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Research Article

Transforming Anaesthesiology Education: Comparing the Flipped Classroom and Jigsaw Models in Anaesthesiology Interns – A Randomized Controlled Trial

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A B S T R A C T

Background: Competency-based medical education (CBME) policy emphasizes learner autonomy, active participation, and self-directed learning. Innovative teaching methods such as the Flipped Classroom (FC) and Jigsaw approaches have gained attention for fostering these skills. However, there is very limited evidence comparing their effectiveness among anaesthesiology interns, who require rapid decision-making by applying their knowledge and performing teamwork in clinical practice.

Methods: This randomized crossover study included 30 anaesthesiology interns divided into five groups of six participants each. Each group attended four classes—two using the FC method and two using the Jigsaw approach. All groups covered identical topics, with classes moderated by faculty members. Pre-tests and post-tests administered via Google Forms assessed knowledge gain. Feedback from interns and moderators was collected at the end of the posting.

Results: Both methods showed significant knowledge improvement within groups ($p < 0.05$). The mean improvement in pre- and post-test scores was 1.7 ± 0.8 for the Jigsaw method and 1.5 ± 0.7 for the FC method, with no statistically significant difference between them ($p > 0.05$). Student feedback indicated comparable satisfaction with both approaches (Jigsaw: 76.7%; FC: 73.3%), though the Jigsaw method showed slightly higher engagement (73.3% vs. 63.3%). Faculty feedback favored the Jigsaw technique, with 60% reporting higher student interaction, teamwork, and participation during sessions.

Conclusion: Both methods are equally effective in enhancing learning outcomes among anaesthesiology interns; however, faculty preferred the Jigsaw method for its superior engagement and collaborative learning environment.

Keywords: Flipped Classroom, Jigsaw Method, Anaesthesiology Interns, Competency-Based Medical Education, Active Learning, Self-Directed Learning

Introduction

The conventional, objective-based method of medical education in India has been replaced by a competency-based curriculum, as recommended in the Medical Council of India's Vision 2015. The ultimate objective of this change is to produce Indian medical graduates (IMG) who are capable of lifelong learning, independent thinking, and clinical competency. The competency-based approach, which emphasizes critical thinking, problem-solving, and reflective practice, empowers them to take greater responsibility for their learning.[1] Consequently, teachers, now called facilitators, are increasingly using creative, learner-centered teaching methods that encourage autonomy and active participation to promote these goals.

Modules for self-directed learning (SDL) have become an indispensable component of this educational revolution. These modules provide students the freedom to learn at their own pace, enabling them to explore materials and develop critical abilities such as self-control, motivation, creativity, and time management. Additionally, SDL promotes continuous learning, even outside the classroom, which is essential for medical professionals who need to stay up-to-date with rapid advances in science and medicine.[2]

In medical education, the Jigsaw and Flipped Classroom (FC) approaches have attracted significant interest among various strategies aimed at promoting active and self-directed learning.[3]

The Flipped Classroom model reverses the traditional order of teaching by introducing foundational learning materials—such as videos, articles, or recorded lectures—before class. This allows students to acquire baseline knowledge independently, freeing classroom time for interactive activities like group discussions, problem-solving, and case-based learning under faculty supervision. It shifts focus from passive reception to active participation. The FC model enhances critical thinking, communication, and knowledge application, which are key attributes of adult learning.[3,4]

In contrast, the jigsaw method is a structured cooperative learning technique wherein a complex topic is divided into smaller subtopics. Students are first assigned to "expert groups," where each member prepares one subtopic.[5] They then return to their "home groups" to teach their peers, integrating all components into a comprehensive understanding. This cooperative method fosters leadership, teamwork, and communication abilities—qualities crucial for multidisciplinary clinical practice.

Anaesthesiology is a specialty that requires quick decision-making, applied knowledge, cooperation, and teamwork. Although both methods encourage active participation, peer learning, and higher-order cognitive skills, there is no research specifically evaluating the efficacy of these approaches in medical education, especially among medical interns.

