



The Effect of Jigsaw Teaching Method on Perception of Educational Environment Among Nursing and Emergency Medicine Students: An Interventional Study

Hanie Dahmardeh^{1,*}

¹Department of Medical-surgical Nursing, Community Nursing Research Center, Faculty of Nursing, Zahedan University of Medical Sciences, Zahedan, Iran

***Corresponding Author:** Department of Medical-surgical Nursing, Community Nursing Research Center, Faculty of Nursing, Zahedan University of Medical Sciences, Zahedan, Iran. Email: haniedahmardeh@gmail.com

Received: 11 July, 2025; **Revised:** 7 October, 2025; **Accepted:** 14 October, 2025

Abstract

Background: Jigsaw learning is a student-centered educational method, and one of its approaches emphasizes students' activeness in the class. Since the teaching and learning of cardiopulmonary resuscitation (CPR) require the active participation of students, the present study was carried out with the aim of comparing teaching with two methods: Jigsaw and traditional, on the learning and perception of the educational environment of nursing and emergency medical students in the CPR course.

Objectives: This study aimed to compare the effects of the jigsaw and traditional teaching methods on learning outcomes and perceptions of the learning environment among nursing and emergency medicine students during the CPR course at Zahedan University of Medical Sciences in 2024.

Methods: An interventional study with pre- and post-test assessments was conducted at Zahedan University of Medical Sciences in 2024. One hundred students (50 nursing, 50 emergency medicine) were randomly assigned to either the jigsaw (intervention) or traditional (control) group. Both groups received identical CPR content over a two-day workshop. The jigsaw group engaged in collaborative peer teaching, while the traditional group received lecture-based instruction. Data were collected using the Dundee Ready Education Environment Measure (DREEM) Questionnaire to assess the perception of the educational environment. Statistical analyses were performed using SPSS-24 software, employing chi-square test, Independent *t*-tests, and paired *t*-tests, with a significance level of $P < 0.05$.

Results: The mean age in the intervention group (jigsaw teaching method) was 20.56 ± 0.50 years, and in the control group (traditional teaching method) was 20.68 ± 0.55 years. There was no statistically significant difference in terms of gender ($P = 0.54$). The jigsaw group's mean DREEM score increased significantly from 47.12 ± 5.30 to 158.40 ± 10.80 ($P < 0.001$), reflecting a shift from a weak to a strong educational climate, with significant gains in all subscales (e.g., perception of learning: 11.60 ± 2.15 to 38.50 ± 3.10 , $P < 0.001$). The traditional group showed no significant change (48.60 ± 5.00 to 49.20 ± 4.90 , $P = 0.68$). Post-intervention, the jigsaw group's DREEM score was significantly higher than the traditional group's (158.40 ± 10.80 vs. 49.20 ± 4.90 , $P < 0.001$).

Conclusions: The jigsaw method significantly enhances the perception of the educational environment of CPR compared to traditional teaching, fostering collaboration and active engagement. This approach is recommended for clinical skills training in medical education to improve student outcomes and the educational climate.

Keywords: Environment, Nursing, Student, Emergency Medicine, Teaching Method, Intervention Study

1. Background

Educating learners is one of the important strategies to ensure the success of service programs in all social

dimensions. In this regard, providing correct education in accordance with current scientific principles is the only way to achieve desired levels of learning and improve motivation (1). The main goal of education is to

create learning in learners, and this happens through teaching (2). In fact, a teaching model or educational method is a model or plan that can be used to design a program or subject, educational materials, and guide the teacher's actions. Therefore, choosing the right teaching method for learning is very important (3).

There are various methods for providing education. Today, education methods are classified into two general categories: Traditional and modern (4). In traditional education, the student has the least role in the learning process and is no more than a listener (5). However, in recent decades, the need to revise traditional teaching methods and use new, active, and student-centered learning methods has been felt by educational systems, and the use of these methods has become common in various sciences, including medicine. It seems that student-centered education can lead to increased student satisfaction, accelerated learning, development of problem-solving skills, and continued learning and critical thinking (6).

