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Original Article

Lessons Learned from Assessing the Quality of Virtual Learning during the COVID-19 Pandemic: Students' Perspectives from Zahedan University of Medical Sciences

Leila Safabakhsh[1], Mohammad Javad Afsharpour[2], Javid Dehghan Haghighi[3], Afsaneh Karimi[4*]

[1]*Educational Development Center, Zahedan University of Medical Sciences, Zahedan, Iran*
[2]*School of Medicine, Zahedan University of Medical Sciences, Zahedan, Iran*
[3]*Department of Community Medicine, School of Medicine, Zahedan University of Medical Sciences, Zahedan, Iran*
[4]*Pregnancy Health Research Center, Zahedan University of Medical Sciences, Zahedan, Iran*

ABSTRACT

Background: The COVID-19 pandemic has led to unprecedented experiences across all facets of life, profoundly affecting medical education and the methodologies employed in teaching and learning. This global health crisis has necessitated significant adaptations within educational frameworks, fundamentally altering how medical training is delivered. The present study aimed to investigate the status of virtual learning from the perspective of students at Zahedan University of Medical Sciences (ZAUMS), Iran.

Methods: In this cross-sectional study, 390 students' perspectives from five faculties of ZAUMS, were selected using a stratified sampling method from January to February 2023. A 51-item researcher-developed questionnaire with six subscales of teaching method (9 items), professors' interaction (5 items), evaluation (20 items), content delivery (6 items), students' participation (3 items), and infrastructure (8 items) was used to collect the data. Responses were rated using a 5-point Likert scale. Experts confirmed the validity, and its reliability was estimated using Cronbach's alpha (0.86). Mann-Whitney, Kruskal-Wallis, and Spearman correlation were used to analyze the data in SPSS 22.

Results: The response rate in the study was 92%. The total mean score of the students' perspective was 3.17±0.43. The mean scores across the six evaluated domains were as follows: teaching methods scored 3.03±0.58, professors' interaction 3.35±0.65, evaluation 3.18±0.43, content delivery 3.22±0.57, students' participation 2.91±0.69, infrastructure 3.34±0.50. The highest and lowest average scores were related to professors' interaction and students' participation, respectively. A significant relationship was only found between students' views and gender (t=2.85, P=0.004).

Conclusion: Students typically regarded virtual learning as quite favorable. However, there is potential to enhance the quality of virtual education, particularly in terms of student engagement. This improvement can be facilitated by incorporating discussion forums and chat rooms, assigning group tasks, developing collaborative projects, and fostering a more engaging learning atmosphere through the use of gamification and simulations.

Keywords: Learning, Education, Distance, Digital Technology, Educational Measurement, Students, Medical

**Corresponding author:*
Afsaneh Karimi,
Pregnancy Health Research Center, Zahedan University of Medical Sciences, Zahedan, Iran
Tel: +98 9132703876
Email: afsanehkarimi2014@gmail.com

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Introduction

The advancement of modern technologies has profoundly influenced various facets of life, particularly in the realms of education and learning (1). In contemporary society, there is a pressing demand for flexibility, dynamism, and creativity, necessitating an education system that adequately addresses these requirements by fostering opportunities for innovation, interaction, and reflection. This includes engaging with complex global challenges through effective problem-solving strategies (1, 2). The emergence of the digital technology era has catalyzed significant transformations within educational frameworks, prompting the need to reassess traditional pedagogical approaches and implement more modern, active learning methodologies as recognized by educational planners (3, 4).

The COVID-19 pandemic significantly affected medical education, prompting many institutions to temporarily halt their programs, particularly in clinical training (5). In response to the shortage of healthcare professionals during this crisis, medical education institutions rapidly adopted e-learning methodologies (6). This shift has led to e-learning becoming an integral component of health science education (7). The rising demand for virtual learning options has resulted in a substantial increase in course offerings at higher education institutions (8). The dual challenges of expanding applicant numbers and advancing digital technologies have fostered a new perspective on educational practices, precisely the embrace of virtual learning. Cross was a pioneer in introducing virtual learning, defining it as the use of digital technologies for educational purposes (9). Kerimbayev emphasizes that virtual training enhances educational quality and allows for personalized learning experiences (10). Nevertheless, various studies have identified several drawbacks associated with virtual education, including technological barriers, suboptimal design, high costs, insufficient technological skills among users, and privacy concerns (7, 11, 12).

