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Effectiveness of Virtual Education on Learning from the Perspective of Dental Students

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ABSTRACT

Introduction: In addition to the crucial importance of clinical training in dentistry, other forms of training such as virtual learning or electronic learning (e-learning) are also being given greater consideration in dental education curricula. The aim of the present study was to evaluate the effectiveness of virtual education from the perspective of dental students at Babol University based on the first stage of Kirkpatrick's pyramid of educational effectiveness.

Materials & Methods: In this cross-sectional study, a questionnaire was designed based on Kirkpatrick's pyramid of educational effectiveness in 5 domains, including demographic characteristics, level of familiarity with the virtual education environment and software, teaching, assessment, and learning interaction questions. Responses were categorized using a Likert scale. An independent t-test and One-Way Analysis of Variance (ANOVA) were used to analyze the data.

Results: Based on the first stage of the Kirkpatrick model for evaluating educational effectiveness, students indicated that the effectiveness of virtual training on learning was average. The Pearson correlation test revealed a positive correlation between students' responses to questions about familiarity with the computer and the Internet and their satisfaction with the overall effectiveness of virtual education, including the three areas of teaching, assessment, and learning interaction.

Conclusion: From the perspective of the students studied, the effectiveness of virtual teaching on learning was moderate. Familiarity with computers and the Internet increased satisfaction with all three areas of education, assessment, and learning interaction of dental students from virtual instruction.

Keywords: Self-evaluation programs, Virtual reality, Education, Students, Dentistry

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Introduction

With the development of e-learning at the level of universities and higher education institutions in the competitive environment of today's world, the issue of evaluating e-learning

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programs and measuring the success rate of these systems has become important to determine the extent to which they have been successful in implementing e-learning courses, [1] because the quality of educational and research courses is one of the concerns that higher education systems always strive for. The continuous improvement of the quality of education also requires the use of educational evaluation. [2]

In general, educational evaluation is a systematic approach to collecting data that helps the administration make useful and valuable decisions about the educational program. [3] Evaluating the effectiveness of education means determining the extent to which education has led to the creation of knowledge and skills needed by the organization in an applied and practical way. [4] The four systems of curriculum, education, teaching and learning always interact with each other and influence the effectiveness of education. [5] As mentioned, evaluating the effectiveness of education is the key to improving the efficiency of education and student learning. [4]

Nowadays, there are various models for evaluating educational programs, with the most well-known evaluation model being Kirkpatrick's four-level evaluation model. These four levels include reaction (the individual's reaction to the educational course and learning experiences), learning (the change in knowledge, skills, or insights), behavior (the rate of change achieved in the behavior of individuals participating in the educational course and detected in the actual work environment through evaluation), and results (quality and quantity of products, etc.). According to Kirkpatrick, his four-stage model provides a logical framework for evaluation. He displays this model in a pyramid and states that the first two levels of evaluation take place in the educational environment, while the last two are measured in the employee's workplace. [6] According to this model, evaluation should always start with the first level, and if time and budget are available, the second level and then the third and fourth levels should follow. [5] Karimi Afshar's studies from 2019 have suggested that about two-thirds of dental school students have a positive attitude towards e-learning and that students have had a good experience with web browsers. A positive and significant correlation was found between the quality of the hardware and the attitude. [7]

Faraone et al. (2013) conducted a study to investigate the efficacy of a blended learning curriculum in developing student competency in both pre-clinical laboratory and didactic components while requiring less direct supervision compared to a traditional curriculum. The researchers hypothesized that this blended approach would be positively received by both students and faculty.The findings indicated that the students' academic performance and satisfaction with the course, as well as the supporting faculty's response to the new blended curriculum, were highly favorable. This suggests that the blended learning model was successful in achieving the desired learning outcomes and garnering positive perceptions from the key stakeholders. [8] The information from each stage serves as the basis for the next stage of evaluation. Given the important role, that virtual education plays in students' educational and research performance, the aim of the present study was to evaluate the effectiveness of virtual education based on the first level of this model.

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Materials & Methods

This study was approved by the Ethics Committee of Babol University of Medical Sciences (ethical number: IR.MUBABOL. REC.1399.438). This descriptive-analytical study was conducted in the 2020-2021 academic year at the Faculty of Dentistry, Babol University of Medical Sciences using the convenience sampling method. In the present study, first, based on previous studies, various aspects of educational effectiveness were investigated in different studies using the Kirkpatrick model were investigated and a questionnaire was designed in 5 parts according to the research purpose with the help of 8 medical education and e-learning experts and professors of dentistry.