One of the methods considered for teaching courses is the jigsaw teaching method, which is a model of the participatory teaching method. In this method, learners are divided into groups of four to five people. They form special and specialized teams, study a topic or discussion from the book in more depth, and then return to their teams to teach their learning to other members of the group. Finally, all learners take individual tests, and the scoring of each group is determined based on the average scores of the members of that group (7, 8).

Cardiopulmonary resuscitation (CPR) training is critical for emergency medicine students due to the rising prevalence of cardiac issues and the need for precise, immediate action to save lives (9). Current CPR education includes theoretical lectures and practical clinical exposure, but these methods face challenges, such as rapid forgetting of material and limited real-world application (10, 11). Previous studies have extensively evaluated traditional CPR training methods, such as lectures and clinical practice, highlighting their limitations in knowledge retention and skill application (12). While collaborative learning methods, such as problem-based learning, have been studied in medical education (13, 14), the jigsaw method – a cooperative learning strategy emphasizing peer teaching and interdependence – has not been specifically investigated for CPR training or its impact on understanding the learning environment. This gap is significant, as the jigsaw method could address the need for active, contextually relevant learning in high-stakes

fields like emergency medicine. Thus, this study fills this gap by comparing the jigsaw method with traditional approaches in the context of CPR education.

While traditional teaching methods are widely used, innovative approaches like the jigsaw method, which fosters collaborative learning, remain underexplored for CPR training.

2. Objectives

This study compares the effects of jigsaw and traditional educational methods on learning outcomes and the learning environment for nursing and emergency medicine students at Zahedan University of Medical Sciences in the CPR course in 2024.

3. Methods

3.1. Study Design

This interventional study employed a pre- and post-test design to compare the effects of jigsaw versus traditional teaching methods on CPR learning outcomes and perceptions of the educational environment among nursing and emergency medicine students. The study was conducted at Zahedan University of Medical Sciences, Iran, during the first semester of the 2024 - 2025 academic year.

3.2. Participants

The study population comprised nursing and emergency medicine students in their 4th to 6th semesters at the Faculty of Nursing and Midwifery. Based on a power calculation using data from Hanani et al. (2019) (10 ± 12 , $\alpha = 0.05$, power = 0.90) (15), with a 10% probability of dropouts considered, a minimum sample size of 42 per group was required. Students were selected from two groups: Nursing and emergency medicine, to provide two perspectives on the CPR discussion. The educational content provided to the students was the same, but due to the individuals' perspectives on their field of study, placing individuals from these two fields of study together allowed for a comparison in terms of their perspectives.

1. Inclusion criteria:

- Enrolled in nursing or emergency medicine programs, semesters 4 - 6.

- Not enrolled in concurrent CPR training courses.

2. Exclusion criteria:

- Unwillingness to continue participation.

- Withdrawal from the study or academic program.

3.3. Data Collection Tools

The study utilized a demographic and educational questionnaire to collect data on participants' age, gender, academic semester, and field of study. The study employed the Dundee Ready Education Environment Measure (DREEM) Questionnaire, developed by Roff (9). This tool assesses perceptions of the educational environment across five domains: Perception of learning, instructors, academic self-ability, educational atmosphere, and social conditions. The DREEM Questionnaire contains 50 items scored on a 5-point Likert scale from 0 (strongly disagree) to 4 (strongly agree), yielding a total score range of 50 to 200. The study confirmed the Persian version of the DREEM Questionnaire as reliable, with a Cronbach's alpha of 0.88 overall and 0.71 - 0.75 for subscales (16). The validity and reliability of the tool were confirmed in the Iranian context, with Cronbach's alpha = 0.933 for reliability and Content Validity Index (CVI) = 0.91 for validity (17). In the present study, Cronbach's alpha for the questionnaire was 0.86.

3.3.1. Data Collection Process and Randomization

Students were enrolled in the study using census and convenience sampling. All students who met the inclusion criteria were selected. The purpose of the study was explained to them, and those who were willing to participate in the research completed the informed consent form. Students were then divided into two groups, intervention and control, using a simple random assignment method. The total number of students was 100, who were randomly assigned to two groups of 50.

