

Original Article

Jigsaw technique: An innovative way to promote cooperative, self-directed learning among 2nd-year medical undergraduates in pharmacology

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ABSTRACT

Objectives: The primary objective of the study was to assess and compare the effectiveness of Jigsaw Technique and Student Seminar during self-directed learning (SDL) sessions. The secondary objective was to evaluate the perception of students towards the Jigsaw technique.

Materials and Methods: Two contact sessions of SDL were planned with a gap of 7 days in between so that the students could learn at their own pace and comfort zone. Each contact session was of 2 h duration. In contact session 1, the entire batch of 200 was divided into two groups. The student seminar group served as the control, and the Jigsaw technique served as the test group. The topic 'Acute Coronary Syndromes' was chosen and further divided into different subtopics. Students were asked to frame learning objectives, and subtopics were assigned to both groups. Details about the two teaching methods were provided in detail. A gap of 7 days was provided for the learners to find resources, read and contact the facilitator if required for guidance. In contact session 2, a pre-test in the form of multiple-choice questions was conducted for the entire batch, following which the student seminar group made PowerPoint presentations, while the jigsaw group had a mixed group discussion, wherein two experts from each subtopic formed a group and taught peers to provide an overall picture of the topic. The facilitator monitored the peer teaching and cleared doubts, if any.

Results: Pre (13.42 ± 6.17) and post-test ($16.19 \pm 5.32^*$) scores of the student seminar were compared. Similarly, pre (11.18 ± 6.36) and post-test ($17.48 \pm 4.40^*$) scores of Jigsaw were compared. Students' performance was better in the post-test ($*P < 0.0001$) in both methods. However, on comparing the post-test scores of both groups, the Jigsaw method showed significant results ($17.48 \pm 4.40^*$), as compared to the student seminar (16.19 ± 5.32) ($P < 0.05$).

Conclusion: The Jigsaw technique is a powerful active learning method that enhances cooperative and SDL among medical undergraduates in pharmacology. Integrating the Jigsaw method into SDL sessions can significantly improve learning outcomes and prepare students for collaborative clinical practice.

Keywords: Acute coronary syndrome, Jigsaw technique, Self-directed learning, Student seminar

INTRODUCTION

Competency-based medical education (CBME) has revolutionised medical training by shifting the focus from time-bound learning to skill acquisition and competency development. Unlike traditional methods that emphasise rote memorisation, CBME requires students to develop clinical reasoning, problem-solving abilities and hands-on skills essential for patient care. However, the conventional lecture-based approach often fails to meet these demands, leading to the need for innovative teaching-learning strategies. Incorporating modern pedagogical

techniques such as the Jigsaw technique could enhance student engagement, improve knowledge retention and foster critical thinking.

CBME for medical undergraduates highlights the approach of self-directed learning (SDL), which is based on adult learning principles and experiential learning. A paradigm shift in the curriculum from teacher-centred to a student-centred approach involves active participation of the learner, whereas a teacher only stimulates students' interest in the subject. The onus of learning ultimately lies with the student. SDL aims to help the learner in identifying their own learning needs as well as to choose and implement a suitable plan of action with evaluation of learning outcomes.^[1] Students understand the topic better when allowed to learn at their own pace and in their own learning styles. There are a number of challenges in medical education that can be overcome by certain modifications in teaching and learning methods. Innovative teaching and learning methods incorporated in SDL sessions can make the topic more interesting and enjoyable. Therefore, the present SDL session was planned among 2nd-year medical undergraduates using two different methods, namely student seminar and the jigsaw technique. Jigsaw method is based on five basic principles, namely individual accountability, peer assistance, group involvement, positive interdependence and interpersonal relationships.^[2,3] We chose 'Acute Coronary Syndromes' (ACS) for the SDL session, as the concept of ACS is not very clear among most of the undergraduate students.