The evaluation and assurance of quality in virtual learning programs are critical components of e-learning. A comprehensive assessment from various perspectives is essential for improving quality. Evaluating the success rates of these systems is crucial for determining their effectiveness (13, 14). Identifying practical indicators for assessing e-learning is essential for course evaluation (15). Safdari and colleagues (2021) identified eight key elements of virtual teaching and learning activities, including flexibility, educational content, feedback, interaction, user support, workload, and the virtual learning system, which they considered vital for improving the quality of online education (16). Zhalehjoo and colleagues (2021) investigated students' perspectives across four areas: lesson introduction, educational content, feedback and interaction, and assessment and evaluation (14).

The attitudes of both students and instructors are critical to the success of e-learning (17). Consequently, understanding students' perspectives on the increasingly prevalent virtual learning systems can significantly enhance the development of these educational frameworks and address their limitations. The absence of research examining students' perspectives regarding virtual learning at Zahedan University of Medical Sciences (ZAUMS), Zahedan, Iran, prompted the initiation of this study, which aimed to address the following questions:

1. What was the status of virtual learning from the perspective of students at ZAUMS?

2. Was there any relationship between students' perspectives and demographic characteristics?

The findings of this study hold significant potential to enhance the strengths, mitigate the weaknesses, and improve the overall quality of virtual learning. Additionally, the study provides pertinent insights for educational administrators and policymakers to formulate effective strategies and policies in this domain.

Methods

Study Design and Setting

This cross-sectional study was conducted

among the students of ZAUMS over two months, from January to February 2023. The study aimed to investigate the status of virtual learning as perceived by students across five faculties.

Participants and Sampling

The study involved approximately 4,300 students from ZAUMS enrolled in the faculties of medicine, dentistry, nursing, midwifery, health, paramedicine, and rehabilitation. Based on Cochran's formula and the stratified sampling method, the estimated sample size was 355. In applying Cochran's formula, the population number (N) was set at 4,300, with parameters set as p and q equal to 0.5, Z at 1.96, and d at 0.05. Considering the possibility of sample attrition and nonresponse in survey-based research (estimated at 10%), the researchers distributed the questionnaire to 390 students. Ultimately, 360 students completed and returned the questionnaires.

$$n = \frac{\frac{Z^2 pq}{d^2}}{1 + \frac{1}{N}(\frac{Z^2 pq}{d^2} - 1)}$$

To be eligible for inclusion in the study, participants were required to have a minimum of one semester of experience with online courses delivered through a Learning Management System (LMS) and to show a willingness to participate in the research. Conversely, individuals were excluded if they were guest students from another medical sciences university or if they did not respond to more than 20 percent of the survey questions.

Tools/Instruments

The data collection tool was a researcher-made questionnaire designed based on a comprehensive literature review (14, 16, 18-20) to evaluate participants' perceptions of virtual learning. The questionnaire was structured into three distinct sections. The first section contained six questions aimed at gathering demographic data from the students, including gender, marital status, place of residence, residential status, level of education, and college affiliation. The second section comprised three questions that explored the methods students employed to engage in virtual classes, their preferred approaches to virtual learning, and the primary challenges encountered in virtual education, categorized by course type. The final section addressed the core objectives of the research and included 51 questions distributed across six domains: teaching method (9 questions; scoring range: 9-45), professors' interaction (5 questions; scoring range: 5-25), evaluation of teaching-learning activities (20 questions; scoring range: 20-100), content delivery (6 questions; scoring range: 6-30), students' participation (3 questions; scoring range: 3-15), and virtual learning infrastructure (8 questions; scoring range: 8-40). All questions were rated using a 5-point Likert scale, where 1 indicated "very weak", 2 represented "weak", 3 denoted "medium", 4 signified "good", and 5 indicated "excellent". The total score for the questionnaire ranged from a minimum of 51 to a maximum of 255.

Validity - To investigate the qualitative face validity, the questionnaire was given to a panel of 10 experts consisting of five medical education specialists and five health information management specialists to refine it and eliminate any ambiguities and misunderstandings. Minor modifications were made according to the experts' opinions.

