Original Article

Evaluation of online education of medical students during the covid-19 pandemic: A case study in northern Iran

Aram Ghanavatizadeh [1], Ghahraman Mahmoudi [2*], Mohammad-Ali Jahani [3]

[1] Ms.c. Student of Medical & Health Services Administration, Sari Branch, Islamic Azad University, Sari, Iran
[2] Associate professor of Hospital Administration Research Center, Sari Branch, Islamic Azad University, Sari, Iran
[3] Associate Professor of Social Determinants of Health Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, Iran

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***Corresponding author:**
Ghahraman Mahmoudi, Associate professor of Hospital Administration Research Center, Sari Branch, Islamic Azad University, Sari, Iran
Email: Ghahraman48@yahoo.com

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Abstract

Background & Objective: The COVID-19 pandemic has made universities of medical sciences face serious challenges as they are responsible for the preparation of the next generation of healthcare workers. The present study aimed to evaluate the online education of medical students during the COVID-19 pandemic, in Mazandaran province, Iran.

Materials & Methods: This descriptive and analytical research was carried out from April 2022 to January 2023 in the universities of medical sciences in the Mazandaran province (Mazandaran University of Medical Sciences, Babol University of Medical Sciences, and Faculty of Medical Sciences of Islamic Azad University, Sari Branch). The participants were selected using the stratified random sampling method, and the sample size was calculated at 507 students. The required data was collected using a questionnaire and analyzed in SPSS software (version 21). It should be mentioned that a p-value of less than 0.05 was considered statistically significant.

Results: The mean age of the students was 21.47 ± 2.34 years, with an age range of 18-43 years. Their mean scores in the dimensions of research, namely interacting, teaching, and learning, were 34.54±8.23, 53.93±10.15, and 33.8±8.01, respectively. The undergraduate students on average acquired 3.72, 1.25, and 1.00 more units of score in the three dimensions of interacting, teaching, and learning, respectively; however, this difference was only significant for the interaction dimension (P<0.001). The results showed that among the variables, the year of study and the level of education had a relationship with the total score (P<0.05) and were identified as independent and strong predictor variables for online education.

Conclusion: Online education during the COVID-19 pandemic could become a suitable alternative to the traditional method of medical education. The most important factors that affect the quality of online education have been identified. Therefore, educational policymakers provide the required plans by considering the effective factors and attempt to improve the quality of online education by providing the necessary conditions and facilities.

Keywords: Active Learning, COVID-19 Pandemic, Feedback, Online Education

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Introduction

The COVID-19 pandemic has created fundamental challenges in all sectors of society; its consequences will be with us for a long time (1). The COVID-19 pandemic has affected the activities of universities and educational institutions. Accordingly, universities of medical sciences are facing more serious challenges as they are responsible for the preparation of the next generation of healthcare workers (2). Although medical education is mainly practice-based, COVID-19 has forced medical students around the world to continue their education online (3).

Therefore, professors need to adopt new teaching methods to communicate with their students. They

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should try to make the shift from the physical classroom learning environment to the virtual learning environment easy for the students and provide real-time visualization and interaction in the virtual classroom (4). Virtual learning can activate interactive learning experiences, as it can involve the learners in the learning process by dynamically reacting to their movements and behavior. Because of the continuous development of technical equipment and common learning methods, such as textbooks, digital media can be increasingly used in education (5).

Distance e-learning in medicine can be a suitable alternative to traditional education and provide high-quality education. The availability of necessary infrastructure and efficient organizational strategies are the major challenge to integrating distance education in medical education (6). Distance education can be both challenging and motivating. Professors have developed innovative strategies to improve student learning and engage students in real-time and non-real-time classes (7). Digital learning and teaching opportunities in medical education are currently very heterogeneous. Formats of classes range from mere lecture recordings to specially designed e-learning tools and are used on a variety of platforms. Digital courses can achieve the same or even better learning opportunities (8).The advantages of online education include the variety of web-based resources and free access of students to medical experts that allow them to stay abreast of the latest medical advances. The disadvantages of online education are technical challenges, confidentiality issues, less student interaction, and loss of evaluations (9).

