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Impact of blended teaching on academic achievement and well-being in operating room students: a semi-experimental study

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Abstract

Background Various virtual education methods, in addition to encouraging student-centered learning, positively impact the development of personal capabilities and improvement of students' personality growth, especially when e-learning is combined with traditional education.

Aim The present study is a semi-experimental study that Impact of Blended Teaching on Academic Achievement and Well-being in Operating Room Students.

Methods This semi-experimental study, conducted over one academic semester, involved pre-test and post-test assessments with 44 operating room students in two university centers. Participants were selected through a census method and assigned to control and intervention groups. Data collection tools included the Hermance's Academic Achievement and Hein's Academic Well-being questionnaires.

Results The results of this study indicated a statistically significant difference in the level of well-being before and after the intervention, demonstrating a significant improvement in well-being in the Blended Teaching group after the intervention ($P < 0.01$). Independent t-tests showed no statistically significant difference in the mean score of academic achievement between the two groups after the intervention.

Conclusion Based on the results of this study, blended teaching led to an increase in academic well-being in undergraduate students. To improve the level of academic well-being of students, educational policy makers should consider ways to educate students about new educational approaches. Prioritizing strategies in using educational methods may enhance academic well-being and leading to positive educational outcomes and fostering qualified and competent care in the nursing profession. Teaching clinical skills needs repetition, daily practice and continuous use to be internalized and become a habit. It may be that due to the short period of time and the absence of the first-semester students in clinical courses and fields, the level of academic achievement of the students did not show any particular change. It is suggested that more studies be conducted on comparing the use of this method with other self-centered and active training methods with a larger sample size.

Keywords Academic achievement, Academic well-being, Blended teaching, Circular technique, Scrub technique

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Background

One of the most important tasks of universities in promoting and improving the health, hygiene, and medical sectors is the training of skilled and efficient human resources [1]. Clinical education is a fundamental component of medical sciences education, playing a vital role in increasing and enhancing students' professional skills and capabilities [2]. Clinical education environments are not planned and predictable like theoretical training environments and consist of psychomotor aspects and various variables in the field of knowledge and attitude [3]. Students in this environment must acquire sufficient skills in addition to acquiring knowledge, but the process of converting theoretical knowledge into practical knowledge is not simple, because teaching and learning in special clinical environments such as the operating room is more complex and different than other clinical environments [4, 5]. In the operating room environment where complex health care is required, students face many problems in applying the theoretical knowledge and skills that have been taught to them theoretically [6]. In this regard, adopting innovative methods in clinical education is one of the necessities for educational institutions and universities [7].

Various teaching methods in the clinical education environment contribute to developing students' clinical skills and preparing them for entry into their professional environment, namely hospitals [8, 9]. During education, the choice of teaching method plays a crucial role in students' overall learning. Lecture-based teaching has a long history as a dominant method in educational systems [10]. In direct teaching or lecturing, the instructor takes a central role in presenting skills and patterns, and with the delivery of educational content, the main responsibility for managing the class lies with them [11]. This method results in the accumulation of knowledge with limited retention and does not foster creative individuals with critical thinking and problem-solving skills facing various challenges in educational systems [12]. Innovative and student-centered learning methods have become essential for educational systems [13].

These methods will promote the flexibility of educational courses and facilitate interactions, something not easily achievable in traditional classroom settings [14]. Students in the operating room technology experience high levels of stress in clinical education due to the nature of their discipline, which significantly impacts their learning and professional performance [15]. Factors such as instructor, surgeon, operating room personnel, large number of students, and patients, variety of surgeries, work pressure, speed and accuracy in performing activities and emergency conditions can affect the educational process in the operating room [16, 17]. The main goal of any clinical experience is to bring students to the

highest level of learning [7]. In various studies, one of the suggested solutions to enhance clinical skills in students, which has been used in some cases, is the use of blended teaching methods [18, 19].