The qualitative face validity of the questionnaire was assessed using the Impact Score Indicator (IPS). Initially, a 5-point Likert scale was applied to each item, with response options ranging as: "I completely agree" (score 5), "I agree" (score 4), "I have no opinion" (score 3), "I disagree" (score 2), and "I completely disagree" (score 1). The questionnaires were then distributed to a sample of 25 students. Following the completion of the questionnaires by the participants, face validity was determined using the IPS (Impact Score=Frequency (%)×Importance). The findings indicated

that all items achieved a score of 1.5 or higher, confirming their inclusion in the final questionnaire.

Content validity was assessed using the Content Validity Index (CVI) and Content Validity Ratio (CVR) (21) based on evaluations from a panel of 10 educational experts, comprising five specialists in Medical Education and five in Health Information Management. Each expert was instructed to rate each item on a three-point Likert scale: 1 = essential, 2 = useful but not essential, and 3 = unessential. The calculated CVI of 0.86 indicated that all items scored above the threshold of 0.79, thus deemed appropriate. Furthermore, the CVR yielded a value of 0.75, with all items exceeding Lawshe's table index of 0.62 (22), falling within a range of 0.71 to 0.92.

Reliability - The internal consistency of the questionnaire was assessed using Cronbach's alpha, which yielded a value of 0.86. Additionally, the reliability was measured through the Intraclass Correlation Coefficient Index (ICC) (23). A test-retest method was employed to further assess the reliability of the questionnaire. In this phase, 25 individuals who were not part of the main participant group completed the questionnaire on two separate occasions at a two-week interval. Reliability values based on the ICC were 0.94 for the teaching method, 0.92 for interaction, 0.88 for evaluation, 0.91 for content delivery, 0.96 for student participation, and 0.89 for infrastructure areas.

Data Collection

A web-based questionnaire was designed using the Porsline platform (https://survey.porsline.ir). A total of 390 students received the electronic questionnaire through various communication channels, including Telegram, WhatsApp, email, and the Learning Management System (LMS), with instructions to complete it within a week. Participants were informed that the estimated time to finish the questionnaire was approximately 20 minutes. Throughout the week, reminder messages were dispatched three times at two-day intervals to those who had yet to respond. Ultimately, 360 completed questionnaires were collected after the one-week period. It is important to mention that the contact information for the students was sourced from the educational unit of the respective faculties.

Data Analysis

The researchers employed the Kolmogorov-Smirnov test to evaluate the normality of the data distribution. Given that the data did not conform to a normal distribution, non-parametric tests, including Spearman correlation, Mann-Whitney, and Kruskal-Wallis, were utilized. The Spearman correlation was explicitly applied to examine the relationship between students' perceptions of virtual learning and their age as well as their grade point average. The Mann-Whitney test was implemented to compare students' opinions on virtual learning across different categories such as gender, marital status, place of residence, and residential status. Additionally, Kruskal-Wallis tests were used to analyze differences in students' views on virtual learning based on educational level and college affiliation. A cut-off point of three was established using a 5-point Likert scale. In all statistical analyses, a P-value of less than 0.05 was deemed significant.

Ethics - Informed consent was obtained from all students who volunteered to complete the questionnaire for this study. Ethical approval was obtained from the Ethics Committee of the Deputy of Research and Technology of ZAUMS, and all the selected participants were provided with information about the study's purpose and procedures before participating.

Results

The research questionnaire was distributed among 390 students enrolled at ZAUMS, resulting in the collection of 360 completed responses. This corresponded to a completion rate of 92%. The mean age of the participants was 22.68±2.37 years, and the average grade of students was 15.80±0.88. The demographic characteristics of participants are shown in Table 1.

Table 1: Demographic characteristics of the participants

Demographic Characteristics		Frequency (%)
Gender	Male	184 (51.1)
	Female	176 (48.9)
Marital Status	Single	323 (89.7)
	Married	37 (10.3)
Place of Residence	Urban	326 (90.6)
	Rural	34 (9.4)
Residential Status	Native	221 (61.4)
	Non-native	139 (38.6)
Level of education	Professional Doctorate (medicine & dentistry)	182 (50.6)
	Master's Degree	23 (6.4)
	Bachelor's Degree	155 (43.1)
College	Medical	141 (39.2)
	Dental	51 (14.2)
	Nursing and Midwifery	61 (16.9)
	Paramedical	43 (11.9)
	Health	37 (10.3)
	Rehabilitation	27 (7.5)

From the students' perspective, the evaluation of virtual learning at ZAUMS was rated as above average (3.17±0.43). Among the six areas examined, all were rated above average; however, the status of students' participation was less than average. The highest average score pertained to the interaction between professors and students (3.35±0.65), while the lowest average score was associated with student participation (2.91±0.69) (Table 2).