Student-student communication and collaboration provide opportunities for them to share experiences, resources, and ideas and engage in learning as a community (10). According to a study performed by Winkler-Prins et al. (2007), the online classroom should be facilitated in a way that helps the students avoid feelings of isolation and loneliness (11). Interaction can be facilitated through the use of particularly written discussions and the use of audio and video responses from the student (12). These tools can promote communication with course content and other colleagues (13).

According to Berge (2002), teamwork is recommended instead of individual activities to prevent isolation and encourage critical thinking and the application of lesson content. Learning is enhanced when it is more like a team effort rather than an individual competition (14). Good learning, like good work, is collaborative and social, not competitive and isolated (15).

High performance expectations, respect for diverse learning preferences, active learning techniques, and adequate time on task are essential for student engagement in the classroom. According to Johnson (2014), high expectations are important for all students, from the unmotivated and unprepared to the high performers (15). Professors must explain the curriculum and the course to the students in such a way that the expectations, goals, and objectives of the class are clearly outlined and then hold the students to those standards (16).

Mottaghi et al. (2020) conducted a study in Tehran, Iran entitled “Comparison of the Effects of Virtual and Real Education Models for Learning Internal Interactions during the Outbreak of COVID-19”. They found one advantage of virtual education is the active participation of all students in clinical reasoning skills (17).

José M. Ramírez-Hurtado et al. (2021) conducted a study in Spain that showed the general dissatisfaction of students with various features of online education (18). In another research conducted by Khalili in America (2020), it was found that online education is becoming a new norm in the university, while this development can cause problems for some since some professors lack the knowledge and expertise to create an interesting, positive, and supportive online environment for students (19).

Schlenz et al. in Germany (2020) conducted a study and found that students and professors had a positive attitude toward implementing online learning, which can provide an opportunity to use online learning in the program even after COVID-19 (20). In a study performed by Hofmann et al. (2020), 92.9% of medical students agreed with online education methods (21).

Students are valuable human resources and the builders of the future of the country; therefore, their academic success is one of the essential goals of educational programs (22). The current technological progress in hardware and software and the ability to access the Internet provides the possibility of extensive usage of technology, compared to a few years ago (23). Besides, following the COVID-19 pandemic, the need to change traditional teaching methods became inevitable (17).

It is necessary to further examine the conditions of students and universities during these times. It should be noted that if educational centers are not equipped

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with e-learning, they will be confused during a lot of educational, social, political, psychological, and religious data. Given the importance of the academic success of students, the need for optimal academic performance, and the lack of research in this field, the present study seems to be necessary. This research aimed to investigate the effects of online education on medical science students during the COVID-19 pandemic in northern Iran.

Materials & Methods

Design and setting(s)

This applied research was carried out based on a descriptive and analytical method from April 2022 to January 2023 in the universities of medical sciences in Mazandaran province, Iran (Mazandaran University of Medical Sciences, Babol University of Medical Sciences, and Faculty of Medical Sciences of Islamic Azad University, Sari Branch).

Participants and sampling

The statistical population included 13,500 students of private and public universities of medical sciences in Mazandaran province. In multivariable regression analysis, the ratio of the number of samples (observations) to the independent variables should not be less than 5, otherwise, the results of the regression equation will not be generalizable. Therefore, a more conservative ratio of 10 observations per independent variable has been proposed by Halinsky and Floret in 1970 (24) and Miller and Kans in 1973 (25).

From the viewpoint of James Stevens, even considering 15 observations for each predictor variable in multiple regression analysis with the common least squares method is considered a good rule of thumb. Hence, to determine the sample size, 5-15 observations can be determined for each measured variable (26). Therefore, according to the number of items in the questionnaire, which is 40, the sample size should be between 200 and 600 participants. In this research, we considered the sample size between 12 and 13 times the number of items of the questionnaire, which is 480 to 520 participants.

In this study, 507 students were selected using the stratified random sampling method. 194, 225, and 88 participants were selected from the Babol University of Medical Sciences, Mazandaran University of Medical Sciences, and the Faculty of Medical Sciences of Islamic Azad University, Sari Branch. The inclusion criteria were willingness to participate in the research, being a student of medical sciences in Mazandaran province, and experience with online education. The exclusion criteria were being a student of technical engineering and humanities in Mazandaran province, and being a university professor in Mazandaran province.

Tools/Instruments & Data collection methods

In this research, first, the library study method was used to collect data regarding the theoretical foundations and compile the literature review and operational definitions. This method included the study of books, articles, publications, theses, and scientific resources available in universities and scientific centers. Field research and standard questionnaires were used to answer the research questions.