The term 'Acute Coronary Syndromes' includes ST-elevation myocardial infarction (STEMI), non-STEMI and unstable angina. Cardiovascular disease is the major cause of death worldwide, with nearly half of these deaths occurring due to ischaemic heart disease.^[4,5] According to study reports by Global Burden of Disease, the prevalence of both ischaemic heart disease and stroke has escalated by 2.3 fold in India between the 1990s and 2016.^[6] The burgeoning cardiovascular disease (CVD) epidemic in India is certainly a matter of concern. If appropriate intervention is not taken at the right time, the morbidity and mortality due to CVD would definitely cripple a developing country like India. ACS requires emergency medical care at the earliest. Increasing awareness among medical undergraduates of the typical and atypical presentations of ACS is extremely important for optimal and timely management of such patients. Knowledge about management of ACS acquired during under studies helps them during postgraduation and beyond as a medical professional. As mentioned earlier, in the Jigsaw technique, students are active learners; they interact with their peers, which helps them in gaining a better understanding of the topic, while teachers act as facilitators. Therefore, the present study was planned on the topic 'Acute Coronary Syndromes' to

evaluate and compare the effectiveness of the Jigsaw technique and student seminar conducted through SDL sessions among 2nd-year medical undergraduates in pharmacology.

MATERIALS AND METHODS

SDL: Plan of action

The topic 'Acute Coronary Syndromes' was selected for SDL for the students to acquire a clear concept of the topic and to stimulate interest among students in learning the topic.

A total of 200 2nd-year medical undergraduate students participated in this study. They were divided into two groups: the Control group ($n = 100$) that engaged in a student seminar-based learning approach, while the test group ($n = 100$) utilised the Jigsaw technique for learning.

The study was approved by the Institutional Review Board at JNMC Institutional Ethics Committee, Jawaharlal Nehru Medical College, KAHER, Belagavi, number MDC/JNMCIEC/562, dated January 4th, 2025. Informed consent was obtained from the participants.

The following flowchart depicts the conduct of the entire study as shown in Figure 1.

Contact sessions and learning structure

Two structured contact sessions were conducted, separated by a 7-day intersession period, allowing students to study at their own pace. Each contact session lasted 2 h.

Contact session 1: Orientation and objective setting

This contact session was common for both the Jigsaw group (test group) and the student seminar (control group)

The flowchart depicts the lesson plan for contact session 1 as shown in Figure 2.

In contact session 1

In the first contact session, the faculty facilitated the students' discussion towards setting the objectives for their learning pertaining to:

1. Definition of ACS and diagnostic criteria for Non ST elevation myocardial infarction (NSTEMI) – ACS and ST elevation myocardial infarction (STEMI)
2. Protocol for management of NSTEMI and STEMI (role of pharmacological and interventional management)
3. Detailed classification of drugs used in the management of ACS and pharmacology of fibrinolytic drugs
4. Role of following drugs – Morphine, beta blockers, nitrates, calcium channel blockers in the management of ACS
5. Rationale for the use of antiplatelet, anticoagulants and angiotensin-converting enzyme inhibitors in ACS.

