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JIGSAW Technique: An Innovative Method in Improving Cognitive Skills of Second Phase Undergraduate Medical Students

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Abstract

Introduction: With the emphasis and implementation of Competency based medical education (CBME) from 2019 by National Medical Commission (NMC), interactive teaching learning methods to be used along with the conventional lectures. Jigsaw technique promotes interactive, cooperative group activity among learners along with self directed learning and promotes peer teaching.

Aims and Objectives: The present study conducted to assess the effectiveness of technique in addition to conventional didactic lecture in enhancing cognitive skills in Microbiology and to assess the perception of students for this technique involving cooperative group activity.

Material and methods: This study was done in the Department of Microbiology. The students were divided into 2 batches. Each batch again divided into two group control and experimental. Two topics selected, topic divided into subtopics. Experimental group divided into parent and expert group for jigsaw technique. Lectures were taken for both groups and jigsaw technique done for the experimental group. Pre-test, posttest in the form of MCQ and feedback was collected. Cross over study was done to minimize bias.

Results: Pretest and posttest marks showed that post test marks after jigsaw technique were statistically significant (p value<0.05). Feedback analysis showed that jigsaw technique was more effective and students agreed that more topics should be taught by this technique.

Conclusion: Jigsaw technique was student centered, involves active student learning, improves problem solving skills, involve active learning and should be promoted among the students.

Keywords: Jigsaw technique, conventional lecture, interactive learning, CBME

Introduction

National Medical Commission (NMC) of India emphasizes the implementation of Competency Based Medical Education (CBME) from 2019. [1] This CBME curriculum is more learner centric emphasizing on self-directed learning approaches. Goal of Medical education is to produce an Indian Medical Graduate (IMG) who is competent in roles of Clinician, Leader and Team member, Communicator, Lifelong learner and Professional. CBME curriculum also emphasizes on use of interactive teaching learning methods compared with the conventional didactic lectures. [1]

Jigsaw technique promotes interactive and cooperative group activity among learners. In this method, students are actively involved in the teaching learning process. [2] Jigsaw promotes group sharing and learning. This method is useful when large content has to be taught. Students learn better in the environment where they are actively involved. [3] This activity promotes peer teaching along with learning, self-directed learning. Students learn through in-depth understanding the subject matters, motivates the students to participate in discussion and problem-solving approach. Student centered activities such as in class quizzes, jigsaw, think and pair, minute papers, reader's theatre and roundtable are some simple collaborative teaching active learning techniques. [4]

Aronson et al. (1978) invented the jigsaw classroom research based cooperative, interactive and collaborative learning technique at the University of Texas and University of California. [5] Students learn a subtopic in a small group and then teach this subtopic to the other members of the group. It is called jigsaw as students represent a block of jigsaw puzzle, they learn collaboratively where students act as learners as well as teachers. As in a jigsaw puzzle, each piece is important, in the same way each student's part is essential for full understanding and completion of the final product [6, 7].

In this present study, the class is divided into two groups, breaking the assignment into pieces that the group has to assemble for the completion of the jigsaw puzzle [8]. A topic is divided into subtopics. The students are divided into primary group allotting each student a subtopic. Topic is learnt in parts by the students and further they teach it to their fellow group members. This helps in improving team work and communication skills and further allows students to learn three roles of IMG i.e. Leader and Team member, communicator and Lifelong learner.

Aim and Objectives

The aim was to study the effectiveness of the Jigsaw method in teaching microbiology to MBBS second-phase students.

The objectives of the study were–

1. To assess the effectiveness of Jigsaw technique in addition to conventional didactic lecture in enhancing cognitive skills in Microbiology.
2. To assess the perception of students for this technique involving cooperative group activity.

