Journal of Multidisciplinary Care (JMDC)
doi: 10.34172/jmdc.1430 2024;13(4):182-188 http://jmdc.skums.ac.ir

Original Article

The Effectiveness of Flipped Classroom and Jigsaw Teaching Methods on Nursing Students' Comprehension of the Classroom Environment in Cardiopulmonary Resuscitation Training

Fatemeh Kiani[1], Mohammadreza Yazdankhahfard[1*], Maryam Ravanipour[2], Razieh Bagherzadeh[3], Amin Beigzadeh[4]

[1]Department of Medical-Surgical Nursing, School of Nursing and Midwifery, Bushehr University of Medical Sciences, Bushehr, Iran
[2]Department of Pediatric Nursing, School of Nursing and Midwifery, Bushehr University of Medical Sciences, Bushehr, Iran
[3]Department of Midwifery, School of Nursing and Midwifery, Bushehr University of Medical Sciences, Bushehr, Iran
[4]Education Development Center, Sirjan School of Medical Sciences, Sirjan, Iran

Abstract

Background and aims: Medical universities are shifting from traditional teaching to active, student-centered approaches. This study evaluated the effectiveness of the flipped classroom and jigsaw methods on nursing students' understanding of the learning environment during cardiopulmonary resuscitation (CPR) training for COVID-19 patients.

Methods: In this quasi-experimental study, 41 seventh-semester nursing students were randomly assigned to either a jigsaw (n = 20) or flipped (n = 21) classroom. Comprehension was assessed using Fraser's questionnaire, and data were analyzed with SPSS through means, standard deviations, and independent t-tests.

Results: The jigsaw classroom group achieved significantly higher average scores across various dimensions compared to the flipped classroom group. Specifically, the jigsaw group scored 27.35 ± 3.63, 26.75 ± 4.96, 22.60 ± 1.79, and 20.55 ± 2.93 for personalization, participation, innovation, and individualization, respectively, with an overall average of 180.20 ± 20.32. In contrast, the flipped classroom group scored lower at 24.67 ± 3.51, 23.38 ± 4.51, 20.48 ± 2.48, and 18.86 ± 2.39, with an overall average of 165.38 ± 19.38.

Conclusion: This study emphasizes the significance of the learning environment in educational success, showing that student-centered strategies like the flipped classroom and jigsaw methods enhance learning, discussion, and communication skills. These approaches can effectively complement or replace traditional methods, particularly in teaching critical skills such as CPR for COVID-19 patients.

Keywords: Medical education, Flipped classroom, Jigsaw, Nursing, Cardiopulmonary resuscitation

***Corresponding Author:**
Mohammadreza Yazdankhahfard, Email: myazdankhahfard@yahoo.com

Received: September 1, 2025
Revised: September 30, 2025
Accepted: October 11, 2025
ePublished: November 5, 2025

Cite this article as: Kiani F, Yazdankhahfard M, Ravanipour M, Bagherzadeh R, Beigzadeh A. The effectiveness of flipped classroom and jigsaw teaching methods on nursing students' comprehension of the classroom environment in cardiopulmonary resuscitation training. Journal of Multidisciplinary Care. 2024;13(4):182–188. doi: 10.34172/jmdc.1430

Introduction

Due to the existing realities in the educational system of medical universities, teaching holds special importance, on the one hand, and enhancing the quality of students' education requires a change in the teaching style and content, on the other hand (1). According to proponents of educational approaches, traditional teaching methods alone lack the capability to respond to the needs and challenges arising from new technologies (2).

Moreover, courses in nursing currently taught in many nursing faculties are primarily based on traditional principles and methods, transferring a substantial amount of information to students without a clear impact (3). Therefore, in recent years, the need for reconsidering traditional teaching methods and adopting innovative and active learning styles, with a focus on student-centered approaches, has been felt by educational systems. The application of these methods has become common in various fields, including medical sciences (4). Accordingly, due to the focus of active methods on student-centered learning (5) and the humanistic paradigm in education (6), participatory learning methods, which culminate in learning through group interaction (7, 8), have been developed.