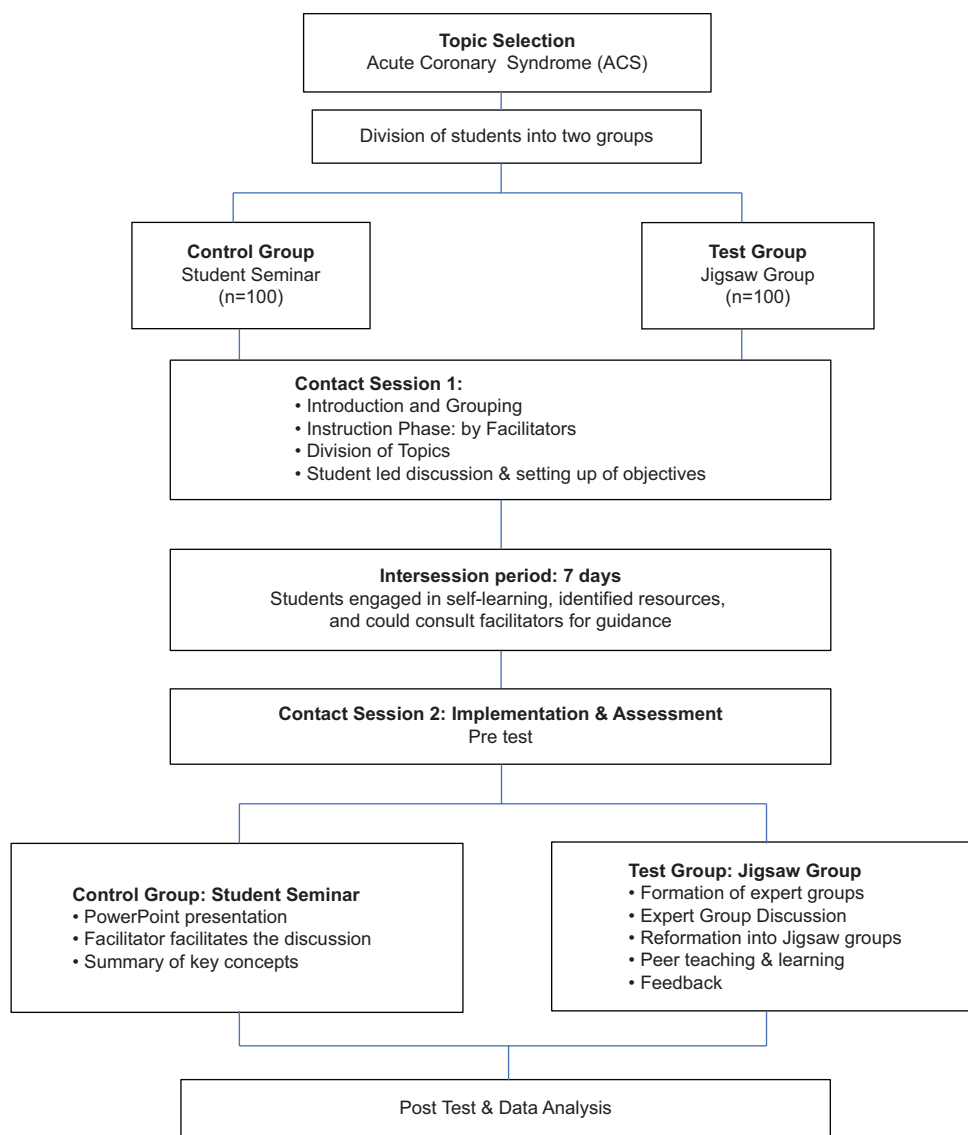


Figure 1: Flow diagram illustrating the conduct of the study.

Figure 3 depicts the division of students and distribution of subtopics (based on objectives) in the student seminar group (control).

Contact session 2: Implementation and assessment

Pre-test (multiple-choice question [MCQs]): A MCQ-based pre-test was conducted for all 200 students.

Implementation of student seminar (control group)

The control group participated in a traditional student seminar-based learning approach.

PowerPoint presentation preparation

Each student prepared a structured PowerPoint presentation based on their assigned subtopic.

Seminar presentations

Each student presented their topic to the rest of the control group. A designated time limit was set for each presentation to ensure structured learning.

Discussion and faculty guidance

The faculty provided insights, clarified doubts and facilitated discussions after each presentation. Students were encouraged to ask questions and engage in critical discussions. In the end, the faculty summarised key concepts from the presentations to reinforce understanding.

Implementation of jigsaw technique (test group)

In the jigsaw technique, students were divided into 5 groups, each consisting of 10 participants and one facilitator. Each

group was assigned a specific subtopic of ACS based on the objectives formulated by them.

Figure 4 depicts the division of students and distribution of subtopics in the Jigsaw group (test).

The learning process followed these structured steps:

Formation of expert groups

Each of the 5 groups was assigned a subtopic. Students within each group worked together as an ‘expert group’ to research and gain a thorough understanding of their assigned topic.

Students utilised textbooks, journal articles and online resources to gather information pertaining to their assigned subtopics. Facilitators provided guidance and clarified doubts.

Expert group discussions

Each expert group discussed key points, synthesised their findings and prepared simplified explanations and key takeaways.

