

Jigsaw Classroom: Is it an Effective Method of Teaching and Learning? Student's Opinions and Experience

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ABSTRACT

Introduction: In this digital era with information overload it is important to train the students in a systematic approach to the information available and a positive interdependence for effective learning. Jigsaw is an active method of co-operative learning which focuses on learning in groups with a specific goal and has shown to improve the student's academic performance.

Aim: To analyse the learning experience of students in Jigsaw Co-operative Learning (JCL) technique and to explore the opinion of students towards the advantages/disadvantages of JCL technique.

Materials and Methods: A cross-sectional study was conducted among first year MBBS students (n=152). The participants were subjected to JCL on folic acid and vitamin B₁₂ during tutorial class after completion of the same topics during didactic lecture class. The participants answered pre-test and post-test for the above topic and feedback was taken using a

pre-tested questionnaire. Descriptive statistics were used for analysis of the data.

Results: Statistically significant difference between pre-test and post-test score (p<0.001) was observed. The overall mean score of the learning experience of participants was 4.14±0.3 with the statement '*the activity helped me in enhancing communication skill*' having highest mean score of 4.59 and '*the activity enabled in depth coverage of the topic*' having lowest mean score of 3.58. Majority of the participants (83%) preferred JCL method of teaching learning. A number of advantages and disadvantages of this method were also opined by the participants in the open-ended questions.

Conclusion: Based on the participants' opinions and positive approach, JCL can contribute to better understanding and comprehension of the concepts, improvement in communication, and analytical skills, making learning an enjoyable experience for the students.

Keywords: Education, Medical, Questionnaire

INTRODUCTION

One of the competencies expected of medical graduates is to be lifelong learner who is able to search and critically evaluate the medical literature and apply this information in the patient care [1]. According to the constructionist theory of learning, knowledge does not come packaged in books, journals, computer disks or teachers head as these are only sources of information [2]. Knowledge needs to be constructed from this information which can be achieved when students are actively involved in processing, critically analysing this information and problem-solving.

The current trends in medical education demands changes in teaching-learning methods with the paradigm shift of teacher centred teaching methods to student centred learning methods such that there is a transition of students from dependency to active, self-directed lifelong learner as directed by Medical Council of India (MCI) in 'Vision 2015 document' [1]. Hence the role of teacher from 'Sage on Stage' as information dispenser needs to be shifted to 'Guide by the Side' facilitating active learning [2].

Cooperative learning is defined as an active learning approach, where a heterogeneous group of students work in small groups with a set of learning objectives to reach a common goal [3]. Jigsaw is one such method which teaches cooperation rather than competition [4]. JCL method was created by Aronson E et al., Santa Cruz professor at the University of California [5]. It is a student centred cooperative learning method which guides student to chat, search, learn and train each other [6]. This method of Teaching Learning (TL) has shown to improve comprehension, knowledge, critical thinking, problem-solving, clinical skills, self-confidence and communication including listening [6,7].

In this method of teaching, the topic is divided into many subtopics (jigsaw pieces). The students are divided into small groups called home group with each group member responsible for learning one subtopic. Students from different groups having the same subtopic meet and form expert group and learn together and become experts in that particular subtopic. The students return to their home group and each student teaches the part of jigsaw puzzle (subtopic) in which they have become expert, to the other members of the home group completing the jigsaw puzzle [8].

Depth knowledge of basic science subject like Biochemistry is important for clinical reasoning, problem solving and improvement in clinical skills. However, the general trend of students and faculty towards this subject is; it is dry, volatile and difficult to learn. The reasons could be due to vastness of the subject, microscopic abstract concepts, complex metabolic pathways, cannot observe the molecular reactions etc. Added to this there may be ineffective instructional methods with major mode of instruction as lecture class with monotonous classroom environment leaving the content to the imagination of learners. This results in inadequate and sketchy knowledge of the subject leading to poor association with clinical concepts [3].

Extensive research has taken place on Jigsaw method of learning across a wide range of education starting from elementary high school to higher education [4,6,7,9]. The method has shown to be an effective teaching method, but students perceptions have appeared to be mixed [7,10]. Also, whether this TL tool can improve the understanding and comprehension of volatile subject like biochemistry needs to be tested.

Hence the present study, was undertaken to assess the learning experiences and perceptions of this instructional method among first year medical undergraduates in biochemistry teaching.

MATERIALS AND METHODS

A cross-sectional interventional study was conducted at Department of Biochemistry, Adichunchanagiri Institute of Medical Sciences, Adichunchanagiri University, B G Nagara, Karnataka, India; among 152 first year MBBS students of 2017-18 batch, during biochemistry tutorial class of two hours duration spanning a period six days in November 2017. Prior to the study ethical clearance was taken from Institutional Ethical Committee and informed consent was taken from the students. A pre-tested questionnaire with minor modification was used to obtain students learning experiences [11]. Further the questionnaire was reviewed by senior teachers and authors and each item of the questionnaire was found to be relevant.

