Satisfaction and Effectiveness of Virtual Education among Clinical Dental Students

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Abstract:

Background and Objective: The rapid advancement of information and communication technology has revolutionized higher education, particularly in the medical and dental fields. Virtual education serves as a critical component of the learning process by offering students increased access and flexibility; however, it also presents challenges that warrant careful consideration. This study aims to evaluate the satisfaction levels of clinical dental students at Tabriz University of Medical Sciences regarding virtual education and to identify the key factors influencing their learning experience.

Materials & Methods: A cross-sectional analytical study was conducted involving 165 clinical dental students who had completed at least one theoretical course through virtual education. Data were collected using a structured questionnaire developed by Horri et al. (2022), which assessed various dimensions of online learning, including content delivery, professor-student interaction, technical support, and evaluation methods. The data were analyzed using SPSS software version 26, applying descriptive statistics, independent t-tests, and one-way ANOVA to explore differences in satisfaction based on gender, academic semester, and year of entry. The Pearson correlation coefficient was employed to examine the relationships between satisfaction scores and demographic factors, with a significance threshold set at a P-value of less than 0.05.

Results Overall satisfaction scores ranged from 27 to 78, with a mean of 47.05 ± 8.60, indicating a moderate to high level of satisfaction with virtual education. The mean satisfaction score was slightly higher among female students (47.36 ± 8.41) than among male students (47.07 ± 8.84); however, this difference was not statistically significant (P = 0.620). No statistically significant differences in satisfaction levels were observed across years of entry, including students admitted in 2018 (47.08 ± 8.13), 2019 (47.90 ± 8.30), and 2020 (46.18 ± 9.53) (P = 0.600). Similarly, satisfaction scores did not differ significantly across academic semesters, including semester 7 (46.18 ± 9.53), semester 9 (47.90 ± 8.30), and semester 11 (47.08 ± 8.13) (P = 0.600).

Conclusion: The findings of this research suggest that virtual education is an effective methods for delivering theoretical knowledge in dental education. However, it is essential to enhance interactive elements, adopt blended learning models, and strengthen technical support to increase student engagement and improve learning outcomes. This study underscores the necessity for ongoing assessment and refinement of virtual education strategies to better align with students' educational needs.

Keywords: Virtual education, dental students, online learning, student satisfaction, e-learning, dental education

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Background and Objective

The evolution of information and communication technology has profoundly transformed the landscape of higher education, particularly in the medical and dental sciences. Distance education has emerged as a vital component for conveying theoretical concepts and skill training, especially in the post-COVID-19 era, which has necessitated a transition toward remote learning.[1] This educational transformation offers opportunities to enhance access, flexibility, and efficiency in the learning process; however, it also presents challenges that require careful monitoring and optimization.[2]

Historically, dental education has emphasized extensive practical and clinical training. The advent of virtual education allows for theoretical knowledge to be imparted in a more interactive and self-directed format. Research indicates that well-designed e-learning courses can markedly improve students' comprehension and retention of complex medical and dental concepts.[2] Furthermore, computer-based learning environments, particularly when integrated with multimedia content and interactive assessments, have demonstrated a positive correlation with increased student motivation and engagement.[3]

Despite these advantages, the effectiveness of virtual education depends on several factors, including the quality of educational resources, faculty engagement, technological infrastructure, and students' digital proficiency. A significant challenge in online learning environments is the diminished opportunity for face-to-face interactions between students and instructors, which can adversely impact the effectiveness of questioning and the immediacy of feedback.[4] Additionally, technical issues can further hinder the educational experience.[5]

As online education increasingly becomes a focal point in the field of dentistry, it is essential to examine student satisfaction with this mode of learning. Prior research has established that student satisfaction is a critical indicator of the effectiveness of educational objectives within online learning environments.[6] Notable factors influencing the overall student experience include the accessibility of course materials, the quality of instructor interactions, and the perceived significance of online assessments.[5] This study aims to assess the satisfaction levels of clinical dental students at Tabriz University of Medical Sciences regarding their experiences with virtual education.

Materials and Methods

1. Study Design and Participants

This cross-sectional analytical study evaluated the satisfaction levels of clinical dental students regarding their virtual education experience at Tabriz University of Medical Sciences. The participants were clinical students who had successfully completed at least one theoretical course via online educational platforms and had provided informed consent to participate in the research.

2. Inclusion and Exclusion Criteria

The study included clinical dental students who had successfully completed at least one theoretical course delivered in a virtual format and who provided informed consent to participate in the research. Students were excluded if they had no prior experience with virtual education or if they did not fully complete the questionnaire.