Reformation into jigsaw groups

Students were reassigned to new groups, ensuring that each group contained one expert from each subtopic. Each expert taught their respective subtopic to the rest of their Jigsaw group, facilitating peer learning and discussion.

Facilitator support

A faculty member was assigned to each Jigsaw group to oversee discussions, provide additional explanations and

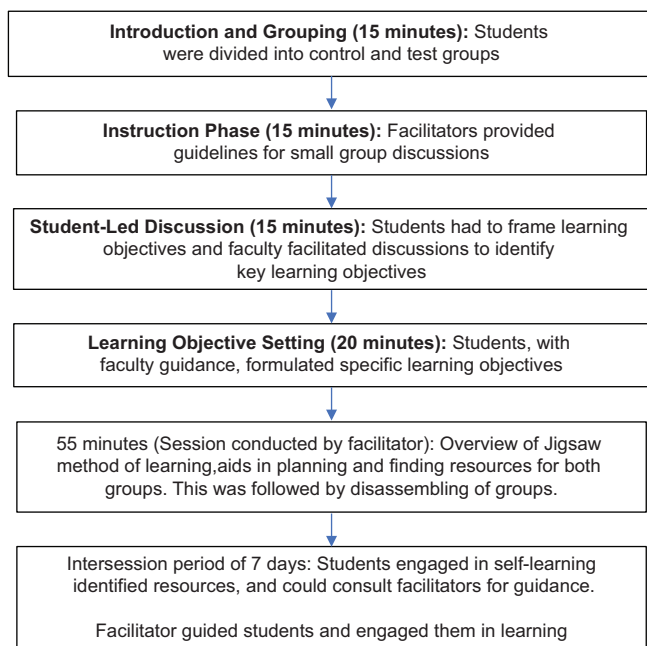


Figure 2: Outline of contact session 1.

ensure accuracy in understanding. The groups engaged in further discussion to consolidate their learning and clarify doubts collectively.

Final review

The students returned to their respective groups. Each group summarised the key takeaways, and facilitators addressed any remaining questions before concluding the session.

The flowchart depicts the lesson plan for contact session 2 as shown in Figure 5.

Statistical analysis

Data analysis was carried out using GraphPad Prism. The pre-test and post-test scores were compared for both the student seminar and the Jigsaw technique using a paired *t*-test. The post-test scores of both methods were also analysed using an unpaired *t*-test. Data were expressed as mean ± standard deviation. *P* < 0.05 was considered statistically significant.

RESULTS

Table 1 depicts a comparison of pre-test and post-test scores of the student seminar. Table 1 shows a significant improvement in post-test scores when compared to pre-test (*P* < 0.0001, *n* = 100).

Table 2 illustrates a comparison of pre-test and post-test scores of the Jigsaw technique. It reveals a significant improvement in post-test scores compared to pre-test (*P* < 0.0001, *n* = 100).

Table 3 depicts the comparison of post-test scores of the student seminar and the Jigsaw Method. As illustrated in Table 3, there was a significant improvement in post-test scores in the Jigsaw method when compared to student seminar (*P* < 0.05, *n* = 100).

Table 4 depicts the perception of students regarding the Jigsaw technique. The majority of the students opined that the Jigsaw technique fosters active learning, boosts motivation, engagement and self-confidence; reduces competition and conflict and fosters a collaborative environment. In addition, they felt that it ensured comprehensive coverage of the topic and also helped them to overcome shyness and hesitation.

Table 1: Comparison of pre-test and post-test scores of student seminar (*n*=100).