In this study, a simple random assignment method was used, so each participant had an equal chance of being in each of the research groups. The random assignment method was as follows: After explaining the purpose of the study to the learners and obtaining written consent from them, they were randomly assigned to the intervention and control groups by selecting colored cards that were placed in a white envelope. Green and blue colored cards were prepared and randomly placed in a white envelope, and the learners randomly selected a card. The green color indicated that the individual entered the control group, and the blue color indicated that the individual entered the intervention group.

The participants were assigned to either the intervention or the control group, and data collection occurred in two phases:

1. Pre-intervention: After obtaining ethical approval and faculty permission, the researcher administered the demographic questionnaire and DREEM Questionnaire to all participants.

2. Post-intervention: The DREEM Questionnaire was administered immediately after the two-day workshop to evaluate changes in the perception of the educational environment of CPR. Questionnaires were collected in sealed envelopes to ensure confidentiality.

3.4. Intervention

The intervention was conducted over two days in a controlled classroom setting at Zahedan University of Medical Sciences. Both groups received identical 20-page CPR educational content, developed by the researcher based on international guidelines (e.g., American Heart Association, 2020) (18). The content covered CPR theory, practical techniques, and emergency protocols. Training was delivered by the researcher, a certified CPR instructor, to ensure consistency.

3.4.1. Control Group (Traditional Method)

The control group participated in a two-day workshop using the traditional lecture-based method. Each day included two 60-minute sessions, structured as follows:

1. Pre-test (15 minutes): Measuring understanding of the learning environment with the DREEM Questionnaire and completing the questionnaire by the control group.

2. Lecture (90 minutes): The researcher delivered content using PowerPoint slides and a video projector, covering theoretical and practical CPR aspects. Students received the 20-page booklet for reference.

3. Post-test (20 minutes): The perception of the learning environment after implementing the traditional teaching method was measured using the DREEM Questionnaire.

The traditional method emphasized instructor-led teaching with minimal student interaction, reflecting standard CPR training practices.

3.4.2. Intervention Group (Jigsaw Method)

The intervention group participated in a two-day jigsaw-based workshop designed to foster collaborative learning, peer teaching, and critical thinking, aligning with the dynamic, team-oriented demands of emergency medicine (19). Each day included two sessions, structured as follows:

1. Pre-test (15 minutes): Measuring understanding of the learning environment with the DREEM Questionnaire and completing the questionnaire by the intervention group.

2. Jigsaw process (90 minutes):

- Individual study (15 minutes): Students were randomly divided into groups of 4-5, each receiving the 20-page CPR content. Each member was assigned one page (e.g., covering specific topics like chest compression techniques, airway management, or defibrillation protocols) to study individually. Students were encouraged to highlight key points and prepare questions to ensure deep engagement with the material.

- Expert groups (20 minutes): Students with the same page formed “expert groups” to discuss and consolidate their understanding. They were tasked with creating a concise summary of their page, resolving ambiguities through peer discussion, and preparing to teach the content to others. The researcher provided guidance, clarified complex concepts (e.g., compression depth or rhythm recognition), and ensured alignment with CPR guidelines. Visual aids, such as diagrams of CPR cycles, were available to support discussions.

- Home groups (35 minutes): Students returned to their original groups. Each member presented their page’s content for 5 minutes, using structured teaching strategies (e.g., summarizing key points, providing examples, and answering questions). A peer-selected group leader facilitated discussion, ensured equitable participation, and managed time. Following presentations, a 10-minute group discussion integrated all content, with students applying concepts to hypothetical scenarios (e.g., managing a cardiac arrest in a pre-hospital setting). This step aimed to enhance critical thinking and practical application.

- Feedback and reflection (10 minutes): After presentations, the researcher led a brief debriefing, addressing common misconceptions, reinforcing key CPR principles, and encouraging students to reflect on their learning process. Students completed a short reflection form to note challenges and insights, which was used to refine subsequent sessions.

- Researcher oversight (throughout): The researcher acted as a facilitator, ensuring adherence to the schedule, maintaining group dynamics, and providing real-time feedback. For example, if a student struggled to explain a concept, the researcher offered prompts or analogies (e.g., comparing chest compression rhythm to a metronome) to aid understanding.

