




Evaluating Virtual Education Quality: Insights from Dental Students during the COVID-19 Pandemic

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Abstract:

Aim: This study aims to evaluate the quality of virtual education in dental training during the COVID-19 pandemic, focusing on student satisfaction and teaching effectiveness at Qazvin University of Medical Sciences Dental Faculty.

Background: The COVID-19 pandemic necessitated a rapid transition to virtual education, impacting various educational sectors, including dental training. While online learning has provided a solution to maintain educational continuity, it has also raised concerns about its effectiveness in imparting practical skills essential for dental professionals. This study seeks to understand how dental students perceive their virtual education experience during this unprecedented time.

Objective: The objective of the study is to assess student satisfaction and identify gaps in virtual education.

Method: A cross-sectional study was conducted with 112 dental students during the 2022-2023 academic year. Participants were selected based on their GPA and willingness to participate. Data were collected using Marsh's 21-question questionnaire, which was distributed electronically. The study adhered to ethical standards, ensuring informed consent from all participants. The minimum sample size was assured and established at 94 students. The descriptive analysis of mean and standard deviation were used for quantitative variables and frequency and percent for categorical variables. Independent t-test and the nonparametric tests of Manwitney-U and Kruskal-Wallis one-way ANOVA were used for quantitative variables, and chi-square and analysis of variance were used to compare and analyze the qualitative data. The collected data was analyzed using SPSS software version 25 (IBM, New York, NY, USA) with a significance level of 0.05.

Results: The findings revealed a generally favorable perception of virtual education among students, with average scores in all dimensions exceeding acceptable levels. Notably, students in endodontics and oral diseases rated their professors higher than those in restorative dentistry and pediatric dentistry ($p < 0.05$). The mean scores in the groups of endodontics and oral diseases were higher than in other groups ($p < 0.05$).

Conclusion: Overall, students expressed a positive attitude toward the quality of virtual education, indicating its effectiveness in enhancing learning outcomes. Continuous improvement efforts are recommended to further enhance teaching quality and adapt to the evolving educational landscape.

Keywords: Dental education, Virtual simulation education, Pandemic, COVID-19, Students, Virtual education quality.

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Received: October 20, 2024
Revised: December 03, 2024
Accepted: January 7, 2025
Published: February 13, 2025

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Cite as: Esfehani M, Sefidi F, Atabaki S, Razzaghi A, Hushmandi K, Daneshi S, Ghorbani A. Evaluating Virtual Education Quality: Insights from Dental Students during the COVID-19 Pandemic. *Open Public Health J*, 2025; 18: e18749445363632. <http://dx.doi.org/10.2174/0118749445363632250206065912>



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1. INTRODUCTION

Since the World Health Organization announced the outbreak of the coronavirus disease (COVID-19) in January 2020, academic institutions around the world have turned to online activities to prevent events the disease spread [1, 2]. In particular, the training of medical students around the world has been significantly affected. Medical education has faced great challenges due to the rapid spread of the pandemic [3]. Restorative instruction isn't restricted to fundamental theoretical instruction but also incorporates practical skills and real-world applications. This approach aims to provide students with a well-rounded education that prepares them for success in both academic and professional settings. Since the outbreak of the pandemic, medical educators have recognized the need to adapt their teaching methods to meet the evolving challenges faced by students. By incorporating innovative learning techniques, such as virtual simulations, tele-medicine experiences, and online tutorials, educators are able to provide a more dynamic and engaging learning experience for students. These new approaches not only help students build essential skills in a rapidly changing healthcare landscape but also allow for greater flexibility and accessibility in their education. Medical educators continue to explore different ways of delivering high-quality instruction while ensuring that students receive the practical training and knowledge they need to succeed in their future careers as healthcare professionals [4-6].

Virtual simulation involves a computer system that can create and provide the experience of virtual environments and scenarios for various purposes, such as training, education, and research. This technology allows users to interact with simulated environments in a realistic and immersive manner, providing them with valuable hands-on experience without the need for physical resources or risks [7-9].