As a direct teaching method, blended teaching has garnered attention in educational patterns over the past few decades [20–22]. Blended teaching involves combining two or more teaching approaches [19]. This method makes online learning resources accessible to students and integrates instructional techniques with opportunities for online participation [23]. Blended teaching utilizes various tools, such as web-based technology, learning portals, video conferences, mobile applications, and many free websites [20, 24]. Furthermore, in this context, the quality of education and excellent infrastructures, such as computers and the adoption of modern information technology equipment, are currently in high demand, leading universities to adapt their educational models using intellectual capital [25, 26]. Various studies suggest that mobile technology, virtual education, and incorporating videos, animations, visual designs, and text into cohesive content benefit students' learning [27–30].

Given students' inclination to use various virtual learning methods, applications, posters, and educational videos, in addition to encouraging student-centered learning, have a positive impact on improving clinical skills and competencies and reinforcing theoretical concepts, especially when combining electronic and face-to-face education. The ultimate goal of any successful educational system is the success of university students, which includes gaining appropriate experiences in all cognitive, emotional, social, behavioral, and biological dimensions. Today, due to its flexibility, timeliness, and continuous effectiveness in learning, blended teaching is the most effective and popular teaching method educational institutions use [31]. Therefore, it seems that blended teaching can contribute to student's academic achievement and academic well-being by blended the strengths of electronic and face-to-face teaching methods.

One of the key indicators in evaluating educational systems is the students' academic achievement [32]. Therefore, the effectiveness of an educational system is determined when the student's academic achievement in various courses is satisfactory as the most important factor in social and individual success [33, 34]. Academic achievement refers to the general or specialized knowledge or skills students acquire in the course content, which instructors often assess through various exams [35]. It indicates the extent to which individuals achieve goals and acquire mastery over a specific skill with a focus on educational activities [36, 37]. This concept plays a crucial role in shaping an individual's perspective on life as one of the important outcomes of educational

performance [38]. According to the meta-analysis study by Bucker et al., academic achievement is associated with academic well-being [39]. In general, academic achievement and well-being serve as central indicators of positive psychological performance in identifying characteristics of high-performing educational systems [40].

Academic well-being is considered a new and comprehensive concept and one of the important indicators in evaluating educational systems [41]. According to the Ryff and Keyes (1995) well-being model, academic well-being includes various dimensions such as independence, mastery of the environment, personal growth, establishing positive relationships with others, having life goals, and self-acceptance [42]. Well-being relates to individuals' feelings and thoughts about their lives [43]. In this regard, universities and higher education institutions not only play a role in acquiring academic skills by students but also provide an environment for individuals to experience all aspects of social life, including the ability to connect with others and develop their personalities, and subsequently contribute to improving academic well-being [40]. In the educational field, academic well-being is important as an internal control source, correlated with high self-esteem, intrinsic motivation, and positive or negative achievement [44, 45].

While there is increasing evidence that various teaching methods affect academic achievement, learning, academic satisfaction, and other educational factors [46–50], However, there is a significant research gap in the effect of using blended methods in teaching clinical skills in relation to concepts such as academic achievement and academic well-being of medical students and especially operating room students. This gap is very important, because the provision of correct education improves the level of knowledge of learners. Fixing this research gap is very important because nowadays blended teaching is considered the most effective and popular educational method due to its effectiveness in flexible, timely and continuous learning. Today, educational systems face various challenges in academic planning and delivering educational content. In these circumstances, investigating the effects, advantages, and disadvantages of employing innovative teaching methods as an achievement in the transformation of modern educational systems is inevitable [51]. Therefore, assessing the effectiveness of education on student's academic achievement, as the fundamental executive policy for achieving educational goals and learners' growth, is essential. It is evident that adopting new teaching and learning methods is contingent upon a fundamental approach to educational research, and today, educational systems cannot be considered independent of research. Since new teaching methods need to be examined in various cultural, educational, and clinical contexts, conducting education research is

deemed necessary. Proper education improves learners' knowledge; subsequently, educating and training qualified and competent human resources through innovative and combined teaching methods prepares students to take on their real responsibilities in improving community health and enhancing the educational system. For this reason, the main goal of this research is to take a positive step towards advancing the objectives of the educational system by examining the Impact of Blended Teaching on Academic Achievement and Well-being in Operating Room Students.