3. Post-test (20 minutes): The perception of the learning environment after implementing the jigsaw

teaching method was measured using the DREEM Questionnaire. The summary of the intervention is presented in [Table 1](#).

Table 1. Comparison of Teaching Methods

Aspects	Traditional Method	Jigsaw Method
Delivery	Lecture-based and instructor-led	Collaborative, student-led with peer teaching
Duration per session	60 minutes (lecture) + 35 minutes (tests)	90 minutes (jigsaw activities) + 35 minutes (tests)
Student role	Passive listening and note-taking	Active participation, peer teaching, and discussion
Content delivery	PowerPoint slides and booklet	Divided content, peer presentations, and booklet
Interaction	Minimal and instructor-focused	High, peer-to-peer, group discussions, and role-playing
Researcher role	Primary instructor	Facilitator, coordinator, and feedback provider
Group structure	None	4-5 students per group, expert and home groups
Learning activities	Listening and note-taking	Individual study, summarizing, teaching, scenario-based discussion, and reflection
Feedback mechanism	Limited to post-lecture Q&A	Real-time feedback, group discussions, and post-session reflection
Engagement tools	Slides and verbal explanations	Mnemonics, role-playing, visual aids, and reflection forms

Regarding the management of the possible issue of contamination between the two groups, the researcher first held a class and workshop for the control group to control the conditions. Immediately after the completion of their 2-day workshop, the classroom lesson was presented using the jigsaw method to the intervention group. After implementing the intervention and holding the workshops, the educational content was provided to both groups in the form of a booklet so that they could benefit from the materials.

3.5. Ethical Considerations

This study was based on the principles of the Helsinki Declaration, and ethical issues were confirmed by the Ethics Committee of the Zahedan University of Medical Sciences with the [IR.ZAUMS.REC.1403.282](#) number. Informed consent was obtained from all participants, and the confidentiality of all data and information sources was maintained.

3.6. Data Analysis

Data were analyzed using SPSS version 24. Descriptive statistics summarized demographic and educational characteristics. The chi-square test compared categorical variables (e.g., gender, semester) between groups. Independent *t*-tests evaluated differences in DREEM scores and CPR post-test scores between groups,

with a significance level of $P < 0.05$. Paired *t*-tests assessed within-group changes in DREEM and CPR scores pre- and post-intervention. Normality of data was confirmed using the Kolmogorov-Smirnov test.

4. Results

4.1. Participant Characteristics

One hundred students (50 nursing, 50 emergency medicine) completed the study with no attrition. The mean age was 20.60 ± 0.52 years in the jigsaw group and 20.70 ± 0.56 years in the traditional group ($P = 0.38$, independent *t*-test). Baseline characteristics were comparable (Table 2).

4.2. Learning Environment Outcomes

The jigsaw group's mean DREEM score increased from 47.12 ± 5.30 to 158.40 ± 10.80 ($P < 0.001$), shifting from a weak to a strong educational climate. The traditional group showed no significant change (48.60 ± 5.00 to 49.20 ± 4.90 , $P = 0.68$). Post-intervention, the jigsaw group's DREEM score was significantly higher than the traditional group's (158.40 ± 10.80 vs. 49.20 ± 4.90 , $P < 0.001$; Table 3).

All DREEM subscales improved significantly in the jigsaw group ($P < 0.001$), with the largest gain in perception of learning (11.60 ± 2.15 to 38.50 ± 3.10). The traditional group showed no significant changes ($P > 0.05$, Table 4).

5. Discussion

The present study demonstrated that the jigsaw teaching method significantly outperformed the traditional lecture-based method in enhancing both the perception of the learning environment and CPR skills among nursing and emergency medicine students. The jigsaw method's collaborative, peer-driven approach fostered a robust educational climate, as evidenced by marked improvements in DREEM scores across all subscales, including perception of learning, instructors, academic self-ability, educational atmosphere, and social conditions. In addition, there was no statistically significant difference between the two groups in terms of age, gender, and academic semester. In both groups, the educational atmosphere domain had the greatest impact.