Student seminar	Mean±SD
Pre-test	13.42±6.17
Post-test	16.19±5.32*

Paired *t*-test, **P*<0.0001, SD: Standard deviation

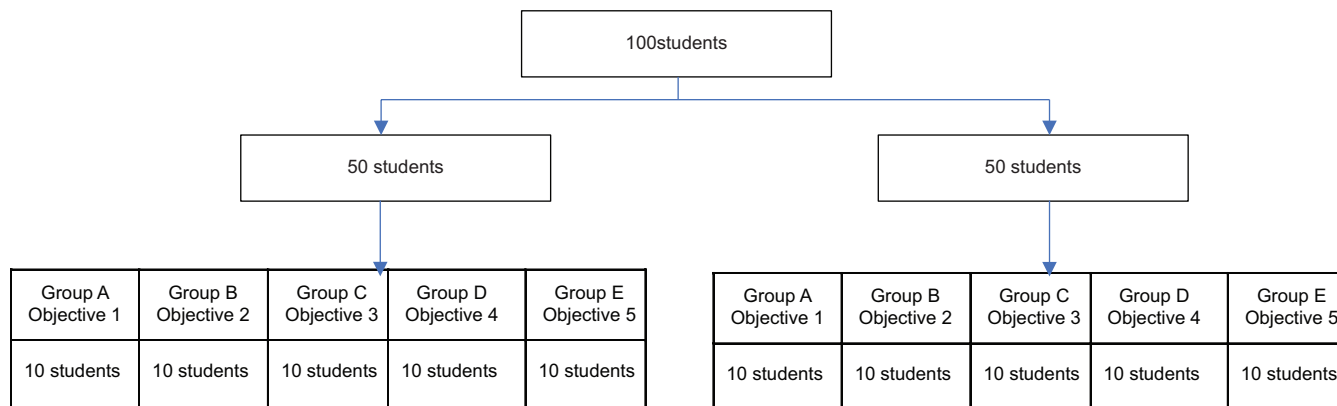


Figure 3: Depicts division of students and distribution of subtopics in the Student Seminar group (control).

Table 2: Comparison of pre-test and post-test scores of Jigsaw method ($n=100$).

Jigsaw method	Mean±SD
Pre-test	11.18±6.36
Post-test	17.48±4.40*

Paired *t*-test, * $P<0.0001$, SD: Standard deviation

Table 3: Comparison of post-test scores of student seminar and Jigsaw method ($n=100$).

Student seminar and Jigsaw method	Mean±SD
Post-test (Student seminar)	16.19±5.32
Post-test (Jigsaw Method)	17.48 ±4.40*

Unpaired *t*-test, * $P<0.05$, SD: Standard deviation

Overall, the students opined that the Jigsaw method was both enjoyable and an effective learning strategy.

DISCUSSION

The present study aimed at encouraging the use of an innovative teaching learning method during SDL sessions to enhance the interest of the students in the topic. SDL can help in the development of metacognitive skills. It is a process where individuals take the lead, identify their learning goals, collect resources for the same, select the appropriate learning strategies, implement and evaluate the learning outcomes.^[1]

SDL improves students' potential to find the association between various learning concepts and improves retention of knowledge as well as its application.^[7] SDL in the form of a routine seminar might lack engagement and fail to sustain student interest. Hence, we planned to adopt the jigsaw technique and compare it to the routinely used student seminar. The topic chosen had enough weightage in the curriculum and was clinically relevant too. The objectives

of the session were discussed in advance during the first session for both groups, and the students had enough time to prepare.

On analysing the results, both methods showed a remarkable improvement in their respective post-test scores when compared to the pre-test. On comparing post-test scores of both methods, the Jigsaw method showed significant results compared to the student seminar.

In the student seminar, the undergraduates presented the allotted topics quite well. They were confident and seemed to have an in-depth knowledge of their respective subtopics. However, students lacked enough knowledge about the subtopics assigned to their peers. Although these presentations were facilitated by a facilitator, students did not seem to be very attentive during the presentations of their fellow students. Furthermore, there was not much interaction and discussion among peers.

On the other hand, in the jigsaw technique, there was active participation and enthusiasm among students. More than 50% of the students opined that there was active communication among their peers, discussions which enhanced logical thinking and motivated them to gain an in-depth knowledge about the subtopics. In mixed group discussions, every student was accountable for learning and shared their knowledge with others. Each student had to prepare well, teach others and learn from them as well. The majority of them opined that it helped them to overcome shyness and hesitation in class. As the students were allotted topics before, it improved comprehension by allowing students to learn from multiple sources and modalities. This maximised interaction among peers and provided an atmosphere of cooperation and mutual respect among peers. Students gained a thorough knowledge of the entire topic rather than a single subtopic. As they were actively involved during the entire session, it helped them in gaining self-confidence. This method also helped them to reduce competition and conflict as it encouraged students to depend on each other for learning and success.