For this study, the data collection tool was a questionnaire that was used for the first time in Turkey by Çakýroglu ÜJSAJoE in 2014, which includes seven components and three main dimensions (namely, the amounts of interaction between students and the professor, cooperation between students, time spent on activities and assignments, feedback, active learning, high expectations of professors, and diverse talents and learning methods).

The psychometrics of the English version of this questionnaire were performed by Çakýroglu ÜJSAJoE, so that, among the 69 results obtained, 40 items remained in this questionnaire and were allocated in seven sections according to seven principles. The reliability was evaluated using Cronbach's alpha method. For this purpose, initially, a test was conducted on 71 pre-service teachers. To determine the internal consistency, the alpha level was calculated for each subsection ($\alpha1=0.87$, $\alpha2=0.83$, $\alpha3=0.79$, $\alpha4=0.84$, $\alpha5=0.76$, $\alpha6=0.78$, and $\alpha7=0.92$) (27).

At the first stage of the present research, the English version of the questionnaire, introduced by Çakýroglu, was examined using the back translation method (2014) (27). The questionnaire was translated using the following three steps. In the first step, two translators with experience in the desired field translated the English version into Farsi. It should be mentioned that the questionnaire was translated using the free translation method instead of the literal method. Clarity, simplicity, and brevity of the translation, the type of audience, and their age and cultural conditions were considered by the translators.

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In the second step, two translators fluent in English, who were not aware of the content of the questionnaire, translated it into English. In these two steps, the semantic similarity was important for the researchers and was taken into consideration. Finally, in the third stage, a team of experts (expert panel) in both languages had a meeting with the researchers and checked the quality of the translations. In case of inconsistency between the translations, they suggested alternative words.

Face validity of the questionnaire was evaluated using the cognitive interview method developed by Çakýroglu (2014). The questionnaire was provided to 20 eligible students (10 male and 10 female) and several related experts. Afterward, they were asked for their feedback about the clarity, readability, writing style, easy understanding, level of difficulty of the items, confusing words, comprehensibility, lack of fitness, and ambiguity of the questionnaire. Subsequently, the questionnaire was revised based on the received feedback. Regarding reliability, internal consistency was evaluated with Cronbach's alpha as an index for the evaluation of the internal consistency of the whole questionnaire and each scale, and values above 0.7 were satisfactory (28). It should be mentioned that, for exploratory studies, values greater than 0.6 are acceptable.

In addition, the interclass reliability assessment was carried out using the test-retest method, based on the data collected from 30 eligible students in two steps, with a time interval of 1 month. Afterward, the scores obtained in these two steps were evaluated using the interclass correlation coefficient. The score ranges from 0.4 - 0.59, 0.6 - 0.74, and >0.74 were acceptable, good, and excellent, respectively (29).

Data collection methods

Students who will complete the questionnaire and participate in the study were included; however, in case of failure to complete the questionnaire, they were excluded from the study. After the proposal was approved and the code of ethics was obtained from the Islamic Azad University, Sari Branch, Iran, the questionnaire was distributed among the participants.

Data analysis

The results were collected, coded, and entered SPSS software (version 21). The descriptive statistics for quantitative variables were reported using the mean and standard deviation with the assumption of normality. Frequency and percentage were reported for qualitative variables. Besides, regarding the analytical statistics, independent samples t-test was used to compare the equality of two mean values between qualitative variables with the assumption of the equality of variances. In addition, the one-way analysis of variance (ANOVA) test was used to compare the mean values of variables with over two categories of qualitative variables. Univariate and multivariate linear regression analyses were employed to examine the main variables with the presence of all variables in the study. In addition, multivariate analysis was used to control the confounding variables. It must be mentioned that p-values of less than 0.05 were considered statistically significant.

Results

This study was performed on 507 students with a mean age of 21.47 ± 2.34 and an age range of 18 - 43 years. Most them were female (62.9%, n = 319), 21 years old (34.3%, n = 174), and undergraduate students (55.0%, n = 279). Based on the descriptive statistics of the scores of axes and dimensions of the questionnaire, the mean value of the total score was 122.28±23.96. Regarding the three dimensions, interacting and teaching received the lowest (57.56) and highest scores (63.44), respectively (figures 1 and 2).