The jigsaw method is one type of new educational method based on participatory learning. This method was first introduced by Aronson with the aim of developing group collaboration skills in learners (9). The implementation of this method involves initially dividing the written content of the lesson, provided by the instructor, into several parts (usually five or six parts). Additionally, the instructor assigns students to small groups, and each group is given one part of the content. The members of each group are then responsible for teaching the segment of the lesson they have to their fellow group members (10-12). In this method, the instructor, considering the learning conditions, establishes an environment based on collaboration. In such an environment, learners learn to engage in discussions and conversations with their classmates at times when they need assistance. Instead of the instructor being the primary reference, classmates are presented as valuable and significant sources of knowledge. Hannani et al explored the jigsaw method in undergraduate operating room students, identifying potential benefits in learning and understanding the environment (13). However, its specific application in CPR training for patients with coronavirus disease 2019 (COVID-19) warrants further investigation to address gaps in high-stakes clinical skills education.

On the other hand, with the development of educational technologies, learners tend to have a greater inclination toward using online teaching methods. These methods are considered the elements of blended learning (learner-centered approaches) (14). In this type of learning, various forms of technology are utilized to enhance active learning for learners. Thus, the flipped classroom is considered a specific learning model, a subset of blended learning (15). This method was initially introduced by two American educators named Jonathan Bergmann and Aaron Sams (16). According to the research by Lage et al, flipped learning involves conducting activities outside the class that would traditionally be done inside the classroom and vice versa (17). In this method, the instructor provides learners with electronic content containing pre-recorded lectures, either by themselves or with other educators. In addition, learners are required to review these electronic materials before class and come prepared to actively participate in various activities arranged by the instructor during the class. Therefore, the flipped classroom provides conditions that cater to different learning styles of learners (18). In other words, in the flipped classroom, instead of spending time explaining content through lecturing, instructors can use this limited class time for more interactive activities, such as class discussions, peer-supported learning, and group work (19).

The impact of the flipped classroom on learner-centered learning outside the classroom and interactive learning inside the class indicates its favorable outcomes on learning (20). In the flipped classroom method, students learn based on their needs and priorities, and instructors have more time to guide students and provide feedback to each of them (21). Özüdoğru and Aksu examined the flipped classroom in pre-service teachers, noting similarities in environmental understanding but higher progress test scores compared to traditional methods (19). Nonetheless, in the context of CPR training, where real-time collaboration is critical, additional research is needed to evaluate its efficacy relative to other active methods.

Students' perception of the psychosocial environment prevailing over the learning space is also an essential aspect in learners' perspectives on the presented courses (22). In addition to the importance of learning and the method of learning acquisition, one cannot ignore the influence of the learning environment and students' perception of the educational environment on the outcome and the way learners acquire knowledge (23). More precisely, the quality of the learning environment can indicate the effectiveness of an educational program (24). Furthermore, the learning environment is one of the principal and crucial criteria for learners' behavior, and its components are aligned with academic progress and satisfaction with the course (25). The learning environment encompasses all spaces and places where instructors and learners interact to achieve their common goals (26). Improving learners' access to educational objectives is one of the significant impacts of this environment (27). Therefore, any ambiguity in this space can lead to a decrease in learners' interest in various academic subjects and ultimately in their field of study (28). One of the most important responsibilities of instructors is to create an effective learning environment, especially in the education of medical sciences, given the continuous and growing changes in healthcare fields. This is crucial because students are expected to be able to investigate and address unexpected issues that may arise in the care environment, make timely decisions, and collaborate with other members of the healthcare team to resolve them (29).

Cardiopulmonary resuscitation (CPR) is one of the unexpected clinical interventions that is continuously under examination and modification due to its significance in the medical sciences (30). During the prevalence of infectious agents (e.g., COVID-19), CPR becomes particularly more challenging and requires more precise considerations in preventing the transmission of infectious microorganisms to other patients, caregivers, and healthcare staff (31). Considering the impact of the learning environment and students' perception of the learning environment on the learning process, it is necessary to conduct research on the effectiveness of educational methods on nursing students' understanding of the psychosocial environment prevailing in the classroom during CPR training for COVID-19 patients. Thus, the present study is conducted to evaluate the effectiveness of the flipped classroom and jigsaw methods on nursing students' understanding of the prevailing classroom environment at Bushehr University of Medical Sciences, Iran, specifically in the context of CPR education

for COVID-19 patients.