In addition, credible methods of validity calculation, namely Content Validity Ratio (CVR) and Content Validity Index (CVI) were used to confirm the validity and quantify the experts' opinions and confirm the ability to implement the questionnaire, respectively. Based on the statistics, CVR = 0.85 and CVI = 0.80 were confirmed with regard to the validity of the aforementioned questionnaire. Moreover, the reliability of the questionnaire was determined by calculating Cronbach's alpha at 0.96 and the repeatability of this questionnaire by the test-retest method at 0.99 in 15 college students.

A total of 140 dental students participated in the current study based on the Karaji and Morgan table.[9] After completing the virtual education course and testing, a 5-item questionnaire was designed that included demographic questions, questions on familiarity with types of virtual education software, teaching, assessment, and learning interaction. In the 2020-2021 academic year, the dental students in the clinical departments who used the virtual education program at Babol University of Medical Sciences for at least half a year were asked to respond to the questionnaire electronically. The questionnaire included 7 demographic questions, 8 questions about the level of familiarity with the Internet,10 questions about the level of satisfaction with the professors' teaching, 6 questions about the type of assessment, and 11 questions about the learning rate.

The responses were categorized on a 5-point Likert scale (very high=5, high = 4, moderate=3, low=2 and very low=1). The obtained scores were also divided into low (low and very low, from 0 to 40%), moderate (from 40 to 60%) and high (high and very high, from 60 to 100%) and, if necessary, further information was provided to the students online. To facilitate analysis, the grade point average (GPA) was qualitatively divided into three ranges: poor (GPA <14), moderate (GPA=14.1-15.9), and good (>16).

Finally, the information was entered into the SPSS 20. After the normal distribution of the data was ensured by the Kolmogorov-Smirnov test, the mean, standard deviation, and frequency were used to describe the data. The independent t-test was used to compare quantitative data with a normal distribution, and the one-way analysis of variance (ANOVA) test was used for data with a normal distribution. Furthermore, the Pearson correlation coefficient test was used to assess the relationship between quantitative variables, and the significance level was considered $P<0.05$.

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Results

A total of 140 (54.3% female, mean age 23.4 SD 4.6) dental students from the clinical departments who used the virtual education program of Babol University of Medical Sciences for at least half a year responded to the questionnaire on the effectiveness of virtual education, whose demographic characteristics are shown in (Table 1). When examining the effectiveness areas of virtual education, the mean scores for the areas of teaching, assessment, and learning interaction were 26.02 (SD = 4.78), 15.4 (SD = 2.8), and 27.1 (SD = 5.7), respectively with the total mean score of 68.5 (SD = 12.00). Additionally, the mean level of familiarity with the computer was calculated to be 23.00 (SD = 2.9) (Table 2).

The result of the Pearson correlation test showed that students' responses to the questions on familiarity with the computer and the Internet were positively correlated with their satisfaction with the total effectiveness of virtual education, including the three areas of teaching, assessment, and learning interaction (p=0.007, correlation coefficient: 0.2). Figure 1 illustrates the frequency distribution and percentage of students' responses to the questions on familiarity with the computer and the Internet. When examining the area of familiarity with the computer and the Internet, the lowest value was related to the electronic content creation software called "iSpring suite" (3.6%) and the highest value was related to the Internet item (72.9%).

Table 1. Demographic characteristics of dental students of Babol University of Medical Sciences in evaluating the effectiveness of virtual education on learning (n=140)

Variable		Frequency	Percentage
Gender	Male	64	45.7
	Female	76	54.3
Marital status	Single	130	92.9
	Married	10	7.1
Academic year	Third	50	36
	Fourth	31	22.3
	Fifth	33	23.7
	Sixth	26	18
Place of residence	Dormitory	47	33.6
	With parents	56	40
	Private house	30	21.4
	Married house	7	5
Duration of using mass communication tools	Less than 2 hours	16	16
	3 hours	37	26
	4 hours	35	25
	More than 4 hours	52	33
Age (mean ± standard deviation)	23.4 ± 4.6		
GPA* (mean ± standard deviation)	15.9 ± 1.3		

*** Grade point average (self-report)**

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Table 2. Mean, range, and standard deviation of dental students' responses to the questions on the effectiveness areas of virtual education at Babol University of Medical Sciences (n=140)

Effectiveness Areas of Virtual Education	Number of Questions	Mean	Standard Deviation	The Least	The Most	Percentage of Effectiveness
The level of familiarity with the computer	8	23.00	2.9	16	32	57.5
Teaching	10	26.00	4.7	20	40	52
Assessment	6	15.4	2.8	12	24	51.4
Learning interaction	11	27.1	5.7	22	44	49.2
Total (teaching + assessment + learning interaction)	27	68.5	12.00	54	108	50

