Section: Physiology

Original Research Article

PROBLEM-BASED LEARNING VERSUS JIGSAW METHOD IN TEACHING PHYSIOLOGY TO PHASE I MBBS STUDENTS: A COMPARATIVE STUDY

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ABSTRACT

Background: The Competency-Based Medical Education (CBME) curriculum recently adopted in India emphasizes active, learner-centred strategies. Approaches such as Problem-Based Learning (PBL) and the Jigsaw technique are increasingly used to promote student participation and deeper understanding. Although both methods are gaining ground in medical education, there is limited evidence comparing their effectiveness in undergraduate Physiology teaching within the Indian setting.

Materials and Methods: This quasi-experimental study was conducted among 110 first-year MBBS students at a government medical college in Kerala. A convenience sample of 110 Phase I MBBS students was randomly allocated into two groups (n=55 each). Perceptions were captured using a peer-reviewed Likert-scale questionnaire. The data were entered in SPSS version 16, and independent t-tests were used to compare mean post-test scores between the two methods.

Results: Across all three sessions, students who underwent the Jigsaw method produced higher mean post-test scores than PBL in all sessions: S1 7.46±1.17 vs 6.26±1.18; S2 7.39±1.10 vs 6.25±0.97; S3 7.41±1.06 vs 6.32±0.92 (all $p<0.001$). Feedback from the perception survey showed that most students found the jigsaw technique more engaging. They felt it improved their communication skills, encouraged teamwork, and made learning more interactive. Many also suggested that this method could be introduced for other subjects.

Conclusion: In this study, the Jigsaw method proved more effective than PBL in improving knowledge acquisition and overall student satisfaction in Physiology. Its collaborative nature supports the objectives of CBME and makes it a promising option for undergraduate medical teaching.

Keywords: Jigsaw method, Problem-Based Learning, cooperative learning, Physiology, CBME.

INTRODUCTION

Physiology is fundamental in medical education, providing the groundwork for understanding how the human body functions in health and disease.[1] A solid grasp of its concepts is crucial before students can move on to clinical fields such as Pathology, Pharmacology, and Medicine.[2] However, many undergraduates find Physiology difficult to master. The subject's vast syllabus, the restricted teaching hours, and the continued reliance on traditional lecture-based methods often add to this challenge.[3] Although lectures allow large portions of content to be covered quickly, they frequently lead to passive learning, waning attention spans, and declining classroom participation.[4]

The National Medical Commission (NMC) introduced the CBME framework in India to address these concerns, emphasizing active, learner-centred strategies to foster critical thinking, self-directed

learning, and problem-solving skills.[5] Two approaches are Problem-Based Learning (PBL) and the Jigsaw method.[6] PBL encourages students to work with clinical scenarios, stimulating group discussion, reasoning, and independent exploration under faculty guidance.[7] The Jigsaw method, introduced by Aronson in 1978, divides a topic into subunits, assigns each subgroup of students to study one part in depth as "experts," and then requires them to teach their peers in their "parent group".[8] This model encourages teamwork, accountability, and collaborative learning.[9]

Although both methods have improved learning outcomes, most available research comes from Western contexts or fields outside Physiology.[10] Few studies have compared PBL and Jigsaw in the Indian undergraduate setting, and even less is known about how students perceive these methods when applied to Physiology, which serves as a bridge between basic science and clinical application.[11]

Against this background, the present study was designed to compare PBL and the Jigsaw method in teaching selected topics in Physiology to Phase I MBBS students. The primary objective was to evaluate knowledge acquisition using post-test scores, while the secondary objective was to examine student perceptions of the two approaches. The study received approval from the Institutional Ethics Committee of Government Medical College, Manjeri, and written informed consent was obtained from all participants.

MATERIALS AND METHODS

This quasi-experimental study was conducted over nine months in the Department of Physiology at Government Medical College, Manjeri, Kerala. It aimed to compare the effectiveness of PBL and the Jigsaw technique in enhancing knowledge acquisition and student engagement among first-year medical students.

The study involved 110 first-year MBBS students from the 2021 admission batch. It was approved by the Institutional Ethics Committee (Approval No.: IEC/GMCM/108 – 07/12/2022). All students who provided written informed consent were enrolled, while those absent from sessions were excluded. The cohort was divided equally into two groups of 55 students using convenience sampling.

Three Physiology topics were selected for the intervention, chosen for their clinical relevance and conceptual difficulty: (1) anemia and factors affecting erythropoiesis, (2) haemophilia and coagulation pathways, and (3) myasthenia gravis and neuromuscular transmission. The sequence of teaching methods alternated between groups to minimize bias.