Materials and Methods

Research Design and Participants

This quasi-experimental, two-group posttest study was conducted to determine the effectiveness of the flipped classroom and jigsaw methods on nursing students' understanding of the prevailing classroom environment at Bushehr University of Medical Sciences, Iran, in 2022. The research participants included all seventh-semester undergraduate nursing students (60 individuals) who were purposefully selected based on the entrance criteria through a census approach (41 individuals). Initially, all 60 students in the seventh semester expressed their willingness to participate in the study. However, during the training and implementation of the methods, only 41 students were present. The students were then randomly assigned to the jigsaw class (n = 20) and the flipped classroom class (n = 21) groups.

Research Approach

In this study, an effort was made to ensure consistency among all students in factors other than the different teaching methods (e.g., content, facilitator, and the learning environment). This implies that the same educational content was presented by a specific facilitator in a uniform learning environment, namely, the Nursing and Midwifery School of Bushehr University of Medical Sciences. Before the start of the teaching sessions, an introductory session was held with the students. Before the teaching sessions began, a separate and in-person introductory session was conducted with the students. In this session, necessary explanations about the research objectives were provided to the students, and their informed consent to participate in the study was obtained. Then, the flipped classroom and jigsaw methods were explained to the first and second groups, respectively. During the same session, for the purpose of monitoring the training course, students joined two separate WhatsApp groups (the flipped classroom and jigsaw groups). Through these groups, they received information regarding the course commencement, coordination details about the day and time of the course for the jigsaw group, the CD delivery day, and ongoing monitoring and studying of content for the flipped classroom group. At the end of this session, the demographic information form was completed by the students.

Intervention

In the jigsaw group, during the one-day class session lasting 110 minutes, the students were divided into groups of 5, and the content of CPR in COVID-19 patients was divided into 5 parts. Each part of the content was assigned to one of the members of the group, and individuals had the opportunity to individually study their assigned topic for 10 minutes. Then, individuals with similar content and discussions from each group were grouped into secondary groups, and within a 10-minute period, they discussed the common content in the new (secondary) group. After the allocated time, individuals returned to their initial groups, and each person was given 5 minutes to explain their content to other group members. Finally, the researcher, acting solely as a facilitator, addressed students' questions and ambiguities through various learning activities, such as holding question-and-answer sessions and presenting different algorithms for CPR using fill-in-the-blank questions. All relevant content was reviewed within the 60-minute session. At the end of the class, relevant exams were administered to the students, and all the content and materials provided to them were collected back in order to prevent interaction and sharing of written content with the flipped class group.

The intervention for the flipped class group was conducted one week later, after completing the intervention for the jigsaw class. In the flipped class group, one week before the class, a researcher-made audio-narrated PowerPoint file, along with a PDF version, about CPR in COVID-19 patients, was provided to the students by the researcher on a CD. On the day of the one-day class, which lasted 90 minutes, a pre-test was conducted in the form of a face-to-face question-and-answer session to ensure students' understanding of the course materials. In the class, the researcher, acting solely as a facilitator, presented a summary of the course topics to the students. Afterward, various learning activities (e.g., holding question-and-answer sessions and presenting various algorithms for CPR in the form of fill-in-the-blank questions) were performed to address the students' difficulties. At the end of the class, students were also assessed through relevant exams.

Survey Instrument

The university and faculty classroom environment questionnaire, designed by Fraser and Treagust (32), consists of 49 items and 7 domains (the domains collectively constitute three dimensions). "Personalization," "Participation," "Cohesion," and "Satisfaction" constitute the connection dimension. In addition, the "task orientation" domain forms the personal development dimension. Moreover, the "innovation and individualization" domains comprise the dimension of change and system maintenance. The response options for the questionnaire items are on a 5-point Likert-type scale (never, rarely, sometimes, often, and always). The stages of translation, cultural adaptation, and psychometric evaluation of this tool were performed while adhering to the principles of translation and cultural adaptation. Considering that there is a potential risk to the credibility of the questionnaire during the translation and back-translation process, the content validity and reliability of the tool were examined in the next stage and throughout the research process. Furthermore, the reliability of the questionnaire, an understanding of the classroom environment, was assessed through internal

consistency analysis. Further, Cronbach's alpha for the areas of understanding the classroom environment ranged from 0.650 to 0.832, and it was 0.896 for overall classroom understanding.