Material and Methods

The study was conducted at the Department of Microbiology, at a tertiary care center in Chhindwara, Madhya Pradesh from July to August 2023. The study was prospective, cross sectional study of 2-month duration. All the second-phase MBBS students comprising of 100 students who gave consent for the study and who were present in the classes during the study were included in the current study and the students who were absent on that day were excluded from this study. 92 students had given consent for the study and had participated in this study, 08 students remained absent on the day of intervention and were excluded from

the study. Informed consent was collected at the start of the study from the students. Ethical clearance was obtained from Institutional Ethical Committee (IEC) of CIMS, Chhindwara (M.P.) [No. CIMS/Ethics Committee/2022/6402 dated 31/08/2022]. Pretest, posttest questionnaire in the form of MCQs (Google form containing 10 questions on each topic) were made and feedback forms for the students (comprising of 10 questions) were designed and validated by two external and one internal subject expert.

Content validity of the pre-test, post-test, MCQ and feedback questionnaire was calculated using Lawshe's Content Validity Index. CVR of the questionnaire was 0.8 for most of the questions which was acceptable. In some necessary modification was done according to the suggestions by the faculties.

A total of 92 students were divided into two batches A and B of 46 students each (Flow chart 1). Each batch was again divided into two groups control and experimental group of 23 students each. Students were selected by chit picking method. Two topics were selected, one topic was Healthcare associated infections and their types and the second topic was Sterilization and Disinfection.

Both the topics were taught in lecture to both the Control group and experimental group. Before the start of the study the students and the faculty of the Microbiology Department were sensitized about the Jigsaw technique. The topic chosen was divided into sub-groups. Pre-test, posttest questionnaire in the form of multiple-choice questions (MCQ) and feedback form was prepared.

Control group and experimental group were instructed to come prepared for the didactic lecture. Pretest was conducted before the start of the jigsaw technique. Two Experimental groups comprising of 23 students each were divided into 5 parent groups. Each student in the subgroup was assigned a number 1,2,3,4,5. The parent group was broken apart, such that all the students with number 1 form one group and so on. These groups were named as Expert groups. The topic was divided in subtopics and each Expert group was allotted a sub-topic. The expert group had shared ideas, searched the topic on internet, e-books, books from library and discussed the subtopic among themselves.

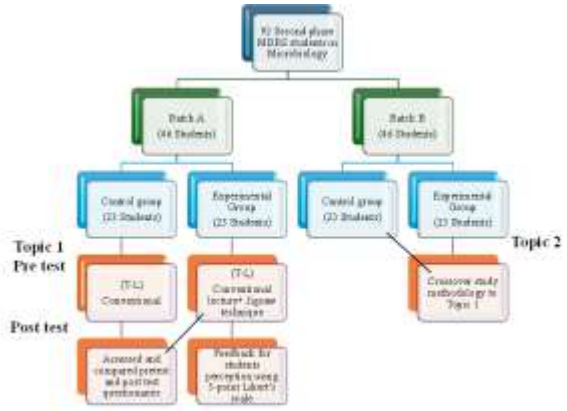
The expert group was again broken apart and returned to their original parent group. Knowledge gained in expert group was shared with others in the parent group. Faculty acted as facilitator and answered the queries if any. All the groups had given a presentation on the topic allotted to them. Post test was conducted and feedback was collected from the students.

A crossover study was also done. The two groups were crossed over to minimize bias. The 23 students in each control group were crossed over to experimental group and those in experimental group were crossed over to control group. The students were asked to come prepared for the second topic in Microbiology. The rest of the methodology and assessment remained the same as explained above.