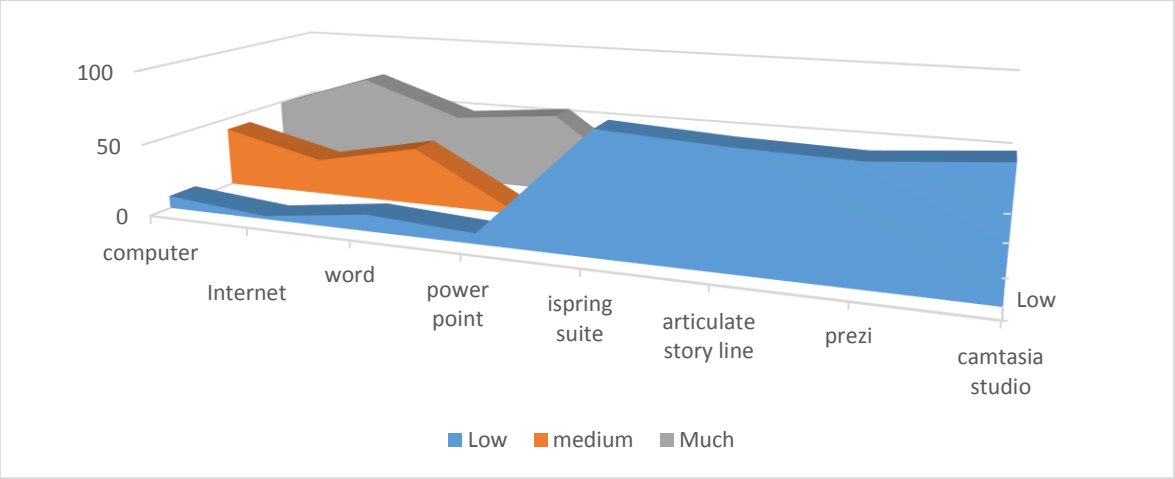


Figure 1. Frequency distribution and percentage of questions on familiarity with computers and the Internet

The frequency distribution and percentage of students' responses to the questions on the teaching areas are presented in Figure 2. The result of the Pearson correlation test demonstrated that the students' responses to the questions on familiarity with the computer and the Internet were positively correlated with their satisfaction with the overall effectiveness of virtual training, including the three areas of teaching, assessment and learning interaction (p=0.007, correlation coefficient: 0.2). When examining the relationship between the effectiveness of virtual teaching and the year of entry, the one-way ANOVA showed that there was no significant difference in the level of familiarity with the computer in the years of entry (p=0.44), but in the areas of teaching (p = 0.18), assessment (p = 0.008) and learning interaction (p= 0.017), the level of effectiveness also increased with the increase in the year of entry. For the overall mean in the different years of entry, the effectiveness rate also increased significantly with the increase in the year of entry (p = 0.006).

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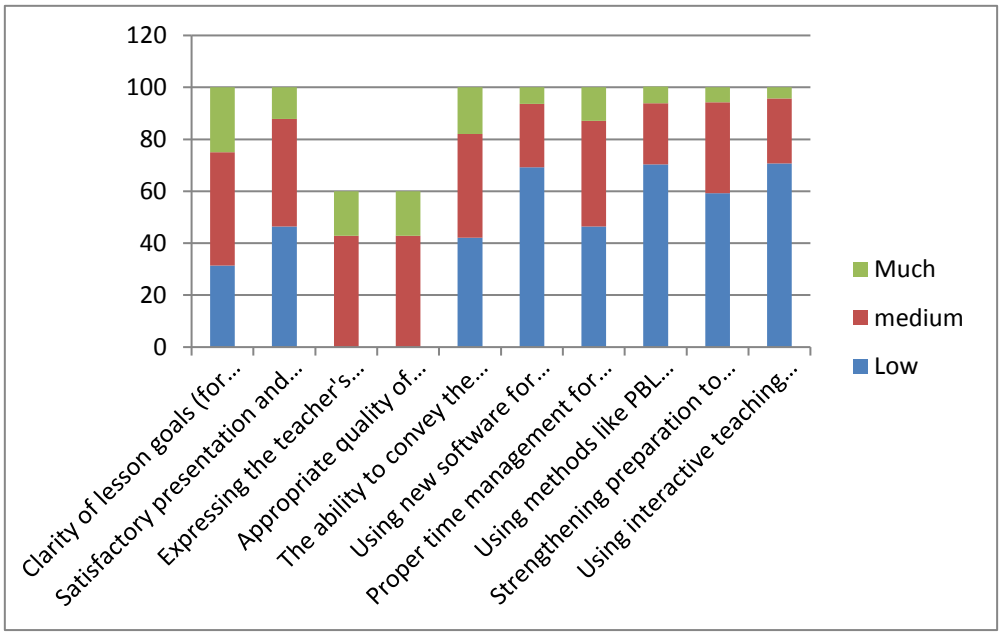