In the PBL sessions, each group was further divided into small subgroups and presented with a clinical case scenario related to the topic. Students identified learning objectives, discussed relevant concepts, and formulated solutions under the guidance of a faculty facilitator. This method encouraged self-directed learning and clinical reasoning.

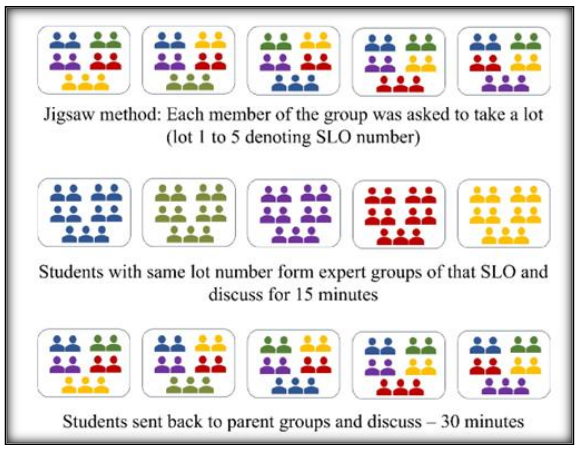


Figure 1: Jigsaw Method Workflow for Active Learning

In the Jigsaw sessions, students were initially assigned to "expert groups," each responsible for mastering one subtopic. After an in-depth discussion, they rejoined their "parent groups" to teach the subtopic to peers. This ensured that every member contributed to and benefited from the learning process, fostering accountability, peer teaching, and collaborative understanding.

At the end of each session, students completed a 10-item multiple-choice question (MCQ) test to assess immediate knowledge acquisition. To evaluate perceptions, a structured questionnaire using a 5-point Likert scale was administered, covering domains such as engagement, communication skills, teamwork, and overall satisfaction. In addition, open-ended questions were included to capture qualitative feedback on the strengths and limitations of each method.

Data entry was performed in Microsoft Excel, and analysis was carried out using Statistical Package for the Social Sciences (SPSS) version 16. Post-test scores were compared between groups using the independent t-test, with a p-value of <0.05 considered statistically significant. Descriptive statistics were used to summarize perception scores, and qualitative responses were analyzed thematically.

RESULTS

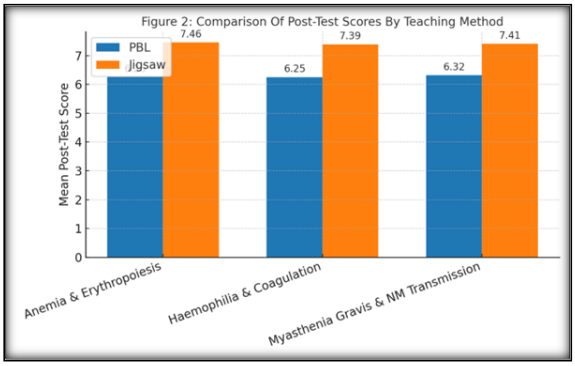
110 Phase I MBBS students participated in the study. All students attended the three sessions and completed the post-test assessments and perception questionnaires.

Post-test Scores

Across all three sessions, students in the Jigsaw group achieved significantly higher mean post-test scores than PBL group students ($p < 0.001$). The details are presented in [Table 1].

Table 1: Comparison of post-test scores between PBL and Jigsaw methods

Session	Method	N	Mean ± SD	t-value	p-value
1	PBL	55	6.26 ± 1.18	5.351	<0.001
	Jigsaw	55	7.46 ± 1.17		
2	PBL	54	6.25 ± 0.97	5.776	<0.001
	Jigsaw	55	7.39 ± 1.10		
3	PBL	55	6.32 ± 0.92	5.741	<0.001
	Jigsaw	53	7.41 ± 1.06		



[Figure 2] shows the bar chart comparison of mean post-test scores between PBL and Jigsaw sessions.

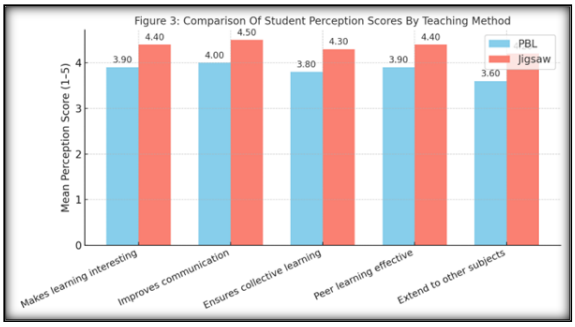
Student Perceptions: Analysis of the Likert-scale responses revealed that Jigsaw was consistently rated more favourably than PBL. Students reported that Jigsaw made learning more interesting, improved communication skills, encouraged teamwork, and facilitated peer learning. Detailed percentages are shown in [Table 2].