Data Analysis

The obtained data were statistically analyzed using SPSS statistical software, version 19. An independent t-test was employed to analyze the differences between the two groups.

Results

Out of 41 participating students in the research, 21 attended the flipped class, including 7 females (33.3%) and 14 males (66.6%). Additionally, 20 students participated in the jigsaw class, consisting of 10 females (50%) and 10 males (50%). Approximately 76.2% of the participants in the flipped class and 70% of participants in the jigsaw class were dormitory residents. Moreover, the average interest in the nursing field among participants in the flipped class (with an average mean of 16.57 ± 1.11) was 6.52 ± 2.36, and among participants in the jigsaw class (with an average mean of 16.59 ± 1.34), it was 6.70 ± 1.92. In addition, it should be noted that the two groups did not exhibit any statistical differences in terms of age ($P = 0.171$), gender ($P = 0.279$), residency in the dormitory ($P = 0.655$), interest in the nursing field ($P = 0.822$), and average ($P = 0.943$).

The comparison of the mean scores in understanding the classroom environment and its domains after the intervention between the flipped and jigsaw classes revealed that in the jigsaw group, the mean scores for personalization (27.35 ± 3.63), participation (26.75 ± 4.96), innovation (22.60 ± 1.79), individualization (20.55 ± 2.93) and the overall mean score of understanding the classroom environment (180.20 ± 20.32) were significantly higher than the mean scores for personalization (24.67 ± 3.51), participation (23.38 ± 4.51), innovation (20.48 ± 2.48), individualization (18.86 ± 2.39) and the overall mean score of understanding the classroom environment (165.38 ± 19.38) in the flipped class group. However, the average scores for other domains (cohesion, satisfaction, and task orientation) showed no statistically significant difference between the two groups (Table 1). These results underscore the facilitator's role in guiding interactions without direct instruction, enhancing the collaborative learning experience in both methods.

Discussion

The present study evaluated the effectiveness of flipped class and jigsaw class methods on the understanding of the classroom environment among nursing students at Bushehr University of Medical Sciences, Iran, with a focus on CPR training for COVID-19 patients.

Both active methods, the flipped class and the jigsaw class, had a positive impact on the understanding of nursing students. This aligns with the findings of Rana et al, demonstrating positive perceptions of active learning among nursing students (33), though our study specifically highlights superior outcomes in jigsaw for CPR-related collaboration. Furthermore, Koohestani and Baghcheghi reported that active learning has a positive and significant impact on nursing students' overall understanding of the psychosocial environment of classrooms. In comparison with traditional lecture methods, nursing students' understanding of this environment is better with active learning (34), which is consistent with our results, where jigsaw outperformed flipped in key domains, potentially due to its emphasis on peer teaching, which is critical for CPR scenarios.

In line with our findings, the results of the study by Khan et al revealed that easy access to study resources–similar to what happens in flipped classrooms through electronic means–anywhere geographically and at any time, leads to positive understanding and acceptance of learners toward learning (35). However, in our CPR-focused training,

Table 1. Comparison of the Mean Scores of Classroom Environment Understanding and Its Dimensions After the Intervention Between the Flipped Class and Jigsaw Class Groups

Domain	Group				Statistic and Significance Level		95% Confidence Interval for Mean Difference (Between-Group Comparison)	
	Flipped Class		Jigsaw Class		Significance Level	*t	Upper Limit	Lower Limit
	Mean	SD	Mean	SD				
Personalization	24.67	3.51	27.35	3.63	0.021	-2.405	-0.43	-4.94
Participation	23.38	4.51	26.75	4.96	0.028	-2.277	-0.38	-6.36
Cohesion	25.52	2.86	27.30	5.01	0.176	-1.386	0.84	-4.39
Satisfaction	26.10	5.59	28.40	4.66	0.166	-1.429	0.96	-5.57
Task orientation	26.38	4.12	27.25	3.49	0.471	-0.727	1.55	-3.29
Innovation	20.48	2.48	22.60	1.79	0.003	-3.129	0.75	-3.50
Individualization	18.86	2.39	20.55	2.93	0.049	-2.031	-0.01	-3.38
Overall environment understanding score	165.38	19.38	180.20	20.32	0.023	-2.363	-2.14	-27.50