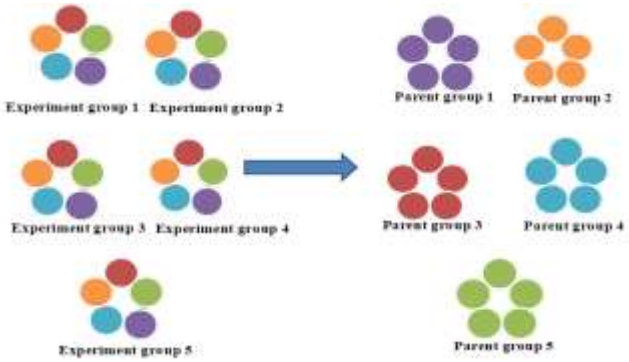
Stastistical Analyses

All data were maintained in Microsoft Office Excel. All statistical analyses were carried out using Microsoft Office Excel. Pre-test and post test scores were analyzed using paired *t* test within the group and 'Independent *t*-test' applied to compare pre and post test scores between the groups. Five-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree) was used to collect feedback from the students in the form of questionnaire regarding jigsaw technique. Data presented as percentages, mean and standard deviations. *p*-values with a significance level of <0.05 were recorded as statistically significant. Descriptive

statistics were analyzed by Sigma plots (10.0 versions) and Origin 7.0 software.



Flowchart 1: Jigsaw co-operative learning strategy



Phase 1: Students meet in Parent group

Parent group 1 Parent group 2 Parent group 3 Parent group 4 Parent group 5

Phase 2: Students meet in Expert group

Expert group 1 Expert group 2 Expert group 3 Expert group 4 Expert group 5

Phase 3: Students return to Parent group to discuss with each other

Parent group 1 Parent group 2 Parent group 3 Parent group 4 Parent group 5

Figure 1: Jigsaw technique scheme

Results

A total of 92 students had participated in this study. 08 students were absent on the day of the intervention, hence were excluded from the study. Pre-test, posttest and feedback of the students were collected and analyzed.

In this study Table 1 shows the comparison of the mean marks in pre and post tests conducted for Batch A and Batch B of the experimental group. In Batch A, mean marks were 5.1 in pretest. Post test marks mean was 7.9. For Batch B, mean marks in pre-test were 4.9 and post test marks mean was 7.7. For Batch A, p value of marks comparison of pre-test and posttest was 0.025 which is statistically significant. For Batch B, *p* value marks comparison of pre-test and posttest was 0.027 which is also statistically significant.

Table 1: Comparison of mean marks in pre and post test

	Experimental group			
	Batch A		Batch B	
	Pre-test (10 marks)	Post-test (10 marks)	Pre-test (10 marks)	Post-test (10 marks)
Mean±SD	5.1±1.2	7.9±1.2	4.9±1.3	7.7±1.3
Mean Difference		2.9±1.2		2.8±1.3
Standard deviation	1.3	1.3	1.4	1.3
p value		0.025194*		0.02273*

**p* value (pre-test and post-test scores) is statistically significant (<0.05) in both the batches

Feedback analysis of the students (Table 2) showed that 79.3% students strongly agreed that Jigsaw technique is more effective as compared to the traditional lecture method. 81.5% students strongly agreed that critical thinking was increased by thorough discussion on the topic. 83.7% students enjoyed team work and built up

confidence for individual presentations in the group. 78.2% strongly agreed that Jigsaw was an interesting activity and 80.4% strongly agreed that more topics should be taught by this technique.

Table 2: Feedback for students (N=92)

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	1	2	3	4	5
Jigsaw teaching methodology was explained beforehand	07 (7.6%)	05 (5.4%)	01 (1.1%)	12 13.0%)	67 (72.8%)
Jigsaw technique is more effective as compared to the traditional lecture method	01 (5.4%)	02 (2.2%)	03 (3.1%)	13 (14.1%)	73 (79.3%)
Students are more involved in active learning in Jigsaw technique	04 (4.3%)	05 (5.4%)	03 (3.7%)	15 (16.3%)	65 (70.7%)
Active student participation and discussions were encouraged in Jigsaw technique	03 (3.3%)	09 (9.9%)	04 (4.3%)	26 (28.7%)	50 (54.3%)
Critical thinking was increased by thorough discussion on the topic	01(1.1%)	07 (7.6%)	02 (2.8%)	07 (7.6%)	75 (81.5%)
Enjoyed team work and built up confidence for individual presentations in the group	00 (0%)	07 (7.6%)	00 (0%)	08 (8.7%)	77 (83.7%)
This technique helped in improving the communication skills	02 (2.8%)	06 (6.5%)	00 (0%)	20 (21.7%)	64 (69.6%)
Students enjoyed and liked the learning by Jigsaw technique	02 (2.2%)	04 (4.3%)	02 (2.8%)	16 (17.4%)	68 (73.9%)
Jigsaw was an interesting activity	00 (0%)	07 (7.6%)	03 (3.7%)	10 (10.9%)	72 (78.3%)
More topics should be taught by this technique	02 (2.8%)	06 (6.5%)	01 (1.9%)	09 (9.8%)	74 (80.4%)