Dental chairside instruction is significantly more intricate than typical higher education experiences, as advanced dental students assume responsibility for overseeing the oral health of patients while receiving guidance from clinical experts [10]. Furthermore, clinical dental procedures require the amalgamation of intellectual and technical competencies, which encompass an awareness of patients' needs alongside technical proficiency, with a paramount emphasis on risk assessment. In essence, dental students acquire knowledge of the appropriate actions to

take, the timing for effective intervention, and the ability to critically evaluate treatment results [11]. Dental schools have had to adapt to the rapidly evolving landscape of education by implementing digital teaching concepts to offer web-based interactions and digital resources for their students. This shift towards online learning has become essential in light of the COVID-19 pandemic, which forced institutions to temporarily close physical classrooms and adopt a remote learning model [12]. By embracing digital technology, dental schools can provide students with access to virtual lectures, interactive tutorials, and simulation tools that simulate real-world clinical experiences. Furthermore, these digital teaching platforms enable faculty members to monitor student progress more effectively and provide personalized feedback. Overall, students appreciate the convenience and effectiveness of e-learning courses and generally have an open attitude toward e-learning courses [13].

One of the challenges of the new millennium universities is the concept of quality and the expectations that the beneficiary groups have of higher education to guarantee and ensure this concept [14]. Research on the quality of teaching in the university is one of the most important issues that not only provides appropriate feedback for the analysis of educational issues, basic decisions, and strategic planning to the authorities and those involved in higher education but also is aware of their performance quality during teaching. In this way, teachers will be able to modify the teaching methods and thus increase the quality of their teaching [15]. According to Boote, teaching is the most technical and main function of the educational system, which must be done skillfully and requires responsibility and responsiveness of professors [16]. According to the mentioned topics, it is clarified that teaching, improvement, and quality assurance are the basis of the approaches and plans that universities put at the top of their programs. Given the experience of the COVID-19 pandemic and the possibility of a similar experience in the future, dental schools need to implement flexible modifications in the provision of educational, clinical services and community outreach to ensure the safety of students, patients, and educators while also maintaining ongoing academic and research advancement for students [11]. Therefore, the present study was conducted to determine the teaching quality of dental faculty professors in virtual education based on students' opinions.

2. METHODS

2.1. Participants, Inclusion and Exclusion Criteria

A total of 112 students participated in the current study in 2022. The students were grouped according to their GPA including under 14, 14 to 17, and over 17.

The inclusion criteria for admission to this study were as follows (1): voluntary participation and (2) completion of at least 5 semesters. At first, the invitation to participate in the study was sent to all students who were studying at the Faculty of Dentistry of Qazvin University of Medical Sciences (N=220) via email. Out of all students, 112 people showed a willingness to participate in the study (50.9%). The students were provided informed consent to voluntarily participate in the study, ensuring that they fully understood the purpose, procedures, risks, and benefits of their involvement. This study adheres to the ethical standards outlined by the Declaration of Helsinki.

2.2. Study Design and Sample Size

This cross-sectional study was carried out at Qazvin University of Medical Sciences.

In the current study, to calculate the sample size for the single proportion, the following population formula [$n = Z_{1-\alpha/2}^2 \times p[1-p]/d^2$] was used. The minimum sample size was guaranteed and determined as 94 students for a 95% confidence interval [$Z\alpha=1.96$], 5% margin of error, and 50% population proportion.

2.3. Data Collection

The required data were collected using questionnaires in two ways. Due to the spread of the COVID-19 epidemic and the holding of theory classes virtually, electronic questionnaires were sent to students by email or were provided to them in social media student learning groups. The students were asked to read each statement carefully and each student needed to answer all 21 items according to the professors of the assigned departments.

2.4. Instrument

The teaching quality evaluation questionnaire was prepared by Marsh. This questionnaire has 21 questions that are graded on a five-point Likert scale from very good [5] to very poor [1]. Six dimensions of teaching, including learning, interest in teaching, group interaction, teacher-student relationship, comprehensiveness of materials, and exams/tasks are measured by this questionnaire. The score of the questions related to each subgroup is collected, so the score of the subgroup and the overall score are obtained [17]. The reliability of this scale has been reported in a sample of Iranian students by calculating Cronbach's alpha from 0.75 to 0.93 for the subscales and a coefficient of 0.95 for the whole scale [18].