Table 2: Student perception responses (%) for PBL and Jigsaw methods

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Makes learning interesting	PBL: 53.6 / Jigsaw: 55.5	PBL: 28.1 / Jigsaw: 32.7	PBL: 14.5 / Jigsaw: 12.0	PBL: 1.8 / Jigsaw: 0.9	PBL: 1.8 / Jigsaw: 0
Improves communication skills	PBL: 32.7 / Jigsaw: 47.3	PBL: 56.3 / Jigsaw: 47.3	PBL: 3.6 / Jigsaw: 6.0	PBL: 7.2 / Jigsaw: 0	PBL: 0 / Jigsaw: 0
Ensures collective learning	PBL: 40.0 / Jigsaw: 50.0	PBL: 44.5 / Jigsaw: 40.0	PBL: 10.0 / Jigsaw: 5.0	PBL: 5.4 / Jigsaw: 3.6	PBL: 0 / Jigsaw: 1.8
Peer learning effective	PBL: 40.0 / Jigsaw: 54.5	PBL: 39.1 / Jigsaw: 26.3	PBL: 13.6 / Jigsaw: 15.0	PBL: 5.4 / Jigsaw: 5.4	PBL: 1.8 / Jigsaw: 0
Extend to other subjects.	PBL: 20.9 / Jigsaw: 37.2	PBL: 59.1 / Jigsaw: 42.7	PBL: 17.2 / Jigsaw: 17.0	PBL: 2.7 / Jigsaw: 2.7	PBL: 0 / Jigsaw: 1.8

Table 3: Selected student comments and suggestions

Positive comments	Suggestions
"We collaborated as a team."	"More time for final group discussion."
"My classmates were able to teach me."	"Encourage shy students to participate."
"It was fun to learn."	"Apply Jigsaw to other subjects."
"I understood the topic completely."	–



[Figure 3] presents a bar chart comparison of mean perception scores between the two methods.

Qualitative Feedback: Open-ended comments highlighted that students found Jigsaw more interactive and enjoyable. Many appreciated the opportunity to learn from peers and expressed that teaching others helped reinforce their understanding. Suggestions included allowing more time for final group discussions and encouraging quieter students to participate actively. A summary of representative comments is shown in [Table 3].

DISCUSSION

This study compared two active learning strategies, PBL and the Jigsaw technique, in teaching selected Physiology topics to Phase I MBBS students. The results demonstrated that the Jigsaw method consistently produced significantly higher post-test scores than PBL across all three sessions ($p < 0.001$). Students also clearly preferred the Jigsaw method, giving it higher ratings for promoting engagement, encouraging teamwork, improving communication, and supporting peer learning. Qualitative feedback further supported these findings, as students described Jigsaw sessions as more interactive and enjoyable.

The superiority of Jigsaw observed in our study is consistent with the findings of Nimesh et al., who reported better comprehension and retention using the Jigsaw technique in medical education [12]. Similarly, Early et al. highlighted the effectiveness of Jigsaw in promoting collaborative learning [13] while

Jepp et al and Fitriana et al demonstrated its value in enhancing teamwork and reasoning skills [14,15]. Bhandari et al. reported better outcomes in physiology teaching when the Jigsaw method was used than conventional approaches.[16] On the other hand, studies on PBL, including those by Jiang et al. and Zhou et al, have highlighted its value in developing critical thinking and clinical reasoning skills.[17,18] The relative underperformance of PBL in our study may be attributed to its reliance on facilitator expertise and group dynamics. In contrast, Jigsaw ensures structured participation and accountability, reducing the variability in student engagement.

The strengths of this study include its quasi-experimental design, the use of objective (post-test scores) and subjective (student perceptions) outcomes, and the inclusion of multiple Physiology topics within the CBME framework. Conducting the study among the entire batch improved representativeness and reduced selection bias. However, being a single-institution study limits the generalizability of the findings. Moreover, only immediate knowledge acquisition was assessed, and long-term retention or impact on summative assessments was not measured. Future multi-centre studies assessing longitudinal outcomes are recommended.

In summary, the Jigsaw technique proved more effective than PBL in enhancing knowledge acquisition and student satisfaction among undergraduate medical students. Its cooperative structure promotes active engagement, communication, and teamwork, aligning well with the goals of CBME. Incorporating Jigsaw into Physiology teaching, either as a standalone method or in combination with PBL, may enrich the learning experience and better prepare students for clinical reasoning.

CONCLUSION

The Jigsaw method outperformed Problem-Based Learning in teaching Phase I MBBS students selected Physiology topics. It resulted in significantly higher knowledge acquisition and positive student perceptions, particularly engagement, teamwork, and communication skills. Jigsaw's cooperative learning framework aligns closely with the objectives of Competency-Based Medical Education and may be recommended for broader adoption in undergraduate Physiology teaching.

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