Note. SD: Standard deviation.

the pre-class preparation of the flipped method allowed for baseline knowledge, but the interactive elements of the jigsaw method could better simulate team-based resuscitation efforts. Busebaia and John also found that using the combination of events in the flipped classroom (e.g., pre-class activities, pre-recorded video lectures, and post-class activities) is an effective strategy for better understanding of educational content by learners (36); nonetheless, our findings confirmed that jigsaw led to higher personalization and participation, essential for mastering CPR protocols under COVID-19 constraints.

Due to the significance of the learning environment in the success of educational programs and the variability of this environment for each teaching-learning process, it was determined that, despite the positive impact of both methods on the understanding of the class environment, the jigsaw method had a greater influence on enhancing nursing students' perception of the classroom space in this study. Consequently, it affected their interaction, management, self-confidence, and initiative more effectively. Similarly, Chopra et al concluded that the jigsaw method facilitates learning and provides opportunities for student discussions, improving communication and teaching skills (37), which translated to better CPR comprehension through group dynamics in our study. Torabizadeh et al found that there is no difference in the impact on students' perception between the two active methods of puzzle and planned lecture, and both groups have similar understanding of the psycho-social environment of the classes (38); nonetheless, it seems that differences in the content of teaching, the number of sessions presented, the sampling method, and the academic term of participating students may contribute to the distinct results in our recent study, particularly when applied to CPR training where real-time collaboration is paramount (39).

Additionally, an examination of the dimensions of understanding the classroom environment between the two flipped and jigsaw groups showed that the average scores for personalization, participation, innovation, and individualization were significantly higher in the jigsaw group compared to the flipped group. However, in other domains, no statistically significant differences were observed, similar to the findings of the study by Özüdoğru and Aksu, where there was no difference in the understanding of pre-service teachers in both flipped and traditional groups regarding satisfaction, cohesion, and task orientation (19). However, our CPR context revealed jigsaw's edge in innovation, aligning with recent research on active methods in nursing (40). As mentioned earlier, participation in the jigsaw group was higher than in the flipped group in our study, which could be related to different tools for measuring the understanding of the classroom environment and different teaching methods. Moreover, in the study by Koohestani and Baghcheghi, the comparison made between team-based learning and the traditional lecture method resulted in improved understanding of the learning environment for nursing students. In the dimensions of innovation and participation, similar to our study, a statistically significant difference was found between the two groups (34), reinforcing the value of jigsaw in CPR education for fostering these skills (41).

As evident in this study, in both jigsaw and flipped classes, the responsibility of learning was placed on the students, and each individual had the opportunity to memorize the content based on their abilities. However, in the jigsaw class, content personalization alongside individualization and opportunities for students to interact with the instructor in the moment of learning (compared to the flipped class where interaction with the instructor occurred after learning) and innovation in the learning-teaching method resulting from students' engagement in the learning and problem-solving process improved nursing students' understanding. Moreover, the interaction of jigsaw students in groups through feedback, effort to repeat and explain the content, and active collaboration for better learning and teaching contributed to the improvement of their understanding. This meaningful difference in these aspects in the jigsaw class compared to the flipped class highlights the impact of active engagement and collaborative learning in the jigsaw method, especially for CPR training, where team coordination can be life-saving (42).

Nevertheless, no statistically significant difference was observed in the cohesion domain between the two groups since the students were classmates, familiar with each other before the study, and willing to help each other in learning. In addition, given that nursing students at Bushehr University of Medical Sciences first encountered these teaching methods and were insufficiently familiar with students with the active and innovative methods of both jigsaw and flipped, there was no statistically significant difference between the two groups in terms of satisfaction and task orientation.

Based on the findings of this study, it is essential to adapt and update the teaching methods and learning environment for more precise planning in order to improve the educational situation. Considering the results of the current study, student-centered and active methods, including flipped classes and especially jigsaw classes, can be effective in improving the quality of university education in CPR training. Eventually, these methods can be utilized as complementary or alternative approaches to traditional methods.