3. Data Collection

Data were collected using a structured, self-reported questionnaire designed to evaluate key aspects of virtual education. This instrument assessed several dimensions, including the quality of content delivery—specifically clarity, relevance, and organization of materials—the nature of professor-student interactions in the online environment, the availability of technical support, the user-friendliness of the Learning Management System (LMS), and the assessment methods employed, focusing on the fairness and reliability of online tests and assignments. Responses were recorded on a five-point Likert scale, where 1 indicated

"strongly disagree" and 5 indicated "strongly agree." Overall satisfaction scores were computed by summing individual item scores, with higher totals indicating greater satisfaction. The questionnaire, developed by Horri et al. at Payame Noor University of Isfahan, demonstrated established validity and a robust reliability coefficient of 94%. The instrument comprised 21 items, with a scoring range from 21 to 105, where higher scores corresponded to higher satisfaction levels. Given its focus on the effectiveness of virtual education, the questionnaire is considered applicable across various academic fields.[7]

4. Sample Size Determination

The sample size was determined based on prior research regarding satisfaction with virtual education. Assuming a standard deviation of 6 and a permissible error margin of one unit at a 95% confidence level, the minimum sample size was calculated to be 138 participants. To account for a potential dropout rate, this number was increased by 20%, resulting in a final sample size of 165 students for the study.

5. Statistical Analysis

Data were analyzed using SPSS software, version 26. Descriptive statistics, including the mean, standard deviation, and frequency distribution, were employed to characterize students' satisfaction levels. The Kolmogorov-Smirnov test was utilized to assess the normality of the data distribution. An independent t-test was conducted to assess differences in satisfaction scores based on gender, while one-way ANOVA was employed to compare satisfaction across different academic years. The significance level was established at $P < 0.05$.

6. Ethical Considerations

This research received approval from the Ethics Committee of Tabriz University of Medical Sciences (approval code: IR.TBZMED.REC.1402.962). Prior to the initiation of the study, informed consent was obtained from all participants, and data confidentiality was rigorously maintained throughout all phases of the research. All participant information remained anonymous and was utilized exclusively for academic purposes.

Findings

1. Demographic Characteristics of the Participants

A total of 165 clinical dental students participated in this study, of whom 52.7% (87 students) were female and 47.3% (78 students) were male. The mean age of the participants was 23.37 ± 0.99 years, with ages ranging from 22 to 26 years. A weak positive correlation was observed between age and satisfaction scores, indicating that older students reported slightly higher levels of satisfaction; however, this correlation was not statistically significant ($r = 0.0001$, $P = 0.98$) (see Figure 1).

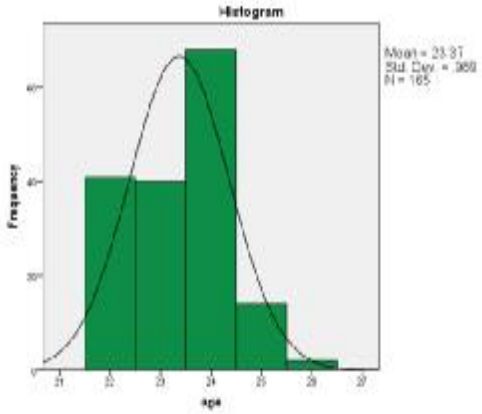

Figure 1- Histogram of age distribution of students

2. Overall Satisfaction with Virtual Education

Satisfaction scores varied from 27 to 78, with a mean of 47.05 ± 8.6. Histogram analysis indicated that the distribution of these scores approximated a normal curve, reflecting that the majority of students reported moderate to high satisfaction with their virtual education experience.

3. Satisfaction Based on Gender

The mean satisfaction scores for female students (41.8 ± 36.47) were marginally higher than those of male students (84.8 ± 7.47); however, this difference was not statistically significant ($P = 0.006$).

Table 1- Comparison of satisfaction based on year of entry

Year of entry	Number	Mean satisfaction score	Standard deviation	P-value
2018	55	47.08	8.13	
2019	55	47.9	8.3	0.006
2020	55	46.18	9.53	

4. Satisfaction Based on Year of Entry

Participants were divided into three groups based on their year of entrt. Comparisons of satisfaction scores among these groups revealed no significant differences (P = 0.600), indicating that students from different academic years exhibited similar levels of satisfaction (see Table 1).