Materials and methods

Design of the study

The present research is a quasi-experimental intervention study with two groups, control and intervention, involving both pre-test and two post-tests.

Participants

The research environment was the schools offering undergraduate programs (bachelor's) in the operating room at Shiraz University of Medical Sciences. The research population included all students admitted in 2022 who met the following criteria: being enrolled in the operating room major, having completed a maximum of two terms of previous studies, having taken the principles and techniques of Scrubbing and Circular course, having selected the course unit, and expressing a willingness to participate in the study. Exclusion criteria included absenteeism during the study, transferring to other universities, conditional status, and academic regression.

Sampling

In this study, a total of 44 students accepted in the field of operating room for the entry of September 2022 participated. Since the number of bachelor's degree students of operating room technology in most universities of the country is 20–30 in each entry, therefore, to avoid reducing the sample size, students from two faculties of Shiraz and Estahban were included in this study. At first, students of one university were selected as the intervention group and students of another university as the control group based on a simple random draw. In the following, students were allocated to intervention and control groups in a non-random manner and based on the attendance and absence list of the university where they studied. In this way, students who met the entry criteria were placed in two control groups (22 people) and intervention groups (22 people). The curriculum and educational content offered officially are the same in both colleges.

The process of randomizing student allocation based on universities serves as a methodological safeguard in educational research [52]. By employing randomization, researchers can mitigate selection bias and ensure that

the sample is representative of the larger population of students across various institutions [53]. This approach is crucial when assessing educational interventions or outcomes that may be influenced by institutional characteristics such as teaching quality, resources available, and student demographics. The quality of evidence regarding the effectiveness of randomization in education stems from numerous studies indicating that randomized designs yield more reliable results than observational studies due to their ability to control for confounding factors effectively [54]. This method ensures that differences in performance can be attributed more confidently to the educational interventions being tested rather than pre-existing differences among students.

Implementation method of the study

In the Iranian educational system, the Operating Room major is an independent field of study. In their first academic term, students in this major choose the “Scrubbing and Circulating Skills” course, comprising two theoretical units and one practical unit. The practical part is conducted in the Clinical Skills Center.

The Clinical Skills Center, located in both faculties, offers similar equipment and facilities for practical training. The course is uniformly taught by professors across both faculties, ensuring consistency in the educational experience.

At the beginning of the semester, before any instructional interventions, a pre-test was administered to both groups of students. Each group received a set of questionnaires along with an informed consent form. The form outlined the research project’s objectives, assured the confidentiality of information, emphasized anonymity, and clarified the option to withdraw without affecting educational programs or relationships with instructors.

Throughout the sampling process, researchers, by explaining the research objectives and conducting multiple follow-ups, endeavored to enhance students’ willingness and collaboration in participating in the study. Subsequently, the educational content aimed at acquiring the necessary knowledge, awareness, and skills related to the duties of a scrub and circulating individual in various surgical procedures was delivered through 26 sessions. These comprised 20 theoretical sessions using a lecture-based method and six practical sessions lasting 2 h each, conducted in a practice room.

In the blended learning group, 18 virtual sessions were conducted, consisting of two theory sessions using a lecture-based method and six practical sessions at the Clinical Skills Center. The educational content covered various aspects, including familiarity with the department and surgical environment, patient admission in the operating room, understanding the surgical team’s responsibilities, principles of counting in the operating room, knowledge

of operating room attire and personal protective equipment, care for pathological specimens, hemostasis methods, wound closure techniques in surgery, principles of prepping and preparing the patient’s skin before surgery, principles of draping, and how to scrub hands before surgery and donning gowns and gloves.