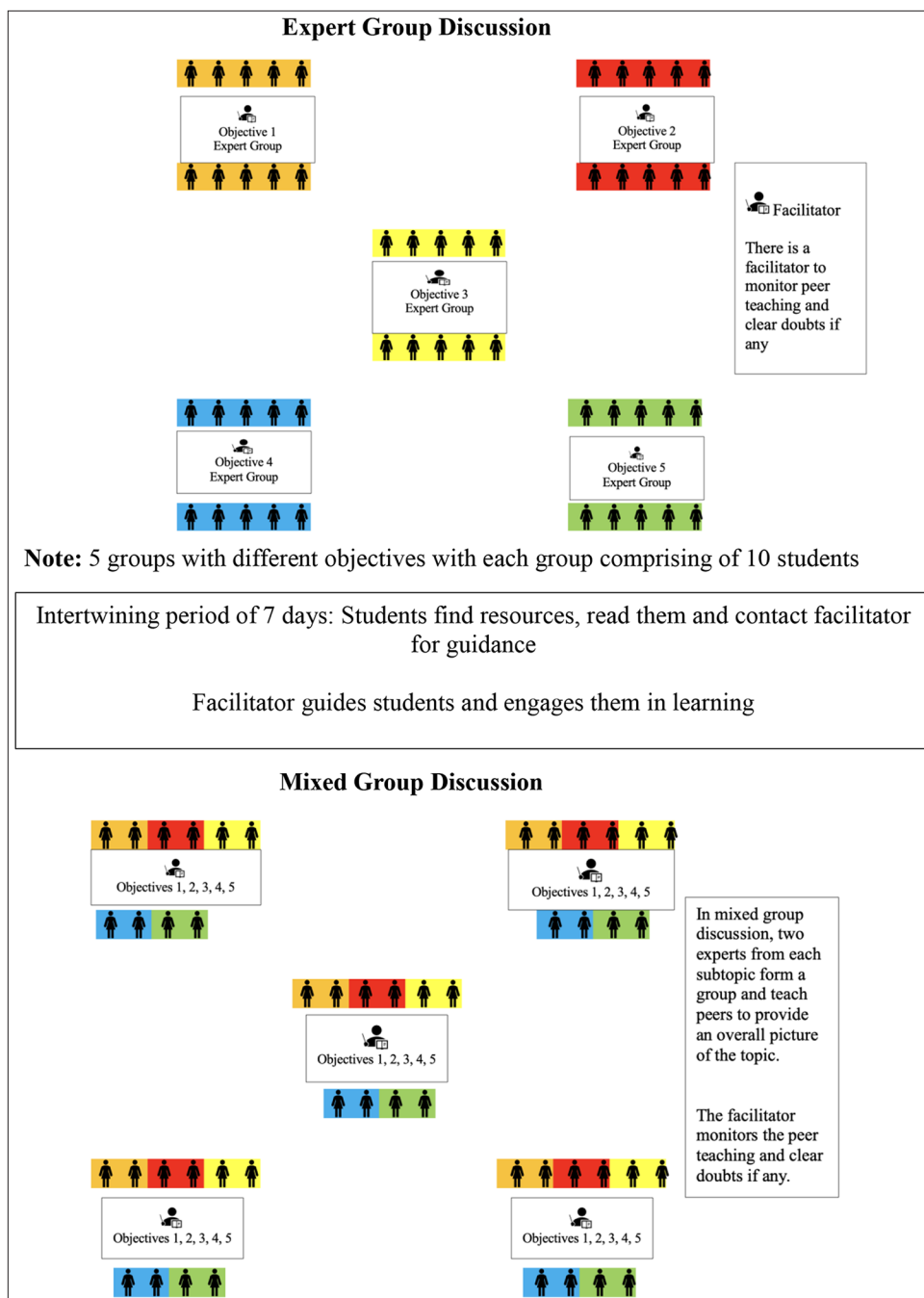


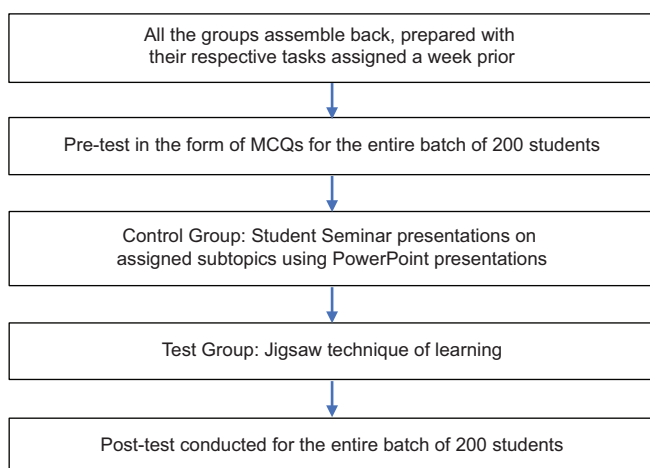
Figure 4: Depicts division of students and distribution of subtopics in the Jigsaw group (test).

This method helped students to transform from passive to active learners, enhance critical thinking and promote life-long learning skills. These findings were in accordance with the results obtained from a study carried out by Bhandari *et al.*^[8] Overall, the majority of them opined that it was enjoyable and an effective way of learning. Open-ended questions regarding the best part of the learning experience using the Jigsaw method were that students found it an effective means

of quick learning and interaction among peers. The students also appreciated the importance of the facilitator in clearing their doubts. They liked the mixed group discussion and peer teaching, which helped them to actively participate in the study. They also opined that it was good to work as a team, which enhanced their clarity about the topic. The limitation mentioned by the students was that the technique was a bit time-consuming. The technique requires a lot of planning

Table 4: Perception of students regarding Jigsaw technique ($n=100$).