Limitations of the Study

This study had some limitations, including the specificity of its results to the Nursing and Midwifery School of Bushehr University of Medical Sciences, the focus only on nursing students, particularly in the area of CPR for COVID-19 patients, and the absenteeism and non-participation of some students. In addition, the other limitations were students' incomplete familiarity with

active methods and the lack of investigation into the long-term learning outcomes of the students. Therefore, it is recommended that, due to the scarcity of research evidence in this area, future studies focus on other disciplines and course contents with a broader community and a more extensive sample. In addition to the influential factors in the present study, other effective causes of students' education should also be taken into account.

Conclusion

In general, the study highlights the effectiveness of active teaching methods, particularly the jigsaw approach, in enhancing nursing students' understanding of the classroom environment during CPR training for COVID-19 patients. Both the flipped and jigsaw classes fostered student engagement. Nonetheless, the jigsaw method proved superior in promoting personalization, participation, and innovation, as it not only facilitates learning but also provides the opportunity for student discussions and improves communication and teaching skills. The findings underscore the importance of adapting teaching strategies to improve educational outcomes, suggesting that student-centered methods can significantly enhance the quality of university education in nursing, especially in critical areas like CPR, where collaborative skills are essential.

Acknowledgements

The authors of this research are grateful to the Research Vice-Chancellor of Bushehr University of Medical Sciences and all students who participated in this study.

Authors' Contribution

Conceptualization: Mohammadreza Yazdankhahfard, Amin Beigzadeh.
Data curation: Fatemeh Kiani.
Formal analysis: Mohammadreza Yazdankhahfard, Razieh Bagherzadeh, Amin Beigzadeh.
Investigation: Fatemeh Kiani, Mohammadreza Yazdankhahfard, Maryam Ravanipour, Razieh Bagherzadeh, Amin Beigzadeh.
Methodology: Fatemeh Kiani, Mohammadreza Yazdankhahfard, Maryam Ravanipour, Razieh Bagherzadeh, Amin Beigzadeh.
Project administration: Fatemeh Kiani.
Resources: Mohammadreza Yazdankhahfard, Amin Beigzadeh.
Software: Razieh Bagherzadeh.
Supervision: Fatemeh Kiani, Mohammadreza Yazdankhahfard.
Validation: Mohammadreza Yazdankhahfard, Amin Beigzadeh.
Visualization: Fatemeh Kiani, Mohammadreza Yazdankhahfard, Amin Beigzadeh.
Writing-original draft: Fatemeh Kiani, Maryam Ravanipour, Razieh Bagherzadeh, Amin Beigzadeh.
Writing-review & editing: Fatemeh Kiani, Mohammadreza Yazdankhahfard, Maryam Ravanipour, Razieh Bagherzadeh, Amin Beigzadeh.

Competing Interests

The authors declare no conflict of interests.

Ethical Approval

The present study is a research project (No. 1772) conducted at Bushehr University of Medical Sciences. It was approved by the Ethics Committee of Bushehr University of Medical Sciences (IR.BPUMS.REC.1400.157).

Funding

We thank the Research Deputy of Bushehr University of Medical Sciences for financially supporting this study.