The theoretical content presented in the lectures was practically taught to the students at the Clinical Skills Center. After obtaining their consent, a local social networking application was installed on the students’ mobile phones to deliver the educational content through the created group, allowing the dissemination of texts, instructional videos, and posters related to skill training and operational principles in virtual (via social networks) and physical (in-class instructional video playback) formats.

At the end of each educational session, the control and intervention groups underwent immediate post-tests by completing questionnaires. Finally, a second post-test was administered to both groups one week after the intervention. It’s worth mentioning that electronic content was also provided to the control group at the end of the study to uphold ethical codes.

Data collection instruments

The data collection tools encompassed three key questionnaires: Demographic Information Questionnaire, Hermance’s Academic Achievement Questionnaire, and Heinz’s Academic Well-being Questionnaire. The questionnaires used are exactly the same English questionnaires that have been re-measured to ensure validity and reliability for students.

The sociodemographic and educational variables, including age, gender, academic term, place of residence, and interest level in the field of study, along with the following variables, were investigated.

Data collection tools

Academic achievement questionnaire

The Hermance Academic Achievement Questionnaire was utilized in this study to assess academic achievement. Hermance (1970) reported correlation coefficients of each item with achievement motivation ranging from 30 to 57%. The reliability of the questionnaire was determined using Cronbach’s alpha as 0.84 [55]. This scale was reduced to 39 items in Iran by Homan and Asgari (1379) based on the reliability coefficient [56]. Each option is scored based on the intensity of academic achievement motivation, ranging from high to low or low to high. Responses are rated on a 4-point Likert scale (A [4] – B [3] – C [2] – D [1]). Higher scores indicate higher motivation for academic achievement, while lower scores suggest lower motivation. The score range is from 29 to 116, reflecting the spectrum of motivational changes.

The scale's homogeneity coefficient was 0.803 in a study by Hooman and Asgari (2000) on 1,073 students. Factor analysis identified seven factors (perseverance, self-confidence, time perception, opportunity-seeking, diligence, competence criteria in choosing friends, high aspiration level, and future orientation) with a factor loading of at least 0.3 [56]. Additionally, ShahbaniFar et al. calculated the reliability of this questionnaire using Cronbach's alpha as 0.86 [57]. In the present study, the reliability of the academic achievement scale was confirmed with a Cronbach's alpha coefficient of 0.81.

Academic well-being questionnaire

The Heinz Academic Well-being Questionnaire, designed and developed by Heinz in 1993 [58], was employed in this study to measure the academic well-being of students. This single-factor scale consists of 102 questions, utilizing a four-point Likert scale (completely agree, agree, disagree, strongly disagree) to assess academic well-being. Higher scores indicate higher levels of well-being, ranging between 102 and 408.

Due to the absence of validity and reliability information for the Academic Well-being Questionnaire, the questionnaire underwent a psychometric evaluation by the researchers before being used in this study.

Reliability and validity of academic well-being questionnaire

In this phase of the study, the content validity of the questionnaire was assessed through expert judgment [59]. They presented the questionnaire to 15 faculty members specializing in operating room and psychometricians to determine its qualitative face validity. The experts examined factors such as the difficulty level, appropriateness, and ambiguity of the questionnaire items. After refining the items and determining the importance of each one, the researchers employed a quantitative impact

item analysis [60, 61]. For the qualitative content validity assessment, the 15 experts provided feedback on the questionnaire's adherence to grammar rules, use of appropriate terminology, and proper placement of phrases.

To quantitatively assess the content validity, the researchers used the Content Validity Ratio (CVR) and the Content Validity Index (CVI). The CVR was determined by asking the 15 specialists to review the items based on a three-part spectrum (essential, useful but not essential, not necessary). Items with a CVR value above 0.62 were considered significant and were retained [62].

The CVI was examined based on Waltz and Basel's content validity index [61]. The researchers provided the questionnaire to the 15 specialists and asked them to assess each item's relevance, clarity, simplicity, and specificity using a four-part Likert scale [63]. Items with a CVI score of 0.79 or higher were accepted [64].