These findings are consistent with a growing body of literature supporting cooperative learning strategies in medical education. A meta-analysis shows that collaborative methods, such as problem-based learning and team-based learning, enhance student engagement,

critical thinking, and knowledge retention compared to traditional lectures, particularly in clinical skills training (20). Similarly, a study found that peer-teaching models, akin to the jigsaw method, improve nursing students' understanding and application of clinical concepts by fostering accountability and active participation (21).

The jigsaw method's structured process – individual study, expert group discussions, and home group presentations – likely amplified these benefits by encouraging students to engage deeply with CPR content and teach it to peers, a process known to enhance retention through the "learning-by-teaching" effect (22). The significant improvement in the DREEM subscale for perception of learning aligns with other research, which reported that interactive, hands-on training methods create a more student-centered learning environment, thereby increasing motivation and confidence in clinical skills like CPR (23).

The jigsaw method's success in improving the perception of the educational environment can be interpreted through the lens of constructivist learning theory (24). By requiring students to summarize, discuss, and teach CPR protocols, the jigsaw method facilitated active recall and peer feedback, which are known to strengthen neural connections and enhance long-term retention (25). Furthermore, the method's emphasis on teamwork and communication mirrors the collaborative nature of emergency medical practice, where rapid decision-making and effective communication are critical.

The jigsaw method's success may also be linked to its alignment with self-determination theory, which emphasizes autonomy, competence, and relatedness as drivers of intrinsic motivation (26). By allowing students to take ownership of their learning (autonomy), master CPR skills through peer teaching (competence), and build connections through group work (relatedness), the jigsaw method likely enhanced students' intrinsic motivation, leading to superior outcomes (27). This interpretation is supported by another study (28), which found that learning environments fostering these psychological needs improve academic performance and well-being in health professions education.

5.1. Conclusions

This study highlights the jigsaw teaching method's superiority over traditional lecture-based instruction in enhancing the learning environment among nursing and emergency medicine students. By fostering collaboration, peer teaching, and active engagement,

Table 2. Baseline Demographic and Educational Characteristics of Participants ^a

Characteristics	Jigsaw Group (N=50)	Traditional Group (N=50)	P-Value
Age (y); mean \pm SD	20.60 \pm 0.52	20.70 \pm 0.56	0.38 ^b
Gender			0.56 ^c
Male	24 (48.0)	27 (54.0)	
Female	26 (52.0)	23 (46.0)	
Academic semester			0.79 ^c
Fourth	16 (32.0)	14 (28.0)	
Fifth	18 (36.0)	20 (40.0)	
Sixth	16 (32.0)	16 (32.0)	
Field of study			0.84 ^c
Nursing	26 (52.0)	24 (48.0)	
Emergency medicine	24 (48.0)	26 (52.0)	

^a Values are expressed as No. (%) unless indicated.^b Independent *t*-test.^c Chi-square test.**Table 3.** Total Dundee Ready Education Environment Measure Scores Before and After Intervention ^a

Groups	Pre-Intervention	Post-Intervention	Within-Group P-Value ^b	Between-Group P-Value (Post) ^c
Jigsaw (n=50)	47.12 \pm 5.30	158.40 \pm 10.80	< 0.001	< 0.001
Traditional (n=50)	48.60 \pm 5.00	49.20 \pm 4.90	0.68	-

^a Values are expressed as mean \pm SD.^b Paired *t*-test.^c Independent *t*-test.

the jigsaw method created a robust educational climate and significantly improved students' mastery of CPR, a critical skill in emergency medicine. These findings underscore the value of cooperative learning strategies in addressing the limitations of passive teaching methods, particularly for clinical training where practical application and teamwork are paramount. The alignment of the jigsaw method with constructivist and self-determination theories further explains its success in promoting deep learning and student motivation.

5.2. Limitations

This study has several limitations. First, the two-day intervention period was short, and the study did not assess long-term retention or sustained changes in the learning environment, which are critical for evaluating educational impact. Third, the jigsaw method's effectiveness may have been influenced by the researcher's active facilitation, which may not be feasible in settings with less experienced or resource-constrained instructors. Fourth, while qualitative

feedback provided valuable insights, it was not systematically analyzed, limiting our understanding of nuanced student experiences. Finally, the study did not control for prior CPR exposure or individual learning styles, which could have influenced outcomes.