3. DATA ANALYSIS

The collected data was analyzed using SPSS software version 25 (IBM, New York, NY, USA) with a significance level of 0.05. The Kolmogorov-Smirnov test was used to

verification of normal distribution of the data. Mean and standard deviation were used to describe quantitative data, and frequency and percentage were used to report qualitative variables. Independent t-test and the non-parametric tests of Manwitney-U and Kruskal-Wallis one-way ANOVA were used for quantitative variables, and chi-square, was used to compare and analyze the qualitative data.

4. RESULTS

Among the 112 examined students, 32.1% were male and 67.9% were female. Most of the students were between 21 and 24 years old (62.5%) and most of them (26.8%) were studying in the 11th semester. The mean and standard deviation of students' GPA¹ was 16.3 ± 1.3 Table 1.

Table 1. Frequency of students by demographic variables and educational status.

Variables	Group	Frequency (%) N=112
Gender	Male	36(32.1)
	Female	76(67.9)
Age	Under 21	27(24.1)
	21 to 24	70(62.5)
	Over 24	15(13.4)
Semester	5	18(16.1)
	7	25(22.3)
	9	25(22.3)
	11	30(26.8)
	Above 12, transitional, other	14(12.5)
GPA (out of 20)	Under 14	9 (8)
	14 to 17	80(71.4)
	Over 17	23(20.6)

Note: Source: Primary Data, 2022.

To examine the 6 dimensions of teaching quality, including learning, teacher interest, group interaction, teacher-student relationship, content comprehensiveness, exams/assignments, and overall teaching quality, the average of each is reported in the table below. As shown in Table 2, the average score of students' comments in all dimensions of teaching quality and its total was good and desirable. The highest score was reported in the areas of group interaction and learning.

In the examination of the teaching quality of dental faculty professors, it was shown that the mean scores of students' opinions in all educational groups were good (Table 3). The mean scores in the groups of endodontics and oral diseases were higher than other groups, and the mean scores in the groups of dental prostheses, restorative dentistry, and children's dentistry were lower than other groups.

By comparing the professors' teaching quality in different educational groups, it was seen that there is a significant difference between students' opinions regarding the quality of teaching of professors in other academic groups. A higher average rank indicates higher scores in the groups of endodontics and oral diseases (Table 4).

¹ Grade point average

Table 2. The mean of 6 dimensions and the overall average of professors' teaching quality based on students' opinions.

Dimensions of Teaching Quality	Mean±SD	Max-Min (range)
Learning	3.6±0.52	4.58-1.73 (2.85)
The teacher's interest	3.5±0.57	4.5-1.8 (2.70)
Group interaction	3.7±0.60	4.83-1.85 (2.98)
Teacher-student relationship	3.54±0.61	4.57-1.77 (2.80)
Comprehensive content	3.54±0.57	4.65-1.53 (3.13)
Exams/assignments	3.54±0.59	4.65-1.53 (3.13)
Teaching quality	3.56±0.52	4.50-1.90 (2.6)

Note: Source: Primary Data, 2022.

Table 3. The mean score of professors' teaching quality in different educational groups.

Dimensions of Teaching Quality	Mean±SD	Max-Min (range)
Orthodontic	3.53±0.78	5-1.14 (3.86)
Endodontics	3.77±0.70	5-1.90 (3.10)
Oral diseases	3.73±0.73	5-1.52 (3.48)
Pathology of mouth, jaw, and face	3.62±0.76	5-1.71 (3.62)
Periodontics	3.55±0.64	5-1.71 (3.29)
Dental prostheses	3.45±0.77	4.76-1 (3.76)
Oral and maxillofacial surgery	3.53±0.57	4.64-2.14 (2.52)
Restorative Dentistry	3.48±0.60	4.67-1.43 (3.24)
Pediatric Dentistry	3.41±0.60	5-1.86 (3.14)
Oral and maxillofacial radiology	3.54±0.65	4.62-1.86 (2.76)

Note: Source: Primary Data, 2022.

Table 4. Comparing the teaching quality of professors based on the opinions of students in different educational groups.