Therefore, the present study was planned to evaluate and compare the effectiveness of the Flipped Classroom and Jigsaw teaching approaches among anaesthesiology interns. Our primary objective was to assess each method›s effect on knowledge acquisition by comparing pre- and post-test scores. Secondary objectives included comparing interns› views on exam performance, class engagement, and satisfaction with knowledge gain, as well as investigating faculty opinions on the advantages, disadvantages, and applicability of each strategy in fulfilling the educational requirements of anaesthesiology interns.

Sample size was calculated using the formula $n=Z^2\times\sigma^2/d^2$, where Z is 1.96, σ is 1.79, and d is 0.817, considering the mean and standard deviation of assessment scores following the Flipped Classroom method as 8.17 ± 1.79.[6] To minimize selection bias, a universal sampling approach was employed, inviting all eligible participants meeting inclusion criteria during the study period to participate.

Materials and Methods

This randomized crossover study was conducted to compare two active learning methods, the "Flipped Classroom" and «Jigsaw,» among medical interns for teaching anesthesiology. The target population comprised interns posted in the Department of Anaesthesiology as part of their compulsory clinical rotation who were willing to participate in the study. Interns who were absent on the day of the session or declined participation were excluded.

The 30 interns were divided into five groups of six participants each. Every group attended four classes, two using the Jigsaw technique and two using the Flipped Classroom approach (Figure 1). To avoid bias, the lot technique was used to randomly assign each group's sequence of teaching methods. The four topics uniformly covered across all batches were: (1) Arterial Blood Gas (ABG) analysis, (2) Acute Respiratory Failure: Diagnosis and Management, (3) General Anesthesia: Indications and Management, and (4) Preoperative Preparation and Management of an Uncontrolled Diabetic Patient Scheduled for Emergency Laparotomy. Each class lasted one hour. Classes were moderated by a faculty member assigned specifically to ensure uniformity and consistency in teaching and evaluation.

All four moderators were faculty members from the Department of Anaesthesiology with more than ten years of teaching experience and consented to participate in the study. Separate consent was obtained from the interns and moderators.

Learning outcomes were assessed using structured pre-test and post-test questionnaires administered via Google Forms

in each class. Neither interns nor moderators were aware of the questions in advance. Additionally, a structured feedback questionnaire was provided to all interns and moderators to gather their opinions and perceptions regarding the effectiveness and engagement of both teaching methods.

Figure 1.Study Flow chart

Statistical Analysis

Statistical analysis was performed using Social Sciences software (SPSS version 19.0). Demographic and categorical variables, such as gender distribution and feedback responses, were analyzed using the Chi-square test. A p-value of less than 0.05 (<0.05) was considered statistically significant. Continuous data were tested for normality using the Shapiro–Wilk test. The paired t-test was used to compare pre-test and post-test scores within each group (Flipped Classroom and Jigsaw), while comparisons between groups were conducted using the independent t-test.

Results

The demographic characteristics between groups, as shown in Table 1, were comparable, and there was no significant difference in gender or prior anesthesia exposure ($p > 0.05$). Both the Jigsaw and Flipped Classroom approaches successfully improved learning outcomes, demonstrated by significant improvements in mean pre-test and post-test scores within both groups ($p < 0.05$). However, there was no statistically significant difference in post-test performance between the two groups when comparing the approaches directly (Table 2).

Classes using the Jigsaw method showed a mean pre-test score of 6.6, which increased to 8.3 after the class, reflecting a mean improvement of 1.7 points. In contrast, classes using the Flipped Classroom method improved from a mean pre-test score of 6.1 to 7.6, an improvement of 1.5 points. This indicates that both methods were effective in enhancing interns› knowledge acquisition, as there was no significant difference between the two methods in post-test performance ($p > 0.05$).

Feedback analysis revealed differing perspectives between moderators and interns. Approximately 33% of students preferred the Jigsaw technique, 30% preferred the Flipped Classroom, and 37% were neutral, reflecting some ambiguity among students about which approach was superior (Table 3). In contrast, moderator feedback showed a clear preference for the Jigsaw technique. As many as 60% of moderators reported greater engagement, interaction, and collaborative learning during Jigsaw sessions, while 20% favored the flipped classroom and 20% remained neutral (Table 4). These findings suggest that while interns perceived both approaches as similarly effective for learning outcomes, moderators believed the Jigsaw approach better facilitated the communication, teamwork, and critical thinking skills essential to competency-based medical education.