Teaching methods: According to Table 2, the "Creating a problem-solving and creative environment" had the highest mean score (3.77±0.91), and the "Similarity of the initial online teaching session to traditional in-person classes" had the lowest mean score (2.49±1.04).

Interaction: According to Table 2, the "Professors' performance in addressing students' frequently asked questions" had the highest mean score (3.49±0.99), and the "Answering students' questions during and after teaching sessions" had the lowest mean score (3.15±0.96).

Evaluation: According to Table 2, the "Ratio of the number of questions to the allotted exam time" had the highest mean score (3.57±0.91), and the "Presentation of research findings and individual practical work" had the lowest mean score (2.57±1.00).

Content delivery: According to Table 2, the "Scheduling of content delivery with the volume of materials available" had the highest mean score (3.49±0.99), and the "Inclusion of additional information to support sources by students" had the lowest mean score (3.06±0.95).

Students' participation: According to Table 2, the "Level of students' engagement in peer review activities" had the highest mean score (3.00±0.97), and the "Interactivity and having at least one meaningful interaction within a 7-minute timeframe" had the lowest mean score (2.85±0.92).

Infrastructure: According to Table 2, the "Availability of internet connectivity at any time and location" had the highest mean score (3.61±1.06), and the "Online and offline technical support for students to address technical problems" had the lowest mean score (2.88±1.08).

The relationship between students' points of view with age (r=0.064, P=0.225) and grade point average (r=0.068, P=0.198) was tested by Spearman correlation. The relationship between students' points of view with gender, marital status, place of residence, and residential status was tested by the Mann-Whitney U test, and a significant relationship was observed only with gender (P=0.004).

Table 2: Status of each component and items of virtual learning from students' perspectives

Components (Items)	Mean±SD
Teaching methods	
• Alignment of virtual learning modalities with learners' preferred learning styles	2.69±0.94
• Similarity of the initial online teaching session to traditional in-person classes	2.49±1.04
• Clarity regarding professors' schedules for online class participation	2.64±1.01
• Inclusion of group activities for each lesson segment, along with timely feedback	2.86±0.99
• Providing a summary of the lesson at the end of each lesson section	3.07±1.11
• Determining key information sources relevant to each lesson section	3.35±0.87
• Creating a problem-solving and creative environment	3.77±0.91
• Use of discussion forums by professors	2.97±0.99
• Satisfaction with attendance and absenteeism in education and online classes	3.43±0.96
Mean	3.03±0.58
Interaction	
• Positive disposition of professors towards all students	3.48±0.98
• Professors' performance in addressing students' frequently asked questions	3.49±0.99
• Having close and friendly relations with all students	3.45±0.92
• Instructors' responsiveness to the desires, expectations, and requirements of learners	3.16±1.00
• Answering students' questions during and after teaching sessions	3.15±0.96
Mean	3.35±0.65
Evaluation	
• Alignment and coordination among objectives, content, and evaluation	2.98±0.99
• Professors' awareness of modern evaluation techniques	3.06±0.95
• Clarity and transparency of evaluation criteria for students	2.85±0.92
• The variety of strategies employed for student evaluation, including quizzes, short and long-form writing assignments, and reasoning-based questions	2.87±0.99
• Evaluation of student's academic progress at various stages (before, during, and after the course)	3.00±0.97
• Presentation of research findings and individual practical work	2.75±1.00
• Influence of feedback on enhancing teaching and learning processes	3.40±1.00
• Quality of exams at the end of each main sections (aligned with the objectives)	3.45±0.87
• Students' satisfaction regarding online exams	2.38±0.94
• Duration allocated for online exams	3.33±0.95
• Complexity level of questions designed in online exams	3.20±0.94
• Ratio of the number of questions to the allotted exam time	3.57±0.91
• Evaluations regarding the quality of conducting online exams	3.30±0.93
• Possibility of navigating quickly between previous/next pages and first/last pages in lessons and online exams	3.29±0.93
• Responsiveness of professors before, during, and after exams	3.00±1.02
• Distribution of the overall course grade across various activities	3.34±1.00
• Clarity in the grading methodology and calculation of the total course scores	3.09±1.01
• Satisfaction with grading in virtual exams	2.96±0.98
• Comparison of average grades in virtual learning courses versus traditional settings	3.13±0.94
• Status of supervision in online exams and prevention of academic dishonesty	3.48±0.98
Mean	3.18±0.43
Content delivery	
• Scheduling of content delivery with the volume of materials available	3.49±0.99
• Up-to-date and relevant e-content	3.45±0.91
• Developing an interactive learning environment	3.16±1.00
• Providing concise summaries of lessons for better understanding and retention	3.16±0.97
• Access to resources, including books, videos, or online content	3.38±0.99
• Inclusion of additional information to support sources by students	3.06±0.95
Mean	3.22±0.57