Rank	Educational Groups	Rank's Mean	p-value
1	Endodontics	6.5	0.001
2	Oral diseases	6.15	
3	Orthodontic	5.66	
4	Oral and maxillofacial surgery	5.60	
5	Periodontics	5.48	
6	Pathology of mouth, jaw and face	5.46	
7	Oral and maxillofacial radiology	5.31	
8	Dental prostheses	5.30	
9	Restorative dentistry	4.96	
10	Pediatric dentistry	4.59	

Note: Source: Primary Data, 2022.

According to the results, there was no significant relationship between the professors' teaching quality and gender; in other words, the opinions of male and female students about the teaching quality of dental faculty professors were the same. Also, there was no significant relationship between the professors' teaching quality and the student's age, grade point average, and semester.

The relationship between all the components of professors' teaching quality, including learning, teacher interest, group interaction, teacher-student relationship, content comprehensiveness, exams/assignments, and the variables of gender, age, academic semester, and grade point average

were investigated, and no significant difference was observed in any case.

Overall, the analysis indicates that there are no statistically significant differences in faculty teaching quality when evaluated against gender, age, semester, or GPA categories, as evidenced by the p-values for each variable being above the conventional threshold of significance (typically $p < .05$). This suggests that factors such as gender, age, semester standing, and GPA do not significantly influence perceptions of teaching quality among students in this sample (Table 5).

Table 5. The relationship between faculty teaching quality according to different variables.

p-value	Mean±SD	Groups	Variables
0.55	3.52±0.60	Male	Gender
	3.58±0.49	female	
0.32	3.67±0.45	Under 21	Age
	3.55±0.55	21 to 24	
	3.41±0.54	Over 24	
0.41	3.47±0.59	5	Semester
	3.72±0.45	7	
	3.60±0.54	9	
	3.46±0.59	11	
	3.54±0.34	Above 12, transitional, other	
0.89	3.61±0.67	Under 14	GPA (out of 20)
	3.57±0.51	14 to 17	
	3.52±0.55	Over 17	

Note: Source: Primary Data, 2022.

5. DISCUSSION

One of the important tasks of medical universities is to train the human resources needed by society to meet the health and treatment needs of society with high quality. Therefore, attention to the quality and quantity of medical education and its improvement leads to the improvement of the quality of services in health and treatment [19]. To achieve the appropriate quality in medical education, it is necessary to evaluate the quality of education and, knowing the current situation, examine the strengths and correct the weaknesses to improve it [20]. Among the types of methods available to evaluate the quality of professors' education, the method of asking students' opinions is the most used. Considering the importance of the topic, this study was conducted to evaluate the professors' teaching quality in different educational groups of Qazvin Dental Faculty.

The results of the present study showed that the professors' teaching quality scores, both overall and in the 6 components, were acceptable from the student's point of view. Gharatapeh *et al.* in examining and comparing the dimensions of teaching quality from the perspective of Kerman University health faculty students, achieved completely similar results to the present study [21]. Khoshrang *et al.* also evaluated the quality of education provided at Gilan University as good, which is similar to the results of the present study [22]. However, Hashemi's study, which was conducted to evaluate the teaching quality from the students of Lamard Nursing School point of view, showed that the teaching quality of professors was not at an optimal level in all the investigated components, which is contrary to the results of the present study [23], the reason could be due to the difference in the examined samples and their fields of study, it should also be noted that the present study was conducted during the time of the COVID-19 disease and the virtual education of students.

It should be noted that students' views on the effective teaching of professors may be more influenced by the professors' personality traits than other teaching charac-

teristics [24]. Interaction with students and relationships between professors and students are among the most important issues in the quality of professors' teaching.

The teaching quality of the professors in all the groups was at a favorable level, but the groups of endodontics and oral diseases had the highest score, and restorative dentistry and pediatric dentistry had the lowest score, which was statistically significant. In other studies, it was also shown that the field of the professors has an effect on the quality of their teaching [15, 25], and the type of course and its difficulty level can affect the evaluations [26]. The nature of work and the kind of work that students do in the department of diseases and the stability of professors in the departments of endodontics and oral diseases can be the satisfactory factors, while in the departments of dental prostheses and children, there is a lot of movement and changes of professors, which affects the quality of professors' teaching.

In the evaluation of the teaching quality of faculty professors according to gender in dental students of Qazvin, although the score of women was higher than that of men, no significant difference was observed between their scores. The results in some studies were in line with our findings [21, 26]. The reason for the discrepancy in others can be due to the difference in the sample size, the difference in expectations, and academic motivation.