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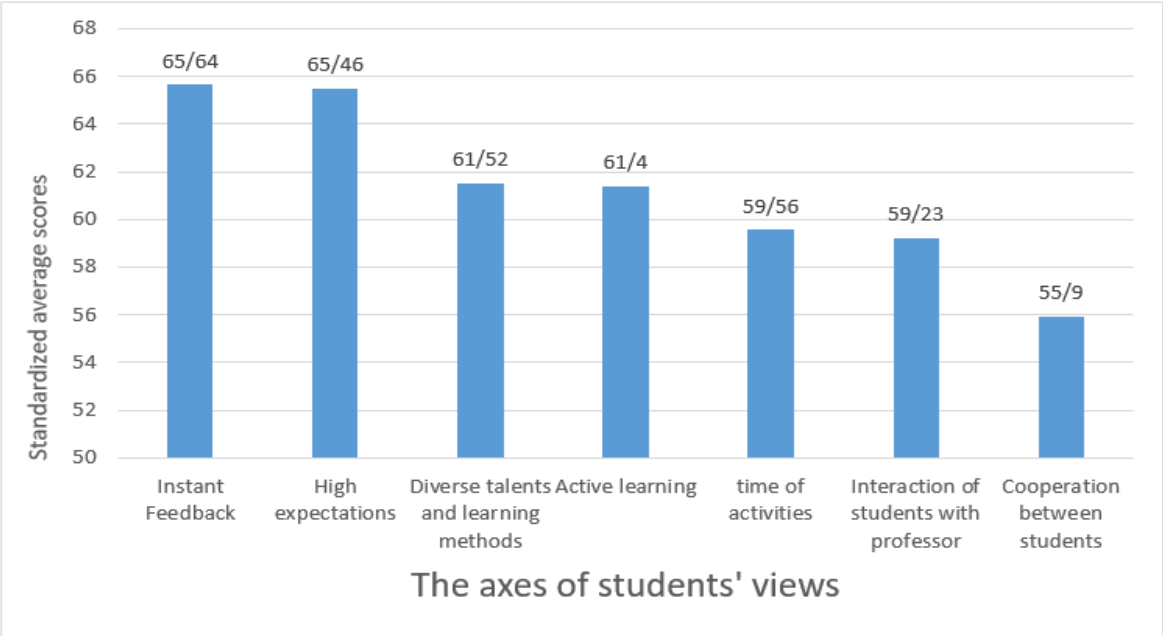

Figure 1. Comparison of the mean scores of the attitudes of students towards online education according to the amount of axes based on the standard scale of 0-100

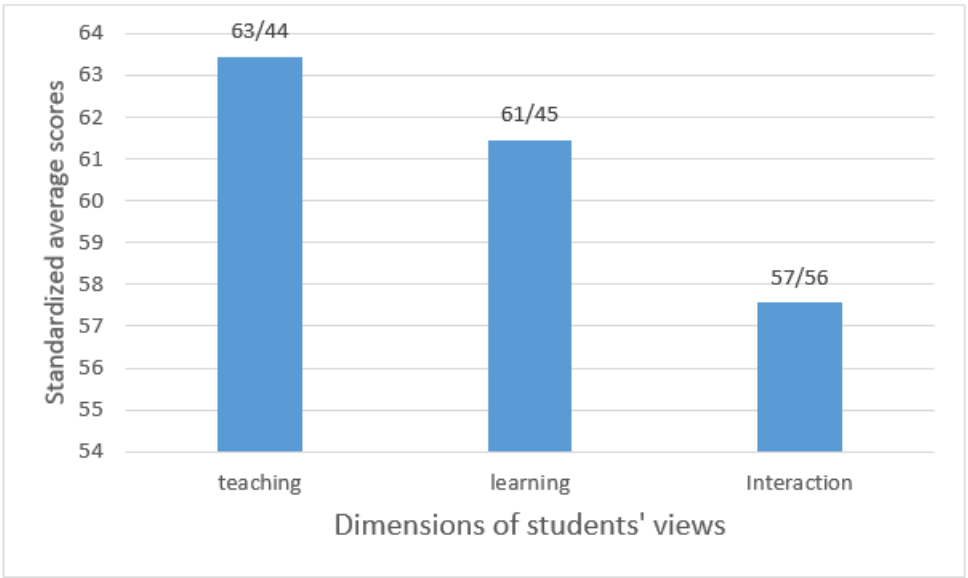

Figure 2. Comparison of the mean scores of the attitudes of students towards online education according to the amount of dimensions based on the standard scale of 0-100

Regarding the relationship of gender with the axes and dimensions of the questionnaire, results of the independent t-test showed that the mean total scores of the questionnaire in male and female students were 123.70 ± 23.71 and 121.44 ± 24.11, respectively. It is noteworthy that the scores of males were 2.25 units higher than those of females; however, this difference was not statistically significant (P = 0.306).