After the content validity assessment, the research team removed 15 items from the questionnaire due to their CVR values being less than 0.62. The final questionnaire was approved with 87 items, and its reliability was assessed with a Cronbach's alpha coefficient of 0.86. Overall, the researchers utilized both qualitative and quantitative methods to thoroughly assess the content validity of the questionnaire, ensuring its appropriateness and reliability for use in the study.

Data Analysis

The collected data were analyzed using the SPSS software, and statistical significance was determined at $P < 0.05$ through descriptive and inferential statistics. The Shapiro-Wilk test was employed to assess the normality of the data. Considering the normal distribution, independent t-test and Chi-square test were used to compare the two groups regarding demographic data.

Repeated Measures Analysis of Variance (ANOVA) was used to analyze the mean scores of academic well-being and academic achievement in the two groups at three different time points. Post hoc comparisons were performed using the Bonferroni post hoc test.

Results

Table 1 provides the demographic characteristics of the study population. Based on the table descriptions, it can be observed that most individuals are male (30 individuals, 68.2%), and the remaining are female. Furthermore, most individuals are single and live with their families, with approximately all individuals (41 individuals, 93.2%) expressing an interest in their field of study. The two groups did not exhibit significant differences in terms of demographic characteristics, residence, and interest in the major ($p > 0.05$) [Table 1].

Table 1 Comparison of participants' demographic characteristics in two groups

Variable	Case group (n = 22)	Control group (n = 22)	Total	P
Gender* N(%)				
Male	13(59.1)	17(77.3)	30(68.2)	0.195
Female	9(40.9)	5(22.7)	14(31.8)	
Marital Status** N(%)				
Married	1(4.5)	1(4.5)	2(4.5)	
Residence** N(%)				
with family	17(77.3)	20(90.9)	37(84.1)	0.412
Dorm	5(22.7)	2(9.1)	7(15.9)	
Interest** N(%)				
Yes	20(90.9)	21(95.5)	41(93.2)	1
No	2(9.1)	1(4.5)	3(6.8)	
Age***	19.95 ± 1.56	20.95 ± 2.66	20.45 ± 2.21	1.38

*Pearson Chi-square test, **Exact Fisher Test, ***Independent Sample Test

Table 2 Comparison of Well-being Mean scores within and between two groups

Time	Control group	Case group	Statistical Test		Mean Difference	Std. Error Difference	95% CI Of The Difference	
	Mean(SD)	Mean(SD)	t	p			Lower	Upper
Before the intervention	223.32(13.86)	223.27(11.69)	3.37	0.2	13.04	3.86	5.24	20.85
Immediately after the intervention	233.14(19.20)	236.14(16.44)	0.19	0.01	1.00	5.39	-9.87	11.87
A week after the intervention	245.18(18.11)	236.45(16.89)	1.65	0.01	8.73	5.28	-1.93	19.38
Repeated measures ANOVA								
F	2.97	6.21						
P	0.06	0.004						

*CI: Confidence Interval, t: value Statistic for independent sample test, F: value Statistic for Repeated measures ANOVA

Table 3 Paired comparison of Well-being Mean scores at different time periods using Bonferroni follow-up test in two groups

Groups	Time		
	Before and immediately after (p)	Before and a week after p	Immediately and a week after p
Control	2.182(1.000)	-8.864(0.104)	-11.045(0.137)
Case	-9.864(0.061)	-13.182*(0.015)	-3.318(1.000)

Table 2 compares academic well-being within and between the two groups at three different time points. The t-test indicates that before the intervention, there was no statistically significant difference in academic well-being between the two groups ($P < 0.06$ and $P < 0.2$). The Repeated Measures Analysis of Variance (ANOVA) immediately and one week after the intervention shows a statistically significant difference in the mean scores of academic well-being between the intervention and control groups, with the intervention group having higher mean scores ($P < 0.01$). The within-group comparison also reveals that the intervention group had significantly higher mean scores of academic well-being ($P < 0.004$). Table 2 presents a comparison within and between the two groups before, after, and one week after the intervention.