Students' participation	
• Interactivity and having at least one meaningful interaction within a 7-minute timeframe	2.85±0.92
• Degree of collaborative assignment completion	2.87±0.99
• Level of student engagement in peer review activities	3.00±0.97
Mean	2.91±0.69
Infrastructure	
• Availability of internet connectivity at any time and location	3.61±1.06
• Capability to utilize standard computing devices	3.09±0.98
• Sufficient Internet bandwidth for downloading course materials and submitting assignments	3.45±0.87
• Accessibility of the virtual learning platform at any time and location	3.38±0.94
• Online and offline technical support for students to address technical problems	2.88±1.08
• Absence of the requirement for users to configure special settings	3.20±0.94
• Proficiency of professors in delivering virtual classes	3.57±0.90
• Competence of students in employing technological tools	3.30±0.93
Mean	3.34±0.50

*SD: Standard Deviation

Females had a more positive view than males (t=2.85, P=0.004). Also, the relationship between students' points of view with the level of education and college was tested by the Kruskal-Wallis test, and no significant relationship was observed (Table 3).

The majority of students (69.2%) reported that they utilized mobile phones to engage in virtual classes and online exams. About 42.2 % of the students preferred a combination of online and offline courses, with more priority given to online classes. From the perspective of the research participants, the most significant issue in holding online classes was related to practical courses (41.1%), and the least problem was related to general classes (6.9 %).

According to the third part of the questionnaire, which specifically addressed the general purpose of this study, 51 questions

Table 3: The correlation between the average score virtual learning and demographic variables

Demographic variables		Descriptive index			Statistics	P value
		Mean±SD	Median	Interquartile Range (IQR)		
Gender	Male	159.05±22.17	160	24.75	t=2.85	0.004*
	Female	165.19±20.44	166.5	26		
Marital Status	Single	161.92±21.49	162	26	t=0.63	0.529
	Married	163.18±22.18	164	24.50		
Place of Residence	Urban	162.19±21.59	163	25.25	t=0.85	0.395
	Rural	160.79±21.27	157	28		
Residential Status	Native	160.96±21.99	162	26	t=0.65	0.514
	Non-native	163.79±20.76	163	25		
Educational level	Professional Doctorate**	162.70±22.53	164	25	F=0.183	0.833
	Masters	162.21±18.57	161	25		
	Bachelor	161.27±0.83	162	23		
College	Medical	163.56±23.09	165	27.50	F=0.821	0.535
	Dental	159.78±20.92	157	26		
	Nursing and Midwifery	165.01±18.57	165	23.50		
	Paramedical	158.93±20.20	160	21		
	Health	159.20±22.44	161	31		
	Rehabilitation	160.96±21.52	158	32		

*Statistically significant P value of Mann-Whitney U test; **Professional Doctorate: Medicine & Dentistry

were asked of the participants in six different areas (Table 2). The range of scores that the questionnaire can assign is between 51 and 255. The total score assigned to the questionnaire from the students' viewpoints was 162±21.53 and the average score was 3.17±0.43.

Discussion

According to findings of the study, the status of virtual learning at ZAUMS is rated as above average. The assessment covered various factors, including faculty interactions, infrastructure, content delivery, evaluation methods, teaching strategies, and student participation, which were ranked from highest to lowest in average scores. Notably, all categories scored above average except for student participation, which fell below the average threshold. When examining the correlation between different variables, a significant association was identified solely between students' perceptions and gender; specifically, female students expressed a more favorable attitude towards virtual learning compared to their male counterparts. Furthermore, a majority of students favored a hybrid model of education that included both online and offline classes, with a leaning towards more online courses. The most common problem raised by students was related to holding practical and specialized courses, respectively.