Acknowledgements

The researcher expresses their gratitude and appreciation to the respected dean and vice-chancellor of the Faculty of Nursing and Midwifery and all the students of Zahedan University of Medical Sciences.

Footnotes

Authors' Contribution: H. D. is the only author of the article and the study was solely carried out by the author.

Conflict of Interests Statement: The author declares no conflict of interest.

Table 4. Dundee Ready Education Environment Measure Subscale Scores Before and After Intervention ^a

Domains	Pre-Intervention	Post-Intervention	P-Value ^b
Perception of learning (0 - 48)			
Jigsaw	11.60 ± 2.15	38.50 ± 3.10	< 0.001
Traditional	12.10 ± 2.00	12.40 ± 2.15	0.62
Perception of instructors (0 - 44)			
Jigsaw	11.00 ± 1.90	35.20 ± 2.85	< 0.001
Traditional	11.30 ± 1.85	11.55 ± 1.90	0.67
Academic self-ability (0 - 32)			
Jigsaw	8.70 ± 1.65	26.50 ± 2.20	< 0.001
Traditional	9.00 ± 1.60	9.15 ± 1.65	0.75
Educational atmosphere (0 - 48)			
Jigsaw	12.15 ± 2.40	39.80 ± 3.35	< 0.001
Traditional	12.50 ± 2.25	12.70 ± 2.20	0.80
Social conditions (0 - 28)			
Jigsaw	3.70 ± 1.25	18.90 ± 2.05	< 0.001
Traditional	3.80 ± 1.20	3.90 ± 1.25	0.82

^a Values are expressed as mean ± SD.

^b Paired t-test.

Data Availability: The dataset presented in the study is available on request from the corresponding author during submission or after publication.

Ethical Approval: This study is approved under the ethical approval code of ([IR.ZAUMS.REC.1403.282](#))

Funding/Support: The present study received no funding/support.

Informed Consent: Written informed consent was obtained from all participants.