References

1. Hmelo-Silver CE. Problem-based learning: what and how do students learn? Educ Psychol Rev. 2004;16(3):235-66. doi: 10.1023/B:EDPR.0000034022.16470.f3.
2. Hadjerrouit S. Developing web-based learning resources in school education: a user-centered approach. Interdisciplinary Journal of E-Learning and Learning Objects. 2010;6(1):115-35. doi: 10.28945/1172.
3. Chacko TV. Simulation-based medical education: Using best practices and curriculum mapping to maximize educational benefits in the context of shift toward competency-based medical education. Arch Med Health Sci. 2017;5(1):9-15. doi: 10.4103/2321-4848.208217.
4. Curran VR, Sharpe D, Forristall J, Flynn K. Student satisfaction and perceptions of small group process in case-based interprofessional learning. Med Teach. 2008;30(4):431-3. doi: 10.1080/01421590802047323.
5. Marques PA, Correia NC. nursing education based on "hybrid" problem-based learning: the impact of PBL-based clinical cases on a pathophysiology course. J Nurs Educ. 2017;56(1):60. doi: 10.3928/01484834-20161219-12.
6. Goldenberg D, Iwasiw C. Reciprocal learning among students in the clinical area. Nurse Educ. 1992;17(5):27-9. doi: 10.1097/00006223-199209000-00009.
7. Smith KA, MacGregor J. Making small-group learning and learning communities a widespread reality. New Dir Teach Learn. 2000;2000(81):77-88. doi: 10.1002/tl.8106.
8. Keramati MR. Competition or friendship in the classroom. J Psychol Educ. 2001;31(2):139-55. [Persian].
9. Aronson E, Patnoe S. The Jigsaw Classroom: Building Cooperation in the Classroom. 2nd ed. New York: Addison Wesley Longman; 1997.
10. Moskowitz JM, Malvin JH, Schaeffer GA, Schaps E. Evaluation of jigsaw, a cooperative learning technique. Contemp Educ Psychol. 1985;10(2):104-12. doi: 10.1016/0361-476x(85)90011-6.
11. Gömleksiz MN. Effectiveness of cooperative learning (jigsaw II) method in teaching English as a foreign language to engineering students (case of Firat University, Turkey). Eur J Eng Educ. 2007;32(5):613-25. doi: 10.1080/03043790701433343.
12. Maftei G, Maftei M. The strengthen knowledge of atomic physics using the "mosaic" method (the jigsaw method). Procedia Soc Behav Sci. 2011;15:1605-10. doi: 10.1016/j.sbspro.2011.03.338.
13. Hannani S, Samii N, Khacian A. Comparison of traditional and jigsaw teaching methods on learning and perception of learning environment of operating room students of Iran university of medical sciences. J Nurs Educ. 2020;8(5):39-46. [Persian].
14. O'Flaherty J, Phillips C. The use of flipped classrooms in higher education: a scoping review. Internet High Educ. 2015;25:85-95. doi: 10.1016/j.iheduc.2015.02.002.
15. Graham K, Burke K. Students' perceptions on a blended and flipped classroom. Int J Process Educ. 2014;6(1):21-6.
16. Moffett J, Mill AC. Evaluation of the flipped classroom approach in a veterinary professional skills course. Adv Med Educ Pract. 2014;5:415-25. doi: 10.2147/amep.S70160.
17. Lage MJ, Platt GJ, Treglia M. Inverting the classroom: a gateway to creating an inclusive learning environment. J Econ Educ. 2000;31(1):30-43. doi: 10.1080/00220480009596759.
18. Gilboy MB, Heinerichs S, Pazzaglia G. Enhancing student engagement using the flipped classroom. J Nutr Educ Behav. 2015;47(1):109-14. doi: 10.1016/j.jneb.2014.08.008.