The Bonferroni test was employed for pairwise comparisons across the three stages. However, due to the lack of significance in well-being means within the control group, there is no necessity to explore pairwise comparisons of the time points in that group. The pairwise

comparisons of time points within the control group did not yield statistically significant results, indicating that the well-being level in the control group remained relatively stable over time. A statistically significant comparison was observed in the intervention group between pre-intervention and post-intervention, signifying a notable improvement in well-being after the intervention ($P < 0.015$). Notably, the well-being level in the intervention group exhibited a significant increase one week after compared to pre-intervention. In contrast, in all other pairwise comparisons, no significant differences were observed between the two time periods [Table 3].

Furthermore, the independent t-test indicated that the mean score for academic achievement did not exhibit a significant difference between the two groups before, immediately, and a week after the intervention ($P = 0.976$, $P = 0.914$, and $P = 0.257$). Additionally, repeated measures of ANOVA were employed separately in each group to assess the mean score of academic achievement among the subjects before, immediately, and a week after the intervention. According to the results of this test, the difference in the mean scores across the three stages was not statistically significant [Table 4].

In both groups, there is no significant difference in the pattern of academic achievement mean scores across the three-time points. As a result, there is no necessity for pairwise comparisons.

Table 4 Comparison of Academic Achievement Mean scores at different time periods in two groups

Time	Control group	Case group	Statistical Test		Mean Difference	Std. Error Difference	95% CI Of The Difference	
	Mean(SD)	Mean(SD)	t	p			Lower	Upper
Before the intervention	125.73(11.76)	125.64(7.25)	0.03	0.976	0.09	2.94	-5.89	6.07
Immediately after the intervention	123.77(12.30)	124.14(9.65)	-0.11	0.914	-0.36	3.33	-7.09	6.36
A week after the intervention	119.86(15.14)	124.45(11.06)	-1.15	0.257	-4.59	3.99	-12.66	3.47
Repeated measures ANOVA								
F	1.82	0.18						
P	0.19	0.84						

*CI: Confidence Interval, t: value Statistic for independent sample test, F: Value Statistic for Repeated measures ANOVA

Discussion

Blended teaching, as one of the modern educational approaches, is important due to its utilization of innovative technologies and interaction applications in the learning process. Additionally, the concepts of academic achievement and academic well-being are considered significant motivational factors in learning [65–67]. Therefore, this research aims to examine the impact of Blended Teaching on Academic Achievement and Well-being in Operating Room Students.

According to the results of this study, the educational intervention led to an increase in academic well-being in the intervention group. As a comprehensive concept, academic well-being is an effective indicator in evaluating educational systems [68]. This result aligns with various studies in the field of academic well-being [69–71]. The findings suggest that one of the influential factors in the academic well-being of students is the implementation of necessary measures and initiatives for education and the execution of curriculum plans by instructors [68, 72].

In this regard, the results of the study by Hietajarvi et al. (2019), aiming to examine the multidimensionality of digital social participation and its relationship with academic well-being in three educational stages, showed that the use of digital tools for acquiring and sharing knowledge reflects multiple dimensions that are related to academic well-being [73]. In their study, Huang et al. (2023), integrating participatory inquiry strategies and blended learning, stated that goal setting and task value determination play a significant role in the well-being of students [74].

The psychological dynamics in relation to academic well-being can be interpreted in various ways. It seems that a blended approach emphasizing multimedia and meta-learning can impact academic well-being. This approach combines the strengths of two teaching methods, lectures and virtual learning, to present educational content tailored to the learners' situation and enhance the academic well-being of students. In this way, improving academic well-being may lead to better interaction with educational goals and achieving the desired educational outcomes [39].

Also, according to the results of this study, there was no statistically significant difference in academic achievement between the intervention group, which received blended teaching, and the control group, which received conventional education. Therefore, the educational intervention did not play a role in enhancing students' motivation for academic achievement. This finding is consistent with the study's results by Hinampas et al., which showed that blended teaching did not impact students' academic achievement. They suggested that more variables related to the learning environment should be examined to

identify factors that could lead to changes in academic achievement [75]. It appears that the students' academic achievement depends on various factors, and identifying these factors, along with the use of innovative teaching methods, can contribute to achieving educational goals more effectively.