Multiple studies that assessed the perspectives of students and professors on e-learning (14, 16, 24-26) found favorable overall sentiment. However, due to the diverse focus areas of these studies, direct comparisons between them are challenging. Consequently, employing a standardized framework to evaluate the state of e-learning (26, 27) would facilitate result comparisons and enable the development of effective interventions aimed at improving the quality of virtual education.

Following the COVID-19 pandemic, medical universities in Iran swiftly transitioned to virtual learning modalities. This shift is expected to encounter various challenges. Research has identified several issues associated with virtual education, including insufficient direct interaction between students and instructors (8, 12, 16, 28, 29), limited access to personal computers, and a lack of proficiency in their use (12, 16, 28-30), poor internet connectivity, and high costs associated with it (8, 12, 16, 28, 30-33), lack of engagement and creativity in online educational methods (32, 34), inadequate familiarity among administrators with digital technologies and their applications (8, 12, 32, 35), and poor coordination among educational stakeholders (12, 16, 32, 36).

The scores achieved in the teaching methods domain of this study exceeded the average benchmark. "Providing a summary of the lesson at the end of each lesson section" and "Inclusion of additional information to support sources by students" contributed to the students' positive attitudes. As indicated by the five items that received below-average scores in the teaching methods category (Table 2), enhancing faculty training to utilize teaching strategies that align with students' learning styles, effectively designing and communicating course and lesson plans via the virtual learning platform, and ensuring faculty adherence to these plans during the training course could lead to improvements in this area. In addition, assigning group projects can stimulate creativity and innovation among students (2). In the context of online education, it is essential to consider individual differences when developing teaching methodologies (18, 37). In Russia, pre-tests are commonly employed within educational programs to customize the learning experience according to students' existing knowledge and skills. Based on the outcomes of these pre-tests, instructors assign tasks that vary in complexity and provide patient guidance to steer students appropriately (18). Additionally, increased interaction between instructors and students allows educators to understand individual student characteristics better, enabling them to adapt teaching methods to meet diverse learning needs.

In this research, the scores obtained in the professors' interaction area were higher than the average. This can be attributed to the diverse utilization of the LMS by professors, especially in discussion forums. Additionally, communication between students and professors via telephone and social media has proven to be effective (38, 39). The traditional teaching methods, which rely solely on lecturing, diminish student motivation to participate in class. Monotonous lectures delivered by professors lack visual stimulation, leading to reduced student engagement in discussions and resulting in boredom (40).

According to this study, the scores obtained in the evaluation area were higher than the average level. Some studies identified that one limitation of e-learning is the occurrence of technical problems during online tests (33, 41). Employing a variety of assessment strategies significantly contributes to improving student outcomes, especially in online learning settings. It is crucial to acknowledge the diverse needs of learners, as some individuals may experience anxiety during examinations, negatively impacting their performance. For these students, alternative assessment approaches—such as essay presentations, continuous assessment throughout the semester, or peer evaluations—might be more effective. Furthermore, training educators to transition from quantitative to qualitative assessment methods can enhance the overall quality of virtual education (18). Clear communication with students regarding exam schedules, evaluation criteria, and the alignment of course objectives, content, and assessments can further elevate the standard of student evaluations in online learning environments.

The scores achieved in the area of content delivery in this study exceeded the average level. This may be attributed to the more efficient and rapid updating and dissemination of educational content in comparison to traditional printed materials (32). This feature can help personalize learning and promote self-directedness among medical students. Previous research has yielded varying results regarding content effectiveness. For instance, studies by Yassini (42), Cidral (43), and Ansong (34), reported favorable content assessments. In contrast, in the studies of Ghanbari (20) and Esmaeeli (44), it was reported as undesirable, which is not consistent with the results of the current study. The discrepancies in results could be explained by the instructors' preparedness to create electronic content and their prior experience with the LMS. The findings from the present study suggest that increasing students' involvement in contributing to content and resources may significantly enhance their satisfaction with the provided course materials.

In this study, the scores obtained in the students' participation area were lower than the average level. Incorporating engaging and interactive environments, such as gamification and simulations, along with utilizing forums and chat rooms, can significantly enhance student participation. To promote a constructive shift in education and practice, it is crucial to prioritize learners by emphasizing pedagogical design that accommodates diverse learning styles and expectations while also integrating e-learning into the curriculum and practices of health science education (7).