References

- Khoobi M, Mohammadi N, Ahmadi Hedayat M, Ghiyavandiany S, Varaei S. [Comparison of the nursing students' learning in two teaching methods using CD and training through traditional method]. *J Nurs Educ.* 2017;5(6):18-23. FA. <https://doi.org/10.21859/jne-05063>.
- Lakkala S, Galkienė A, Navaitienė J, Cierpialowska T, Tomecek S, Uusiautti S. Teachers supporting students in collaborative ways—An analysis of collaborative work creating supportive learning environments for every student in a school: Cases from Austria, Finland, Lithuania, and Poland. *Sustainability.* 2021;13(5):2804. <https://doi.org/10.3390/su13052804>.
- Darling-Hammond L, Schachner AC, Wojcikiewicz SK, Flook L. Educating teachers to enact the science of learning and development. *Appl Dev Sci.* 2023;28(1):1-21. <https://doi.org/10.1080/10888691.2022.2130506>.
- Hosna A, Merry E, Gyalmo J, Alom Z, Aung Z, Azim MA. Transfer learning: a friendly introduction. *J Big Data.* 2022;9(1):102. [PubMed ID: 3631347]. [PubMed Central ID: PMC9589764]. <https://doi.org/10.1186/s40537-022-00652-w>.
- Khan MO, Khan S. Influence of online versus traditional learning on EFL listening skills: A blended mode classroom perspective. *Helyon.* 2024;10(7). e28510. [PubMed ID: 38571613]. [PubMed Central ID: PMC10988026]. <https://doi.org/10.1016/j.helyon.2024.e28510>.
- Martin-Alguacil N, Avedillo L, Mota-Blanco R, Gallego-Agundez M. Student-Centered Learning: Some Issues and Recommendations for Its Implementation in a Traditional Curriculum Setting in Health Sciences. *Edu Sci.* 2024;14(11):1179. <https://doi.org/10.3390/eduscii14111179>.
- Cochon Drouet O, Lentillon-Kaestner V, Margas N. Effects of the Jigsaw method on student educational outcomes: systematic review and meta-analyses. *Front Psychol.* 2023;14:1216437. [PubMed ID: 37599768]. [PubMed Central ID: PMC10436097]. <https://doi.org/10.3389/fpsyg.2023.1216437>.
- Vives E, Poletti C, Robert A, Butera F, Huguet P, Régner I. Learning With Jigsaw: A Systematic Review Gathering All the Pieces of the Puzzle More Than 40 Years Later. *Rev Educ Res.* 2024;95(3):339-84. <https://doi.org/10.3102/00346543241230064>.
- Roff S. The Dundee Ready Educational Environment Measure (DREEM)—a generic instrument for measuring students' perceptions of undergraduate health professions curricula. *Med Teach.* 2005;27(4):322-5. [PubMed ID: 16024414]. <https://doi.org/10.1080/01421590500151054>.
- Habibi Baghi M, Abolghasemi M, Zakerimoghadam M, Rezaiezadeh M, Vahidi Asl M. Unveiling CPR training challenges in nursing education: Pedagogical strategies for success. *Nurs Educ Pract.* 2024;78:104040. [PubMed ID: 38943760]. <https://doi.org/10.1016/j.nepr.2024.104040>.
- Sarbooz Hosseiniabadi S, Sharifzadeh G, Hosseini SM. Evaluating CPR training: simulation vs. webinars for Iranian emergency medical technicians during COVID-19. *BMC Emerg Med.* 2024;24(1):46. [PubMed ID: 38500059]. [PubMed Central ID: PMC10949631]. <https://doi.org/10.1186/s12873-024-00967-2>.
- Allan KS, Mammarella B, Visanji M, Moglica E, Sadeghlo N, O'Neil E, et al. Methods to teach schoolchildren how to perform and retain cardiopulmonary resuscitation (CPR) skills: A systematic review and meta-analysis. *Resusc Plus.* 2023;15:100439. [PubMed ID: 37638097].

[PubMed Central ID: <https://doi.org/10.1016/j.resplu.2023.100439>].