On average, the scores of male participants were 0.32, 0.74, and 1.19 units higher in the three dimensions of interacting, teaching, and learning, respectively; none of the differences were statistically significant (P=0.104, 0.428, and 0.673, respectively). Males acquired higher scores on all the axes, except the axis of cooperation between students. This difference between the scores of males and females was statistically significant only in the axes of diverse talents and learning methods (P=0.019) (Table 1)

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Table 1. Examination of the relationship between gender and dimensions of the questionnaire of the attitudes of students toward online education during the COVID-19 pandemic

	Axes and dimensions	Gender		MD*	t	p-value**
		Man 188(37.1%)	Woman 319(62.9%)			
Axis	Student-teacher interaction	17.99±5.43	17.63±5.19	0.35	0.73	0.467
	Cooperation between students	16.75±3.65	16.79±3.88	-0.03	-0.09	0.921
	Time Of Activities	18.08±4.14	17.75±4.21	0.32	0.85	0.393
	Instant Feedback	16.46±3.28	16.37±3.32	0.09	0.30	0.763
	High expectations	19.84±4.24	19.37±4.50	0.31	0.78	0.432
	Active learning	18.61±4.51	18.31±4.44	0.30	0.74	0.456
	Diverse talents and ways of learning	15.94±3.96	15.05±4.18	0.89	2.36	0.019
Dimensions	Interaction	34.75±8.22	34.42±8.25	0.32	0.42	0.673
	Teaching	54.39±10.01	53.65±10.23	0.74	0.79	0.428
	Learning	34.55±7.85	33.36±80.08	1.19	1.62	0.104
	total score	123.7±23.71	121.44±24.11	2.25	1.02	0.306

*MD=Mean Difference, the mean difference between men and women
**Independent-Sample Ttest, significance level P<0.05.

Regarding the relationship of the educational level with the axes and dimensions of the questionnaire, the mean total scores of the questionnaire for undergraduate and doctoral students were 124.97 ± 23.76 and 118.99 ± 23.85, respectively. Scores of undergraduate students, on average, were 5.98 units higher than those of the general doctoral students. It must be mentioned that this difference was statistically significant (P = 0.005).

The scores of undergraduate students on average were 3.72, 1.25, and 1.00 units higher than those of the general doctoral students in the three dimensions of interacting, teaching, and learning, respectively; however, these differences were only statistically significant for the interacting dimension (P < 0.001). Regarding the axes, undergraduate students achieved higher scores in all seven axes, and this difference was statistically significant for the axes of student-teacher interaction, cooperation between students, and activity time (P < 0.05) (Table 2).

Based on the results of the ANOVA test, the year of study of the student had a relationship with the total score, axes, and dimensions of the questionnaire. Students in the second year of study obtained the highest total score of the questionnaire (133.35 ± 16.94), followed by students in the third, first, and fourth year of study with scores of 118.29 ± 23.66, 117.99 ± 24.42, and 109.15±31.48, respectively (P<0.001). Second-year students achieved the highest scores on all axes and dimensions, compared to others (P < 0.001) (Table 3)

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Table 2. Relationship between the level of education and the dimensions of the questionnaire of the attitudes of students toward online education during the COVID-19 pandemic