S. No.	Content	Response using Likert scale				
		5	4	3	2	1
1	Jigsaw method encourages active learning	20 (35.1)	29 (50.9)	4 (7)	0 (0)	4 (7)
2	Promotes cooperative learning	18 (31.6)	31 (54.4)	4 (7)	0 (0)	4 (7)
3	Enhances motivation, engagement and self-confidence as students have a clear role and purpose in the group	18 (31.6)	33 (57.9)	2 (3.5)	0 (0)	4 (7)
4	Reduce competition and conflict as it encourages students to depend on each other for learning and success (teamwork)	17 (29.8)	31 (54.4)	3 (5.3)	2 (3.5)	4 (7)
5	Improves retention and comprehension by allowing students to learn from multiple sources and modalities	21 (36.8)	27 (47.4)	4 (7)	1 (1.8)	4 (7)
6	Encouraging active learning and promoting social skills such as communication, collaboration, listening and respect	20 (35.1)	31 (54.4)	2 (3.5)	0 (0)	4 (7)
7	Activity was useful in comprehending the given topic and enabled in-depth coverage of the topic	22 (38.6)	28 (49.1)	3 (5.3)	0 (0)	4 (7)
8	Activity helped in overcoming shyness and hesitation in class	21 (36.8)	28 (49.1)	2 (3.5)	2 (3.5)	4 (7)
9	Exercise was enjoyable and an effective way of learning	19 (33.3)	31 (54.4)	2 (3.5)	1 (1.8)	4 (7)