Table 1.Demographic Profile of Participants

Variable	Category	Number (n=30)	Percentage (%)	Statistical Test
Age (years)	Mean ± SD	23.1 ± 0.9	—	Descriptive
Gender	Male	18	60	
	Female	12	40	Chi-square test (p = 0.42)
Previous posting in Anesthesia	Yes	10	33.3	
	No	20	66.7	Chi-square test (p = 0.18)

Table 2.Comparison of Learning Outcomes between Jigsaw and Flipped Classroom

Parameter	Jigsaw (Mean ± SD)	Flipped Classroom (Mean ± SD)	Mean Difference	t-value	p-value	Statistical Test
Pre-test Score	6.6 ± 1.0	6.1 ± 1.1	0.5	1.52	0.14	Independent t-test
Post-test Score	8.3 ± 0.9	7.6 ± 1.0	0.7	1.73	0.09	Independent t-test

Improvement (Post–Pre)	1.7 ± 0.8	1.5 ± 0.7	0.2	0.68	0.50	Paired t-test within groups
Students rating Jigsaw better	—	—	33%	—	—	Descriptive
Students rating Flipped better	—	—	30%	—	—	Descriptive
Students Neutral	—	—	37%	—	—	Descriptive
Teachers favoring Jigsaw	—	—	60%	—	—	Descriptive
Teachers favoring Flipped	—	—	20%	—	—	Descriptive

Table 3.Feedback Summary from Students (n = 30)

Feedback Parameter	Jigsaw Method – No. (%)	Flipped Classroom – No. (%)	Interpretation
Helped understand concepts better	20 (66.7%)	18 (60%)	Both methods effective; slightly higher with Jigsaw
Improved engagement during class	22 (73.3%)	19 (63.3%)	Jigsaw showed higher engagement
Encouraged active participation	24 (80%)	20 (66.7%)	Jigsaw promoted more active involvement
Preferred learning flexibility	12 (40%)	19 (63.3%)	Flipped classroom favored for flexibility
Helped in retention and application	18 (60%)	17 (56.7%)	Comparable
Overall satisfaction (Very satisfied/ Satisfied)	23 (76.7%)	22 (73.3%)	Similar satisfaction levels
Preferred method overall	10 (33.3%)	9 (30%)	Equivocal
Neutral preference	—	—	11 (36.7%) neutral across both methods

Table 4.Feedback Summary from Teachers (n = 8)

Feedback Parameter	Jigsaw Method – No. (%)	Flipped Classroom – No. (%)	Interpretation
Observed high student engagement	(80%)	(50%)	Jigsaw more engaging
Encouraged collaborative learning	(90%)	(60%)	Stronger teamwork in Jigsaw
Stimulated critical thinking/problem-solving	(70%)	(50%)	Slightly higher in Jigsaw
Ease of implementation	(40%)	(70%)	Flipped easier to organize
Improved student questioning and interaction	(80%)	(50%)	Jigsaw favored
Better retention of knowledge observed	(60%)	(40%)	Moderate difference favoring Jigsaw
Higher overall teaching satisfaction	(90%)	(60%)	Teachers preferred Jigsaw
Perceived scalability to other subjects	(70%)	(60%)	Both applicable with adaptation

Discussion

Today, educational professionals employ various approaches to teaching, one of which facilitates active learning and has been shown to improve students' academic performance. Self-directed learning (SDL) tools encompass a wide range of strategies customized to individual needs, interests, and learning capabilities (Figure 2). Students are

encouraged to establish clear, achievable goals guided by the SMART criteria—specific, measurable, achievable, relevant, and time-bound.[7-9]

Our study results show that although both teaching strategies successfully improve cognitive outcomes, moderators' and students' opinions vary. The interns' ambivalent reactions indicate that both strategies accommodate varying learning styles, with the Jigsaw model promoting collaborative learning and the Flipped Classroom supporting self-paced study.