	Axes and dimensions	Grade		MD*	t	p-value**
		Bachelor 279(55%)	Postgraduate education and general doctorate 228(45%)			
Axis	Student-teacher interaction	18.77±5.29	16.54±5.01	2.22	4.81	< 0.001
	Cooperation between students	17.45±3.78	15.95±3.65	1.49	4.50	< 0.001
	Time of activities	18.21±4.24	17.46±4.08	0.74	1.99	0.047
	Instant Feedback	16.53±3.32	16.25±3.28	0.28	0.96	0.338
	High expectations	19.74±4.24	19.51±4.36	0.23	0.58	0.557
	Active learning	18.66±4.16	18.12±4.81	0.53	1.35	0.177
	Diverse talents and ways of learning	15.59±4.05	15.12±4.20	0.46	1.27	0.204
Dimensions	Interaction	36.22±8.23	32.5±7.78	3.72	5.19	< 0.001
	Teaching	54.49±10.25	53.24±10.01	1.25	1.38	0.166
	Learning	34.25±7.61	33.25±80.46	1.00	1.41	0.164
	total score	124.97±23.76	118.99±23.85	5.98	2.81	0.005

*MD=Mean Difference, the mean difference between men and women
**Independent-Sample Ttest, significance level P<0.05.

Table 3. Relationship between the academic year and the dimensions of the questionnaire of the attitudes of students towards online education during the COVID-19 pandemic

	Axes and dimensions	Grade				f	p-value**
		first year 113(22.3%)	second year 161(31.8%)	third year 193(38.1%)	Fourth year and Above 40(7.9%)		
Axis	Student-teacher interaction	16.43±5.34	20.65±3.73	16.54±5.35	15.82±5.57	27.37	< 0.001
	Cooperation between students	16.05±4.01	18.19±2.96	16.46±3.81	14.60±4.21	14.83	< 0.001
	time of activities	17.89±3.98	18.88±3.16	17.38±4.62	16.15±5.19	6.48	< 0.001
	Instant Feedback	15.99±3.13	17.56±3.05	15.97±3.20	15.05±3.95	11.17	< 0.001
	High expectations	18.91±4.34	21.33±3.67	19.03±4.36	17.87±5.51	13.21	< 0.001
	Active learning	18.11±4.58	19.68±3.64	17.93±4.65	16.55±5.12	7.89	< 0.001
	Diverse talents and ways of learning	14.59±4.31	17.01±2.94	14.94±4.18	13.10±5.12	15.90	< 0.001
Dimensions	Interaction	32.48±8.64	38.85±5.67	33.01±8.20	30.42±9.16	25.96	< 0.001
	Teaching	52.79±9.93	87.78±7.85	52.38±10.18	49.07±13.74	13.71	< 0.001
	Learning	32.7±8.18	36.7±5.86	32.88±8.34	29.65±9.85	13.04	< 0.001
	Total Score	117.99±24.42	133.35±16.94	118.29±23.66	109.15±31.48	20.58	< 0.001

**The test used is ANOVA (one way ANOVA), significance level is P<0.05.

Based on the results of the linear regression test in a separate examination of the relationship between the total score of the questionnaire and four variables of the demographic characteristics of the students in the study, the variable of the year of study and degree level was associated with the total score. The addition of one year to the year of study and the Bachelor's Degree led to a crease in the total score of the questionnaire by an average of 3.21 and 5.98 units, respectively (P < 0.05). Results of the multivariate regression analysis, regarding the simultaneous relationship of four variables in the model with the total score of the questionnaire, showed that among these variables, the year of study and the degree level are associated with

the total score. On average, the addition of one year to the year of study and also the change in the degree level from Bachelor's degree to Doctorate led to a decrease of 2.62 and 5.11 units in the total score of the questionnaire (P<0.05). Therefore, the variables of the year of study and degree level were identified as independent and strong predictive variables in the model for the total score of the questionnaire on the attitudes of students toward online education (Table 4).

Table 4. Correlation between the total score of the questionnaire of the attitudes of students towards online education during the COVID-19 pandemic and the characteristics of students based on univariate and multivariate regression analysis

Variables	Univariate Analysis (raw effects)			Multivariate Analysis (adjusted effects)		
	B(SE)*	%95 CI**	P-value***	B(SE)*	%95 CI**	P-value***
Age (Years)	0.77(0.45)	-0.12 to 1.66	0.090	1.05(0.45)	0.15 to 1.95	0.021
Academic year	-3.21(1.16)	-5.51 to -0.92	0.006	-2.62(1.27)	-5.31 to -0.12	0.040
gender(man/woman)	-2.25(2.20)	-6.58 to 2.07	0.306	-3.02 (2.21)	-7.37 to 1.32	0.173
Education (Bachelor's Degree/General Medicine)	-5.98 (2.12)	-10.16 to -1.81	0.005	-5.11(2.32)	-9.66 to -0.55	0.028

*B regression slope - CI=Confidence Interval
** confidence interval.
*** Significance level: P>0.05- The test used is linear regression

Discussion

This study aimed to evaluate online education during the COVID-19 pandemic among medical students in the north of Iran. Based on the results, medical students considered the dimension of interaction as the challenge of online education. From the examined axes, the axis of immediate feedback was considered being the advantage of online education, while the interaction of students with professors was considered a challenge.