Contrary to the present study's findings, various studies have reported a significant correlation between blended teaching and academic achievement [76, 77]. Ceylan and Kesici, in their study, utilized a blended learning environment enriched with web technologies such as video conferencing, learning management systems, and supportive blogs for teaching students. The results indicated a significant difference in students' academic achievement due to the blended teaching environment [78]. Blended teaching, through the enrichment of web technologies, seems to provide more effective learning outcomes. In their study, Kassab et al. (2015), which aimed to investigate the relationship between factors measuring the experience of blended teaching and the academic achievement of medical students, stated that the quality of teaching and appropriate workload significantly influences the motivational aspect of students.

According to the results of this study, high teaching quality was associated with increased self-efficacy, individual effort, mastery of content, and greater motivation for learning, ultimately leading to improved academic achievement among students by controlling internal and external factors [79]. In explaining this issue, it can be stated that various factors are influential while implementing blended learning increases students' use of academic skills [80, 81]. One aspect relates to the type of educational intervention, which in this study involved using instructional videos and posters related to teaching skills and operational principles, delivered virtually (via social networks) and in person (screening instructional videos in class). The results of the present study show that despite the introduction of blended teaching method aimed at enhancing student engagement and learning outcomes does not support a significant difference in academic achievement when compared to traditional instructional strategies. This suggests that factors influencing student success may extend beyond mere instructional methodology [82]; aspects such as student motivation, curriculum design, assessment strategies, and institutional support may play critical roles that warrant further investigation [83]. Thus, while educators may continue to explore innovative pedagogical approaches within their curricula, it is essential to recognize that substantial shifts in academic performance metrics may require more comprehensive systemic changes rather than simply altering teaching methodologies alone.

In general, various studies have investigated the effect of blended teaching on academic well-being. In these

studies, the aspect of learners' learning styles, the use of diverse methods of content presentation, the introduction of new technologies and platforms for learning, communication and the evaluation of the use of multimedia based on multisensory have had a positive effect on the well-being of students, because they It enables them to maintain a better balance between their studies and personal life and manage their time better [84, 85]. However, planning to design and determine the important features of the blended teaching method can directly affect it. The results of Clarkson's study on the effects of media tools related to blended teaching reported no significant difference in teaching quality and improved student academic performance [86, 87]. In this regard, based on previous studies, the support of instructors in innovative teaching and learning by maintaining interactions significantly improves the level of academic progress. It seems that when students are motivated, they develop their personal and academic characteristics and are able to achieve a higher level of academic achievement. In fact, academic progress is influenced by various factors, including the way the training course is designed, the support of instructors, the training environment, innovative techniques and tools, the use of virtual reality technology, artificial intelligence, and project-based learning. In addition, the results also show that instructors should carefully consider the needs and preferences of students when designing courses and curricula in order to encourage and support students to achieve higher academic motivation [74, 85, 87, 88].

The present study may increase our knowledge about the effect of blended teaching on academic well-being and academic achievement. The findings of this research have useful applications for planners and educational managers. It seems that the results of this research can be used in the educational programs of all medical and nursing students according to the educational content they need. The improvement of practical and attitudinal abilities will improve the clinical competence and professional performance of students, which subsequently, by using its benefits in different ways, it will be possible to benefit from the improvement of the health care system. Paying attention to the flexibility of the course structure, educational content according to the desired goals and controlling the speed of education in using the blended learning method is very important. It is important that the educational system and learners have a clear understanding of the concept and nature of blended learning skills to further develop it and improve the level of knowledge. These findings suggest important elements to consider when designing blended teaching courses in diverse student populations.

