with the present study [24].

Therefore, the results of Naderi *et al*. and Ravanbakhsh *et al*. align with the present findings, supporting the effectiveness of mobile and online educational interventions in improving student learning performance.

In recent years, with the advancement of educational technologies, the use of e-learning has become increasingly widespread within educational systems [25]. E-learning has introduced new tools and technologies, creating expanded learning environments that differ substantially from traditional classrooms. Today, smartphones are extensively used both in medical education and in clinical training within health science disciplines [26, 27].

Conclusion

Overall results indicate that the initial needs assessment of dental students identified five key educational priorities. The quasi-experimental evaluation of the developed educational application demonstrated its effectiveness in improving fundamental technical skills such as establishing a clear gingival floor, creating smooth line angles, and controlling cavity width. However, the impact was less pronounced for more complex tasks, such as determining the depth of the proximal box.

From a technical perspective, the application received positive feedback regarding its graphic quality and user-friendliness. From an educational standpoint, the majority of users confirmed the adequacy of the core content, its up-to-date nature, and the app's ability to facilitate the learning process effectively.

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