In Turkey, in 2014, a study was conducted by Çakýroglu in this field and the results showed that from a constructivist perspective, interaction is important for both instructors and students. Therefore, to facilitate supportive and corrective feedback, instructors should prepare a strictly interactive design. In the aforementioned study, the views related to learning were very satisfactory, while the sub-section of active learning, diverse talents and methods, was evaluated as satisfactory. Therefore, the teaching dimension of the questionnaire was very satisfactory, followed by the interaction dimension, which was evaluated as satisfactory. It is noteworthy that cooperation among students was evaluated as satisfactory, as the lowest level of evaluation (27).

Based on the results of the present study, the axis of immediate feedback from professors to students got the highest score (65.64) followed by high expectations (65.46). The lowest score was given to the axis of cooperation between students (55.9). As medical curricula are increasingly including online learning in the post-pandemic era, and the digital transition is becoming rapid, educators should constantly seek student feedback (30). Desirable feedback and assessment refer to the timing of responses, such as the return of test scores and email responses. The syllabus should also be provided for the students and used for all assessments in class.

Based on the findings of a study conducted by Cynthia Janet Tanis in the United States in 2020, 75% of professors and 63% of students stated it is important for students to be informed about the scores of their tests and assignments. In addition, in the aforementioned study, 75% of professors and 59% of graduates stated it is important for the professors to provide constructive written or audio comments besides grades (31). Lee (2014) carried out a study on online education and confirmed this finding since 95% of students agreed or strongly agreed that timely and constructive feedback from the professor is important to them (32).

Gallien and Oomen-Early (2008) also stated that the overall satisfaction of students in the class is related to the immediate feedback from professors (33). Magnussen (2008) recommended that faculty members set boundaries to maintain a manageable workload and determine the feedback waiting time (34). In the aforementioned study, among the three dimensions of interacting, teaching, and learning, teaching got the highest score (63.44) followed by learning (64.45), while interaction received the lowest score (57.56).

In their study, Craig (2015) found that faculty should provide academic freedom for the interaction and

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education of students using both real-time and non-real-time tools. Without this opportunity, the online class is merely a repository of information with repetitive lectures, assignments, and boring discussions (35). The results of the present study showed that students need to use other online tools, such as blogs and social networks. One caveat is that online sessions require a fast internet connection with sufficient capacity. Therefore, remote areas with reduced technological infrastructure will be disproportionately affected (36). A study conducted by Al-Balas in Jordan in 2020 aimed to evaluate the experiences of clinical medical students in terms of computer-mediated distance e-learning. Results of the aforementioned research revealed that implementing distance e-learning in medical education is challenging, especially in countries with a lower average income. Obstacles to the adoption of distance e-learning can be divided into three major categories: 1) technological/infrastructure barriers, 2) organizational/educational barriers, and 3) student barriers (6).

A study was conducted by Jiang Z in China in 2021 regarding online dental teaching methods during the COVID-19 pandemic. Based on the findings of the above study, online dental teaching provided an alternative teaching method for dental education; the COVID-19 pandemic caused challenges and created an opportunity for the development of online education technology (19).

However, in the aforementioned study, it was found that in online education, professors cannot create learning environments based on different learning styles, and they also do not use different educational materials effectively.

Modern learning materials, interactive media, information technology, and new tools can provide a better learning ecosystem (20). Based on the findings of a study conducted by Cynthia Janet Tanis in America in 2020, respecting learning priorities also includes proper orientation and technical support for faculty and students to help them work easily and without obstacles. The results of the aforementioned research showed that 58% of faculty members and 43% of students considered this important for their teaching and learning, respectively. One respondent emphasized it is very important for students and professors to easily navigate the technology; otherwise, online education will be negatively affected (31).