**Figure 5:** Outline of Contact Session 2

and execution, which may not be acceptable to all faculties. The results of the jigsaw technique in terms of retention of knowledge have not been evaluated further due to time constraints. Another limitation is that the evaluators, as well as the students, were not blinded in the study. However, in an educational research involving active learning strategies such as the Jigsaw technique, complete blinding of participants and evaluators is inherently difficult due to the interactive and participatory nature of the intervention. Students were actively involved in group-based learning formats that were distinct from traditional seminars, making concealment impractical. While blinding was not feasible, we took several steps to minimise potential bias. A uniform, structured and pre-validated questionnaire was used for both pre- and post-tests to ensure consistency in assessment. We also observed relatively wide standard deviations in pre- and post-test

scores, particularly in the pre-test phase of both the Student Seminar and Jigsaw groups. This variation is likely reflective of differences in baseline knowledge, individual learning pace and varying levels of prior exposure to the topic among students, a common occurrence in diverse undergraduate medical cohorts. Importantly, despite the initial heterogeneity, the reduction in standard deviation from pre- to post-test in both groups (especially noticeable in the Jigsaw group) suggests that the learning interventions, particularly the Jigsaw technique, contributed to narrowing the performance gap. This reinforces the value of collaborative and self-directed strategies in harmonising learning outcomes across a diverse group of learners.

Thorough knowledge, ability to work as a team and communication skills are crucial in becoming a successful Indian Medical Graduate. Hence, we could achieve this using the jigsaw technique efficiently.

Overall, the students were quite satisfied with this cooperative learning method, which can be easily adopted for other topics as well. This study provides a framework for broader implementation that, in turn, would enhance the practical applicability of our findings. While the primary aim of this study was to evaluate the effectiveness of the Jigsaw technique in a controlled classroom setting, we recognise the importance of scalability in educational interventions. Based on our experience, we propose a stepwise framework for implementation at scale, which includes faculty sensitisation and training to ensure consistent facilitation, standardised content templates for topic division and subgroup allocation, integration into existing curricular modules where cooperative learning is feasible, use of peer evaluation and structured assessment rubrics to maintain quality, feedback

loops for continuous refinement based on student and faculty input highlighting its potential as an effective strategy in the evolving framework of medical education.

CONCLUSION

The Jigsaw method is an effective active learning strategy that enhances cooperative and SDL among medical undergraduates in pharmacology. By promoting peer teaching, critical thinking and teamwork, this method encourages deeper understanding and engagement with complex pharmacological concepts. Our study highlights its potential in fostering student-centred learning, making it a valuable addition to modern medical education. Incorporating the Jigsaw method into SDL sessions can significantly improve learning outcomes and prepare students for collaborative clinical practice.

Ethical approval: The research/study was approved by the Institutional Review Board at JNMC Institutional Ethics Committee, JNMC, Belagavi, approval number MDC/JNMCIEC/562, dated 4th January 2025.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship: Nil.

Conflicts of interest: There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript, and no images were manipulated using AI.

REFERENCES

1. Murad MH, Varkey P. Self-directed learning in health professions education. *Ann Acad Med Singap* 2008;37:580-90.

2. Smith KA, Sheppard SD, Johnson DW, Johnson RT. Pedagogies of engagement: Classroom-based practices. *J Eng Educ* 2005;94:87-101.
3. Sagsoz O, Karatas O, Turel V, Yildiz M, Kaya E. Effectiveness of Jigsaw learning compared to lecture-based learning in dental education. *Eur J Dent Educ* 2017;21:28-32.
4. Roth GA, Abate D, Abate KH, Abay SM, Abbafati C, Abbasi N, *et al.* Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980-2017: A systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 2018;392:1736-88.
5. Abbafati C, Abbas KM, Abbasi M, Abbasifard M, Abbasi-Kangevari M, Abbastabar H, *et al.* Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: A systematic analysis for the Global Burden of Disease Study 2019. *Lancet* 2020;396:1204-22.
6. Prabhakaran D, Jeemon P, Sharma M, Roth GA, Johnson C, Harikrishnan S, *et al.* The changing patterns of cardiovascular diseases and their risk factors in the states of India: The Global Burden of Disease Study 1990-2016. *Lancet Glob Health* 2018;6:e1339-51.
7. Boyer SL, Edmondson DR, Artis AB, Fleming D. Self-directed learning: A tool for lifelong learning. *J Mark Educ* 2014;36:20-32.
8. Bhandari B, Mehta B, Mavai M, Singh YR, Singhal A. Medical education/original article jigsaw method: An innovative way of cooperative learning in physiology. *Indian J Physiol Pharmacol* 2017;61:315-21.

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