Table 2- Satisfaction based on academic semester

Academic semester	Number	Mean satisfaction score	Standard deviation	P-value
Semester 11	55	47.08	8.13	
Semester 9	55	47.9	8.3	0.006
Semester 7	55	46.18	9.53	

5. Satisfaction Based on Academic semester

In our analysis, students were classified into three groups according to their academic semester. Statistical evaluation indicated no significant differences in satisfaction levels among these groups (P = 0.6), suggesting a consistent level of satisfaction across different stages of clinical education (see Table 2).

Discussion

Virtual learning utilizes the Internet and digital technologies to provide students with access to educational content without necessitating physical presence in a traditional classroom setting.[1,5] The COVID-19 pandemic has brought significant changes to educational systems worldwide, prompting many institutions to transition fully or partially to virtual learning platforms.[5,8] This sudden shift not only created new learning opportunities but also posed challenges for both students and instructors. In dental education, virtual learning has gained attention for its capability to transcend geographical and epidemiological barriers, facilitating remote education tracking for students.[10] Previous research has shown that such approaches can effectively enhance theoretical knowledge and introduce students to innovative educational practices.[11] The findings of the present study, which report moderate to high satisfaction levels among clinical dental students at Tabriz University of Medical Sciences regarding virtual education, support this existing evidence.

Our study aligns with the findings of Wenger et al. (2023), who explored the implementation of interactive e-learning modules in medical education and concluded that formal digital educational tools significantly enhance student engagement. Furthermore, our results resonate with the research conducted by Yu et al. (2024), which demonstrated that interactive e-books surpass traditional resources in fostering confidence and comprehension in nursing education. These parallels underscore the pivotal role of interactive components in optimizing virtual education within clinical dentistry.[7,10]

A cross-sectional onducted by Mohammed et al. (2022) found that approximately 75% of students expressed satisfaction with online education, emphasizing factors such as easy access to resources, technical support, and meaningful interaction with instructors as primary contributors to their satisfaction. Conversely, the review also identified significant shortcomings, including the lack of in-person interaction and direct guidance—challenges that our current study also recognized as detrimental to the quality of learning.[6]

Subsequent studies have underscored significant limitations of virtual education in practice-oriented disciplines. For example, research by Marcus Palmier et al. and Naciri et al. assert that while international online courses offer valuable global perspectives, the absence of practical experience remains a significant barrier.11,12 Additionally, a study by Bassey et al. revealed the effectiveness of mobile visual atlases in teaching histology, suggesting that integrating such tools into dental education could create a more enriched and visually engaging learning experience.[13]

Despite the distinct advantages offered by virtual education, inherent weaknesses that adversely affect student satisfaction must be acknowledged. The foremost deficiencies include a the lack of clinical practical experience; limitations in real-time faculty-student interactions[8] that hinder active engagement and mentorship;[14] technical difficulties such as slow internet speeds and inadequate educational platforms;[5] and concerns regarding the reliability and fairness of online assessments.[6] To optimize this educational modality, we advocate adopting hybrid models that integrate hands-on workshops with online theoretical instruction designed to develop practical skills. Furthermore, the inclusion of interactive elements such as virtual simulators, case discussions, and game-based learning modules could substantially bolster student engagement.[10]

Enhancing technical infrastructure, improving the quality of learning management systems, and ensuring equitable internet access and technical support are critical measures to pursue in the future. In terms of assessment, implementing supervised testing, competency-based evaluations, and AI-assisted grading tools can increase the credibility and fairness of evaluations.[7]

This study, which included a substantial sample of 165 students, provides valid and generalizable quantitative insights into satisfaction levels with virtual education in clinical dentistry. The findings not only confirm the effectiveness of this educational approach but also illuminate the urgent need for structural and content reforms to significantly enhance the quality and effectiveness of virtual education.

Conclusion

The results of this research indicate that virtual education is a valuable asset in contemporary dental education, offering flexibility and accessibility while also revealing several challenges. The study highlights the potential of hybrid educational models to promote more effective interactions between instructors and students, thereby enhancing the overall effectiveness of virtual education in dentistry through improved technical support. Moreover, the integration of interactive elements, competency-based assessments, and advanced digital resources is essential for enriching the quality of virtual education in clinical dentistry.

However, several limitations must be acknowledged in the present study. First, the effectiveness of virtual education is significantly influenced by the existing technological infrastructure across different institutions, which may restrict the generalizability of the results. Second, this research did not assess variations in participation and learning outcomes based on students' levels of digital literacy or access to equipment. Another limitation concerns the predominant emphasis on the technological aspects of virtual education, with less focus on the pedagogical strategies required for optimal implementation in clinical settings. Finally, it is important to recognize that the findings reflect current trends, and future innovations or challenges in virtual education—evolving alongside technological advancements— may not be comprehensively captured.

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