Findings of the above study indicated that it is not possible for students to work effectively in groups and also professors cannot provide group activities. It was found that technical problems have a negative effect on the time management of students.

In the study conducted by Cynthia Janet Tanis in America in 2020, it was found that fast interaction and communication among peers were beneficial for online learning, while isolation and lack of communication were harmful. However, teamwork was not the preferred method of learning. Students considered delayed responses and limited work from their classmates as harmful to their learning and preferred to work at their own pace (31). Although Berge (2002) recommended teamwork to prevent isolation, it is important to engage students in active learning and its practices. It promotes team dynamics and prevents isolated learning (14). In the aforementioned research, it was found that the professors use different methods to evaluate the students and also adjust the course program and schedule correctly.

Rossettini in Italy investigated the effects of online education on student satisfaction and performance in physiotherapy during the COVID-19 pandemic in a retrospective case-control study. According to the main findings of the aforementioned study, entry level physiotherapy stated that: 1) there is no difference in their satisfaction whether they attend the course in person or online, and 2) they had higher performance in online courses, compared to in-person courses. The study seems to support these findings, as in this online course, students are satisfied with face-to-face. These findings are related to the fact that the content of the course, the instructor, and the type of final exam have been the same throughout the years (39).

The results of the above study showed that in online education, students have enough time to do their homework, and professors encourage students to express their opinions, which increases their motivation. Moreover, the students can use the audio files of the sessions they miss, and also revise the uploaded assignments after the review by the professors.

However, there is a gap in the literature regarding the evaluation of the success of online quality improvement training. The purpose of the aforementioned review was to focus on the effectiveness of online quality improvement training and educational interventions to provide recommendations for adapting quality improvement training content to e-learning. This review showed that distance learning approaches for quality

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improvement help to overcome the obstacles of traditional quality improvement education, such as the lack of trained professors and deficiencies in the organizational structure to support quality improvement education (40).

In addition, many participants in that study preferred hybrid approaches to traditional approaches (41). The above review highlighted important lessons for future programs, including balancing virtual and non-virtual methods, improving technology, and providing special resources and support for learners (42). Similar to other quality improvement programs, distance learning quality improvement training also requires significant organizational commitment and cooperation among participants, professors, and leaders for success (43). At this historical turning point, medical educators should use what they have learned from the experience of this pandemic to foster positive educational changes in the future (44).

Research limitations

This research was limited in terms of location to Mazandaran province and in terms of time to the year 2022-2023. The data collection tool was limited to a questionnaire; therefore, the biases in the answers to the questionnaire and the lack of control of the variables could distort the results. In addition, this study was limited to students of medical sciences universities and students of medical departments. Besides, the evaluation was limited to the opinions of the students and not those of the professor; hence, it was necessary to be careful in generalizing the results.

Conclusion

Online education during the COVID-19 pandemic could be a suitable alternative to the traditional method of medical education. Given the identification of the most important factors affecting the quality of online education and also regarding the shift from the traditional teaching approach to online or combined teaching methods, policymakers in education consider these factors in their planning. They should pay special attention to the conditions and facilities necessary to improve the quality of online education to ultimately increase the quality of active learning in medical students.

Ethical considerations

Ethical approval and consent for study participation were obtained after the code of ethics (IR.IAU.SARI.REC.1401.061) was received from Islamic Azad University. Informed consent was obtained from all study participants.

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Conflicts of interest

The authors declare that they have no conflict of interest.

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Data availability

The authors have full control over the primary data. The data analyzed in this study are in Iran, Mazandaran, Sari, 7 km of Sea Road, Islamic Azad University, Sari Branch. According to the approval of the Ethics Committee, this dataset is subject to ethical restrictions and local data protection regulations regarding raw data. However, despite the approval of the study by the Ethics Committee in research, all the legal and professional responsibilities of project implementation are attributed to the senior executive and colleagues. All the data related to the conclusions are presented in the manuscript.

Authors' contributions

A.GH., MA.J., and M.GH. were the principal investigators who designed the study. A.GH. searched the literature. MA.J. and GH.M. supported the development of the study. A.GH. collected the data and prepared the data for analysis. GH.M. and MA.J. supervised the data collection. A.GH. drafted the manuscript and GH.M. and MA.J. supported the draft of the manuscript. All authors provided critical comments and revisions to the manuscript, and also read and approved the final manuscript.

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