Conclusion

According to the results of this study, education using a blended teaching approach led to an increase in students' academic well-being. Attention to this issue and using student-centered teaching methods can create a psychologically favorable environment for enhancing student education. It is worth mentioning that educational software and electronic learning resources, combined with traditional teaching methods and complementary education, can provide a suitable platform for improving individual capabilities and personal growth, yielding fruitful outcomes. Therefore, enhancing students' academic well-being through mentoring programs, peer support groups, tutoring services, and opportunities for student engagement is recommended. Although the results of this study did not show a significant difference in the academic achievement of the two groups, considering that students' academic achievement is an important criterion for enhancing the quality of education, it is also necessary to pay attention to this aspect. The small sample size due to the decrease in the number of entries in the field of operating room technology in the current academic year, and the lack of full review and study of the educational content (posters and educational videos) by the students had a great impact on the results of this study. However, using the blended learning method using posters and educational videos along with the lecture method in clinical education helps to create diversity in the educational methods and increases the attraction and learning of students. While the current study provides promising preliminary evidence, more research is needed to fully understand the application of the blended teaching method in the training of operating room students. Blended teaching can be used as an interactive tool to complement traditional teaching methods and provide more diverse learning opportunities to students. This can lead to a deeper understanding of concepts and improve learning.

Limitations

This study employed clinical skills training, which included cognitive, emotional, and psychomotor aspects. Since these skills require repetition, daily practice, and continuous use to become internalized and habitual, it is possible that, due to the short duration and the absence of first-semester students in clinical internships and fields, the students' academic achievement level did not show a specific change. Another limitation of the study was the short intervention period. It is suggested that longer and longitudinal studies be conducted in this field. Also, in the present study, to prevent contamination, information about the intervention was not provided to the participants of the control group, and the subjects of the intervention group were instructed not to share

any information about the educational resources. One of the other limitation of this study is the small number of sampled students due to the limited acceptance of students and the necessity of sampling among students who had chosen the scrub and circular skills course. Given the limited studies on the effectiveness of blended teaching methods on clinical skills learning, it is recommended that further research be conducted to compare the use of this method with other learner-centered and active teaching methods with a higher sample size. In this study, posters and educational videos were used to teach students along with the lecture method, which seems that using this blended method alone cannot practice a wide range of clinical skills and help improve academic achievement in be considered. Also, this educational method cannot put the student in direct clinical contact with the real clinical environment and helps to prepare them to face various conditions in the real environment. Thus, it is necessary to conduct more research to determine the effectiveness and efficiency of using the blended teaching method with educational videos in the training of operating room technology students. In addition, it is necessary to develop strategies for using this educational method along with other electronic education methods in existing educational programs.

Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s12912-024-02356-3>.

Supplementary Material 1

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Author contributions

FV, S G: Conceptualization, Methodology, Software, Data curation, Writing-Original draft preparation, Visualization, Investigation, Supervision, Validation, Writing- Reviewing and Editing. M H: Conceptualization, Methodology, Investigation, Supervision, P GM statistical analysis and writing results.

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Data availability

Upon request from the first author data is available (somayeh.gh65@yahoo.com).

Declarations

Ethics approval and consent to participate

All Intervention performed in the current study were approved by the Ethics committee of Shiraz University of Medical Sciences (approval number: IR.SUMS.NUMIMG.REC. 1401.053). The study will be carried out in accordance with the basic principles of the Helsinki Declaration (2013), Investigator commitment will be requested of all students' that participate in the study.

The investigator will duly inform the subjects that all participate in the study and will request their informed consent, signed, and dated in writing. Informed consent to participate was obtained from all of the participants in the study. He/she will provide complete and adequate verbal and written information about the nature, purpose and possible risks and benefits of the study. Any modifications to the protocol which may impact on the conduct of the study, potential benefit of the student's or may affect safety, including changes of study objectives, study design, patient population, sample sizes, study procedures, or administrative aspects will require a formal amendment to the protocol. Such amendment will be agreed upon by the vice chancellor of research and Ethics committee of Shiraz University of Medical Sciences.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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