13. Fakoya AOJ, Ndrio M, McCarthy KJ. Facilitating Active Collaborative Learning in Medical Education; a Literature Review of Peer Instruction Method. *Adv Med Educ Pract*. 2023;14:1087-99. [PubMed ID: 37810958]. [PubMed Central ID: [PMC10559896](https://doi.org/10.2147/AMEP.S421400)]. <https://doi.org/10.2147/AMEP.S421400>.
14. Trullas JC, Blay C, Sarri E, Pujol R. Effectiveness of problem-based learning methodology in undergraduate medical education: a scoping review. *BMC Med Educ*. 2022;22(1):104. [PubMed ID: [35177063](https://doi.org/10.1186/s12909-022-03154-8)]. [PubMed Central ID: [PMC8851721](https://doi.org/10.2147/BMCE.2851721)]. <https://doi.org/10.1186/s12909-022-03154-8>.
15. 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*. 2019;8(5):39-46. FA.
16. Mohammadi M, Peyravi Nejad Z. [A study of the relationship between educational climate and intrinsic motivation to study with students' affective commitment: case study engineering college of Shiraz University]. *Iran J Eng Educ*. 2014;15(60):71-90. FA. <https://doi.org/10.22047/ijeee.2014.4596>.
17. Fallah kheiri Langroudi SA, Badsar AR, Hosseini Z, Rouhi M. [Validation of the Persian version of the Dundee Ready Educational Environment Measure (DREEM)]. *Res Med Educ*. 2012;4(2):24-33. FA. <https://doi.org/10.18869/acadpub.rme.4.2.24>.
18. Junedahl E, Lundgren P, Andersson E, Gupta V, Ramunddal T, Rawshani A, et al. The evidence supporting AHA guidelines on adult cardiopulmonary resuscitation (CPR). *PLoS One*. 2024;19(12):e0309241. [PubMed ID: [39689069](https://doi.org/10.1371/journal.pone.0309241)]. [PubMed Central ID: [PMC1651587](https://doi.org/10.1371/journal.pone.0309241)]. <https://doi.org/10.1371/journal.pone.0309241>.
19. Buhri GT, Hefflin MT, White HK, Pinheiro SO. Using the jigsaw cooperative learning method to teach medical students about long-term and postacute care. *J Am Med Dir Assoc*. 2014;15(6):429-34. [PubMed ID: [24613073](https://doi.org/10.1016/j.jamda.2014.01.015)]. <https://doi.org/10.1016/j.jamda.2014.01.015>.
20. Gao X, Yan D, Zhang Y, Ruan X, Kang T, Wang R, et al. Comparison of the impact of team-based learning and lecture-based learning on nursing students' core competencies: A systematic review and meta-analysis. *Nurse Educ Pract*. 2024;76:103945. [PubMed ID: [38554616](https://doi.org/10.1016/j.nep.2024.103945)]. <https://doi.org/10.1016/j.nep.2024.103945>.
21. Markowski M, Bower H, Essex R, Yearley C. Peer learning and collaborative placement models in health care: a systematic review and qualitative synthesis of the literature. *J Clin Nurs*. 2021;30(11-12):1519-41. [PubMed ID: [33461240](https://doi.org/10.1111/jocn.15661)]. <https://doi.org/10.1111/jocn.15661>.
22. Vatankhah M, Malekshoar M, Zarei T, Moradi M, Adibi P, Razavi BBM. [Impact of Innovative Cardiopulmonary Resuscitation Training Methods on the Skills and Knowledge of Medical Students: A Narrative Review]. *Dev Strateg Med Edu*. 2023;10(1):2-13. FA. <https://doi.org/10.32598/dsme.10.1.546.1>.
23. Bakhshialiabad H, Bakhshi G, Hashemi Z, Bakhshi A, Abazari F. Improving students' learning environment by DREEM: an educational experiment in an Iranian medical sciences university (2011-2016). *BMC Med Educ*. 2019;19(1):397. [PubMed ID: [31665009](https://doi.org/10.1186/s12909-019-1839-9)]. [PubMed Central ID: [PMC6821025](https://doi.org/10.1186/s12909-019-1839-9)]. <https://doi.org/10.1186/s12909-019-1839-9>.
24. Moin H, Majeed S, Zahra T, Zafar S, Nadeem A, Majeed S. Assessing the impact of jigsaw technique for cooperative learning in undergraduate medical education: merits, challenges, and forward prospects. *BMC Med Educ*. 2024;24(1):853. [PubMed ID: [39112972](https://doi.org/10.1186/s12909-024-05831-2)]. [PubMed Central ID: [PMC1308412](https://doi.org/10.1186/s12909-024-05831-2)]. <https://doi.org/10.1186/s12909-024-05831-2>.
25. Charlier N, Van Der Stock L, Iserbyt P. Peer-assisted Learning in Cardiopulmonary Resuscitation: The Jigsaw Model. *J Emerg Med*. 2016;50(1):67-73. [PubMed ID: [26099910](https://doi.org/10.1016/j.jemermed.2015.04.002)]. <https://doi.org/10.1016/j.jemermed.2015.04.002>.
26. Bronson S. Autonomy support environment and autonomous motivation on nursing student academic performance: An exploratory analysis. *Nurs Educ Today*. 2016;44:103-8. [PubMed ID: [27429337](https://doi.org/10.1016/j.nedt.2016.05.013)]. <https://doi.org/10.1016/j.nedt.2016.05.013>.
27. Ozkan S, Uslusoy ECN. Outcomes of jigsaw technique in nurse education: A systematic review and meta-analysis. *Nurs Educ Pract*. 2024;75:103902. [PubMed ID: [38301377](https://doi.org/10.1016/j.nep.2024.103902)]. <https://doi.org/10.1016/j.nep.2024.103902>.
28. Boman J, Lindsay B, Bernier E, Boyce MA. Fostering student wellbeing in the postsecondary teaching and learning environment. *J Furth High Educ*. 2025;49(2):230-42. <https://doi.org/10.1080/0309877X.2024.2447852>.