In the examination of the teaching quality of the professors according to age, although the teaching quality score decreased with the increasing students' age, no significant difference was found. The reason can be due to the difference in the sample size and their field of study, which was related to management.

The results showed that there was no significant difference between the teaching quality of faculty professors in terms of GPA in Qazvin dental students, which was in line with the results of other studies [26-28].

In the study of the teaching quality of the professors of the faculty, according to the academic semester of the students, no significant difference was found. In the study of Aghamirzayi [29], a significant difference was observed between the students' educational level (Bachelor's and

Master's), and the scores of master's students were higher than those of undergraduate students; the difference may be related to the level of students' expectations, judgment and understanding of the university and the professor.

The current study was carried out during the COVID-19 epidemic when the teaching of theoretical courses was done virtually. Also, the students who were examined studied in different semesters, so it is possible that the students of the lower semesters still do not have a course with some professors. These can affect the results of the present study. On the other hand, during the COVID-19 pandemic [30], issues such as reduced physical activity can affect mental health [31], and mental health may also affect teachers' educational activities and student's learning. It is recommended that future studies include these topics in their reviews. Research in this area indicates that sadness and suicide rates have risen during the COVID-19 pandemic [32]. The experiences acquired during the COVID-19 pandemic, especially exploring the psychological aspects of virtual learning - learning about technological adaptations during the pandemic, can be leveraged to enhance the efficiency of healthcare systems and mitigate its effects on various life domains, particularly in education and learning [33, 34].

CONCLUSION

The findings indicate that, overall, students perceive the teaching quality as acceptable across various components, aligning with similar studies from other institutions. This suggests a consistent standard in teaching quality within dental education, although variations exist among different specialties. Notably, the research emphasizes that factors such as professors' personality traits and student-professor interactions significantly influence perceptions of teaching effectiveness. The study also reveals that while certain groups, like endodontics and oral diseases, scored higher in teaching quality, others, such as restorative and pediatric dentistry, faced challenges that may stem from faculty turnover and course difficulty. Despite these encouraging results, the study acknowledges limitations due to the impact of the COVID-19 pandemic on educational delivery methods and student experiences. The transition to virtual learning may have affected both students' engagement and professors' teaching dynamics. Future research should consider these variables to further enhance educational strategies and outcomes. In conclusion, maintaining high standards in medical education is essential for producing competent healthcare professionals. Continuous evaluation and adaptation of teaching methods, especially in response to changing circumstances such as a pandemic, are vital for improving educational quality and ultimately enhancing healthcare services. The insights gained from this study can inform future educational policies and practices within medical universities, ensuring they remain responsive to the evolving needs of society suggestions.

- It is suggested that this research be carried out in other fields of study and be cautious in generalizing these results to other people.

- It is also suggested to hold appropriate educational workshops for teachers in order to improve the quality of teaching.

LIMITATIONS OF THE STUDY

The limitations of the study include the following:

- The study was conducted only for dental students and no information was obtained from other fields of Qazvin University.
- Lack of articles with the same topic to compare the results and contextual variables with each other.
- Studying during the COVID-19 pandemic and holding theory classes virtually.

AUTHORS' CONTRIBUTION

Study conception and design were provided by SM and ME, data were collected by FS, analysis and interpretation of results were contributed by SA, AR and KH and the manuscript was drafted by AG and SD. All authors reviewed the results and approved the final version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study received ethical approval from the Research Ethics Committee in the Qazvin University of Medical Sciences, Iran, with Ethical code of IR.QUMS.REC. 1400.456.

HUMAN AND ANIMAL RIGHTS

All procedures performed in the study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1975 Helsinki Declaration and its later amend-ments or comparable ethical standards.

CONSENT FOR PUBLICATION

Informed consent was obtained from the participants.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

FUNDING

This research was done with the financial support of the Qazvin University of Medical Sciences.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

This research would not have been possible without the assistance of the Vice-Chancellor of Research and Technology at Qazvin University of Medical Sciences, the research participants, and everyone else who assisted us. We would like to express our gratitude to all the people who helped us with this research references.

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