According to the findings of the current study, the score obtained in the infrastructure area was higher than the average level. This may be attributed to the effective support provided by the technical team to the students, along with the use of simple and lightweight content by the professors, which minimized bandwidth requirements. Also, the implementation of the LMS and the availability of training resources, including videos accessible to both students and faculty, proved to be effective. Numerous studies have identified key infrastructural challenges, including limited access to computers, insufficient internet speeds, and frequent disconnections during online learning. Additionally, there is a notable deficiency in the skills required by both

instructors and students to effectively utilize the virtual education system (7, 25, 30, 41, 45, 46). Considering the widespread use of smartphones in comparison to computers and laptops, it is more beneficial to adopt e-learning applications that can be installed on smartphones. Moreover, providing adequate training for both instructors and students before the rollout of e-learning initiatives can effectively address infrastructural challenges. Additionally, ensuring that there is sufficient bandwidth for the successful implementation of e-learning is a crucial concern that necessitates collaboration among various organizations. Support from internet service providers, in the form of sustainable and reliable services for students, is also vital.

In this study, women's view toward virtual education was more positive than men's. A study by González-Gómez and colleagues in Spain revealed that female students expressed higher levels of satisfaction with virtual learning compared to their male counterparts (47). Furthermore, the findings revealed that female students prioritized planning and diverse forms of interaction with their instructors more than male students. Conversely, another study carried out in Pakistan, indicated that men reported a greater readiness for e-learning compared to women (48). Additionally, some studies found no significant relationship between satisfaction with virtual learning and gender (25, 49, 50). The discrepancies observed across these studies may be attributed to various factors, particularly the cultural and social contexts of the populations studied.

In this research, the primary obstacle identified by students concerning e-learning in practical courses and internships was highlighted. Several studies have recognized this challenge (7, 19, 25, 33, 51). In a survey conducted by Rahm and colleagues, it was mentioned that the clinical context, interactive elements, game-like interface, and integrated learning opportunities of the cases encourage students to actively participate with the learning materials presented asynchronously and to navigate through the cases (52). Virtual clinical experiences would allow medical students to assume the role of healthcare professionals by conducting patient interviews, collaborating with staff to develop treatment plans, assisting with documentation, and providing guidance to patients regarding their conditions (53). In several studies, a combination of face-to-face and online learning has been suggested (32, 33), and the impact of problem-based classes and flipped classrooms for practical and clinical courses has been reported positively (25).

Limitations and Suggestions

This study was limited to a single medical university, which necessitates caution when generalizing the results. Therefore, it is suggested that further studies should be conducted at a regional level (such as South-East Iran) or on a national scale to validate the applicability of these results across different institutions. Furthermore, the questionnaire utilized in this research was developed by the researchers and was employed for the first time, indicating a need for further validation. Additionally, the focus of the questionnaire was primarily on theoretical courses and classroom environments, which does not adequately address the evaluation of virtual learning in clinical settings. Therefore, it is advisable to carry out studies that place greater emphasis on the clinical components of the curriculum.

Conclusion

The findings of this study indicate that students generally perceive virtual learning as relatively favorable. However, there are opportunities to enhance the quality of virtual education, particularly in terms of student engagement. Strategies to achieve this improvement include the implementation of discussion forums and chat rooms, assigning group projects, designing collaborative assignments, and fostering a more engaging learning atmosphere through gamification and simulations.

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Authors' Contribution

LS and MJA developed the concept and designed the study. AK and MJA collected the data. JDH analyzed the collected data. LS and AK drafted the manuscript. All authors approved the final manuscript.

Conflict of Interest

The authors declare that they have no conflicts of interest to disclose.

Ethical Considerations

This research is derived from a Doctor of Medicine thesis (NO: 3216) that was approved by the Ethics Committee of the Deputy of Research and Technology at Zahedan University of Medical Sciences (ZAUMS), Zahedan, Iran, with code IR.ZAUMS.REC.1401.047. Informed consent was obtained from all students who volunteered to complete the questionnaire for this study, and all the selected participants were provided with information about the study's purpose and procedures before participating.

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Availability of Data and Materials

The authors confirm that the data supporting the findings of this study are available within the article. Further data can be obtained upon reasonable request from the corresponding author.

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