The two most essential elements of competency-based medical education are engagement and active interaction.[10] In our research, teachers favored the Jigsaw approach because it fosters interns' active engagement and interaction.[11,12] These results align with past studies demonstrating increased engagement and satisfaction with peer-assisted learning styles in medical education. Academicians deploy a variety of teaching tools to enhance students' academic achievement.[13] While both strategies effectively raise cognitive outcomes, instructor and student opinions diverge. The interns' ambivalent attitudes imply both strategies accommodate varying learning styles, with the Jigsaw model encouraging collaborative learning and the Flipped Classroom enabling self-paced study.[14-16]

Despite both the Jigsaw and Flipped Classroom (FC) approaches encouraging intern participation and active learning, students and instructors have recognized limitations with each strategy (Table 5). Regarding FC, students reported challenges such as heavy pre-class preparation, reliance on self-motivation, difficulty balancing clinical work and education, dependency on technology, and inconsistent content quality.[17,18] Moderators noted that maintaining consistent student active participation is challenging, laborious, and time-consuming. It is also difficult to monitor individual preparation, correct misunderstandings, and produce high-quality pre-class materials.

Although the Jigsaw method promotes peer teaching and collaboration, students expressed concerns about dependency on peers, unequal team participation, anxiety when teaching others, and fragmented understanding until all subtopics are integrated.[19-20] Faculty observed challenges including excessive pre-class preparation for dividing topics into equally distributed subtopics. Additional issues include self-motivation, balancing clinical practice with coursework, technology reliance, and uneven content quality. Faculty also highlighted difficulties in maintaining consistent student engagement, monitoring preparation, correcting misconceptions, and generating high-quality pre-class materials.

These results imply that although both approaches encourage active learning, maximizing learning outcomes requires addressing drawbacks through organized preparation, clear guidance, and faculty support.[21] However, students reported that Jigsaw-based learning was more meaningful, successful, and enjoyable, according to Kumar et al.,[22] Bhandari et al.,[23] and Jafariyan et al.[24] The advantage of the Jigsaw model lies in developing teamwork and communication skills, making it a valuable addition to intern teaching modules despite its greater planning and preparation demands.

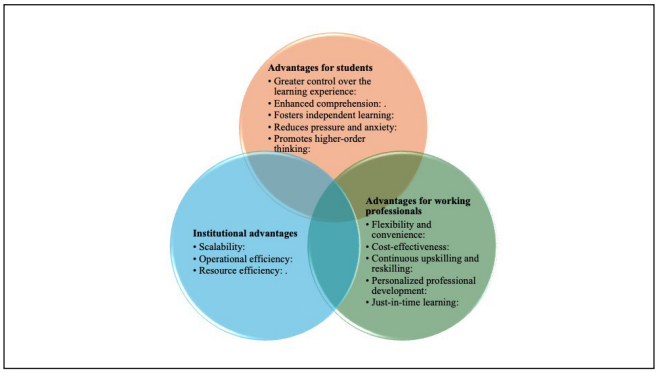

Figure 1.Advantages of Self-Directed Learning

Table 5.Summary of Student and Faculty-Perceived challenges

Method	Student Perception	Faculty Perception
Flipped Classroom	Heavy pre-class workload; requires self-motivation; passive pre-class learning; tech dependence; variable content quality	Ensuring engagement; monitoring preparation; clarifying misconceptions; time-consuming content creation
Jigsaw	Peer dependency; unequal participation; anxiety teaching peers; fragmented understanding	Accuracy of peer teaching; managing groups; limited time for complex topics; maintaining motivation

Conclusion

Learning outcomes in anesthesia interns can be enhanced by using either the Jigsaw or Flipped Classroom approach. Although faculty highly favored the Jigsaw method for its superior engagement, interaction, and collaborative environment, student perceptions were mixed and revealed equivalent learning experiences.

We suggest that the optimal teaching model for competency-based medical education (CBME) should be a hybrid approach, integrating the preparatory benefits of the Flipped Classroom with the interactive peer-learning environment of the Jigsaw method.

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