19. Özüdoğru M, Aksu M. Pre-service teachers' achievement and perceptions of the classroom environment in flipped learning and traditional instruction classes. Australas J Educ Technol. 2020;36(4):27-43. doi: 10.14742/ajet.5115.
20. Khanova J, Roth MT, Rodgers JE, McLaughlin JE. Student experiences across multiple flipped courses in a single curriculum. Med Educ. 2015;49(10):1038-48. doi: 10.1111/medu.12807.
21. Berrett D. How 'flipping' the classroom can improve the traditional lecture. Chron High Educ. 2012;78(1):1-14.
22. Goh SC, Young DJ, Fraser BJ. Psychosocial climate and student outcomes in elementary mathematics classrooms: a multilevel analysis. J Exp Educ. 1995;64(1):29-40. doi: 10.1080/00220973.1995.9943793.
23. Shirazi M, Aghamolaei T, Dadgaran I, Ghanbarnejad A. Comparison of health students' perceptions and expectations of their educational environment. Br J Med Med Res. 2014;4(35):5657-66. doi: 10.9734/bjmmr/2014/8078.
24. Aghamolaei T, Fazel I. Medical students' perceptions of the educational environment at an Iranian Medical Sciences University. BMC Med Educ. 2010;10:87. doi: 10.1186/1472-6920-10-87.
25. Soemantri D, Herrera C, Riquelme A. Measuring the educational environment in health professions studies: a systematic review. Med Teach. 2010;32(12):947-52. doi: 10.3109/01421591003686229.
26. Dyrbye LN, Thomas MR, Harper W, Massie FS Jr, Power DV, Eacker A, et al. The learning environment and medical student burnout: a multicentre study. Med Educ. 2009;43(3):274-82. doi: 10.1111/j.1365-2923.2008.03282.x.
27. McRobbie CJ, Roth WM, Lucas KB. Multiple learning environments in the physics classroom. Int J Educ Res. 1997;27(4):333-42. doi: 10.1016/s0883-0355(97)90015-x.
28. Fathiazar E. Teaching Methods. 1st ed. Tabriz: Tabriz University Publication Office; 2003. [Persian].
29. Babaei P. Comparing traditional lecture and combination of case and lecture in teaching endocrine physiology for medical students. Res Med Educ. 2012;4(1):1-8. doi: 10.18869/acadpub.rme.4.1.1.
30. Madden C. Undergraduate nursing students' acquisition and retention of CPR knowledge and skills. Nurse Educ Today. 2006;26(3):218-27. doi: 10.1016/j.nedt.2005.10.003.
31. Bai MR, Barati S, Gurjani KH, Payandehmehr P, Totunchi Z, Zanganeh MI, et al. Guide to Resuscitation in Patients with or Suspected of COVID-19. Available from: https://treatment.sbmu.ac.ir/uploads/oldfile/ACLS_&_COVID-19__final_99-01-15.pdf.
32. Fraser BJ, Treagust DF. Validity and use of an instrument for assessing classroom psychosocial environment in higher education. High Educ. 1986;15(1):37-57. doi: 10.1007/bf00138091.
33. Rana S, Garbuja CK, Rai G. Nursing students' perception of online learning amidst COVID-19 pandemic. J Lumbini Med Coll. 2021;9(1):6. doi: 10.22502/jlmc.v9i1.408.
34. Koohestani HR, Baghcheghi N. The effects of team-based learning techniques on nursing students' perception of the psycho-social climate of the classroom. Med J Islam Repub Iran. 2016;30:437.
35. Khan MA, Nabi MK, Khojah M, Tahir M. Students' perception towards e-learning during COVID-19 pandemic in India: an empirical study. Sustainability. 2020;13(1):57. doi: 10.3390/su13010057.
36. Busebaia TJ, John B. Can flipped classroom enhance class engagement and academic performance among undergraduate pediatric nursing students? A mixed-methods study. Res Pract Technol Enhanc Learn. 2020;15(1):4. doi: 10.1186/s41039-020-0124-1.
37. Chopra D, Kwatra G, Bhandari B, Sidhu JK, Rai J, Tripathi CD. Jigsaw classroom: perceptions of students and teachers. Med Sci Educ. 2023;33(4):853-9. doi: 10.1007/s40670-023-01805-z.
38. Torabizadeh K, Fathiazar E, Rahmani A. The effect of two teaching methods on nursing students perception of psycho-social climate of the classroom: jigsaw puzzle versus programmed lecture. Iran J Med Educ. 2010;9(4):290-300.
39. Khodadadeh A, Rivaz M, Torabizadeh C. The effects of flipped classroom and jigsaw teaching strategies on learning, retention of course content, and satisfaction among nursing students: a quasi-experimental study. BMC Med Educ. 2025;25(1):1118. doi: 10.1186/s12909-025-07662-1.
40. Nasiri S, Hosseinabadi R, Mokhayeri Y, Beiranvand S. Impact of flipped classroom-based simulation of CPR on nursing students' self-confidence, satisfaction, knowledge and skill: a quasi-experimental study. BMC Med Educ. 2025;25(1):980. doi: 10.1186/s12909-025-07525-9.
41. Chen Y, Song J, Li M, He H, Wang X, Zhou S, et al. Integrating jigsaw teaching into self-regulated learning instruction: an instructional design to improve nursing students' self-regulated learning. Front Public Health. 2025;13:1437265. doi: 10.3389/fpubh.2025.1437265.
42. Chandel R, Bhagat A, Malhotra AS, Rohilla R, Kaur G, Prakash K. Jigsaw technique: will it help Gen Z nursing students? Adv Physiol Educ. 2025;49(6):304-13. doi: 10.1152/advan.00145.2024.