Figure 2. Frequency and percentage of questions on the teaching area

When examining the relationship between the effectiveness of virtual education and GPA, no significant relationship was found between GPA and the effectiveness domains of familiarity with the computer (p=0.07), teaching (p=0.85), assessment (p=0.73), learning interaction (p=0.71), and overall (teaching, assessment, learning interaction) (P=0.76) using the one-way ANOVA test. Moreover, no significant relationship was observed between the place of residence and the effectiveness areas of familiarity with the computer (p=0.22), teaching (p=0.19), assessment (p=0.17), learning interaction (p=0.46), and overall (teaching, assessment, learning interaction) (P=0.22). When examining the relationship between the effectiveness areas and the duration of use of mass communication tools, the frequency of hours of use was observed as follows: Less than 2 hours of mass communication media use (frequency=11.5%), 3 hours of mass communication media use (frequency=26.4%), 4 hours of mass communication media use (frequency = 25%), and more than 4 hours of daily mass communication media use (frequency = 37.1%).When examining the relationship between the effectiveness of virtual education and gender, no significant relationship was observed between gender and the effectiveness areas of familiarity with the computer, teaching, assessment, learning interaction and overall, taking into account the independent t-test.

Discussion

In general, dental students at Babol University of Medical Sciences indicated that the effectiveness of virtual education on their learning was average. The area of teaching was the most effective, the area of assessment was next, and the area of learning interaction was the least effective. In addition, students indicated that they were slightly more familiar with the computer and virtual learning environment and software than average. There was also a positive correlation between students' responses to the computer and Internet familiarity questions and their satisfaction with the overall effectiveness of virtual education, and students who were more familiar with the computer and Internet were more successful at e-learning. Two-thirds of the studied students were moderately and highly satisfied with the clarity of course

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objectives, while the effectiveness of teaching and interaction in education at Tehran University of Medical Sciences was reported as low. [10] Similar to the 2016 study by den Harder et al. at Utrecht University Medical Center, two-thirds of the students in the present study reported low satisfaction with the course content, teaching method, and learning level according to the Kirkpatrick model. [11] Students were less satisfied with virtual education than with traditional education, [12] which is similar to the results of the current study, indicating low student effectiveness in terms of end-of-course assessment type.On the other hand, this effectiveness was moderate at the University Center of Toronto, which may be due to a different model used in virtual education. [13]

Dental students at Luther University in Brazil also found that the use of virtual classes strengthened their learning skills and provided them with the opportunity to communicate with their professors and learn effectively. [14] From the perspective of Babol dental students, no significant relationship was found between demographic variables such as dental students' place of residence and the effectiveness of virtual education, which is consistent with the results of the study by Dalmolin et al. at the Department of Periodontics. [15] It has been shown that students in most of the units studied were not very satisfied with blended learning based on a Learning Management System (LMS) [16], but in the present study, students expressed an average effectiveness of virtual teaching. It appears that different virtual education models may have an impact on dental students' satisfaction.Because this study only examined student satisfaction with the effectiveness of virtual instruction at the first level of the Kirkpatrick pyramid (reaction), it is suggested that research on this topic be conducted in the coming years to evaluate the effectiveness of virtual instruction among these students at the higher levels of the Kirkpatrick pyramid (learning and behavior).

Conclusion

The educational system at Babol University of Medical Sciences, like many other institutions worldwide, was caught off guard by the sudden need for virtual education due to the COVID-19 pandemic. This study was conducted after only one semester of implementing virtual education, and the results could change if the study were conducted later.Several factors influenced these changing results, including improvement of the virtual education management system, empowerment of professors, introduction to e-content creation software, and increased direct oversight of educational activities related to e-education and assessment. Although students were only moderately satisfied with the effectiveness of virtual education, the findings of this study can serve as a guide to improve e-learning resources and better prepare students for virtual learning. With the increasing number of college admissions each year and the growing need for e-learning and the integration of artificial intelligence into education, it is crucial to rethink educational programs and conduct further research in this area.

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Conflicts of Interest

There is no conflict of interest to declare.

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Author's Contribution

Maryam Ghaemi-Amiri introduced the topic of the article, designed the research protocol, and wrote the article; Saber Zarbjani implemented the research protocol, Hemmat Gholinia performed the statistical analysis, and Mohammad Mehdi Naghibi Sistani reviewed and edited the article.

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