Discussion

Jigsaw technique was useful in improving and enhancing student's communication skills, peer learning and actively involves the students in the learning process. The philosophy behind jigsaw learning was learning could be developed when it acquired and taught to others. Students get exposed to a lot of material in a short span of time. It uses a blended learning approach with a face to face element which not only allows independent reading and reflection but also discussion of the subtopics with the peer learners. [9] Jigsaw technique not only improves students learning but also accountability in learning thus, making it interesting and cooperating. [10]

The results from Table 1 show that the mean difference in the pre-test and post marks in batch A was 2.9 ±1.25 and that of batch B was 2.8±1.34. The post test scores of the students improved significantly in both the batches that used jigsaw technique. *p* value of post and pre

testscore of batch A was 0.025 and *p* value of post and pre-test score of batch B was 0.022 which was statistically significant ($p<0.05$). Appandraj et al. (2021) showed that there was an improvement of marks of 2.6 in the study population after using the jigsaw technique. [11] Swathi et al. (2017) observed a significant improvement in the post test scores after the Jigsaw Technique. [12] One of the reasons for high significant post test scores after the jigsaw technique could be because it involves actively participation and learning of the students. Higher learner achievement was seen in the jigsaw technique. Students in the experiment group know that they have to teach the assigned subtopic to their colleagues of the parent group and hence, were more involved in the thought-provoking task. [13]

The students who learnt through jigsaw technique had much better performance than those who learnt through the conventional teaching methods. These findings were similar to the other authors findings who also were of the opinion that achievement scores improved by jigsaw technique in comparison with the conventional teaching techniques. [14, 15] Students took pride, became invested in their work and had a sense of ownership in learning and learning was more student centered. [16]

In this study, student's feedback was also taken. Most of the students agreed that Jigsaw technique was better compared to the traditional didactic lectures, critical thinking increased through discussion on the topic. They also strongly believed that the jigsaw activity helped them to build up confidence for individual presentation and team work also improved. Many students liked this activity and were of the opinion that more topics should be taken up using the interesting jigsaw activity. Swathi et al. (2017) reported that students wanted learning through jigsaw sessions often. [12] According to Sreenivasulu et al. (2020) students were more actively involved and were more attentive in the jigsaw process. For adult students learning was more meaningful and more enjoyable and most of the students showed promising results. [17]

In house faculty training programs for teachers were necessary to make them participate and become familiar with benefits and effects of learning on student's success. If the teacher or facilitator was not competent enough then this technique can be ineffective. A study by Doymus et al for-chemistry course jigsaw method was less effective than other interactive teaching methods. [18]

Limitation of this study was time consuming and required pre planning in learning a topic. Long term retention of the students was not evaluated in this study.

Conclusion

NMC has implemented CBME curriculum since 2019. CBME curriculum was student centered. Jigsaw technique was student centered, involves active student learning. This study demonstrates that Jigsaw technique was more effective than the conventional didactic lecture. Students have found this technique to be very interesting and to be used for more topics more often. This helps in improving communication skills, team work. It also improves problem solving skills and jigsaw method involving active learning should be promoted among the students.

Abbreviations

NMC –National Medical Commission

CBME –Competency Based Medical Education

IMG - Indian Medical Graduate

MCQ - Multiple choice questions

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