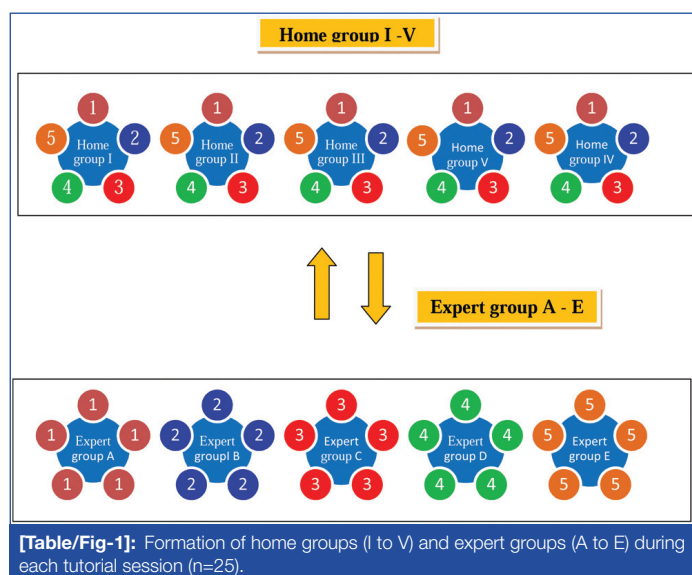
The topic chosen for this TL technique was on vitamins; folic acid and vitamin B₁₂. The topic was priorly taught in a lecture class by one of the faculty during didactic lecture class. The JCL tool was adopted for the reinforcement of the topic in the tutorial class. The entire faculty involved in the study was oriented towards jigsaw method of TL. One hundred and fifty students volunteered and two students were absent and were excluded from the study. The students were divided into six batches of 25 each and the study was conducted during tutorial class in six consecutive days.

During each tutorial class attended by one batch

Step 1: The students were subjected to pre-test consisting of eight Multiple Choice Questions (MCQ's) for five minutes.

Step 2: After explaining the TL technique, the 25 students were grouped as five home groups, I to V of five students each according to their role numbers. In each group, the students were numbered as 1 to 5 as shown in [Table/Fig-1].

Step 3: Then the students were re-grouped to form expert new group labelled as A to E consisting of the common numbers from home group as shown in [Table/Fig-1]. This new group was given one subtopic to prepare from various resources (class notes, textbooks, online resources etc.), discuss and debate for 30 minutes.



The subtopic distribution was as follows:

Expert group A- Structure, co-enzyme and functions of folic acid

Expert group B- Recommended Daily Allowance (RDA), dietary sources and deficiency manifestation of folic acid

Expert group C- Structure, absorption, transportation and storage of Vitamin B₁₂

Expert group D- Biochemical functions and deficiency manifestation of Vitamin B₁₂

Expert group E- RDA, sources of B₁₂ and folate trap

Step 4: After 30 minutes, each student returned to home group. In home group, each student was an expert in one subtopic. The students taught each other, had discussions and debates such that

all students in the group are well versed with the complete topic. Time allotted was 60 minutes.

Step 5: The students from each home group was randomly selected to present randomly one subtopic for five minutes followed by two minutes of questioning and debate by other home groups and the facilitator. Time required to complete this activity by all groups was 35-40 minutes.

Step 6: All 25 students were subjected to post-test on same MCQs given during pre-test for five minutes.

Step 7: Finally the students were asked to fill a feedback questionnaire consisting of both closed ended and open ended questions. The questionnaire had 10 statements on perception of students on jigsaw technique on a five-point Likert's scale with least score of 1 for strongly disagree to maximum score of 5 for strongly agree. The second part of questionnaire had open ended questions to obtain the students' opinion on advantages, disadvantages (optional) and preference of jigsaw technique as TL method.

STATISTICAL ANALYSIS

Descriptive statistics were used and data was expressed as percentage. The mean±standard deviation of pre-test and post-test marks were calculated and compared by paired student t-test and a p<0.05 was considered as significant. Mean score was calculated for the close ended statement with Likert's scale response. The open ended questions were analysed by content analysis for identifying, interpreting and obtaining themes for the student's responses.

RESULTS

The study had 150 participants divided into six groups and JCL was conducted in six consecutive tutorial classes of 25 students each. Of the 150 participants, 46% were males and 54% were females with a mean age of 19.73±1.26 years. There was a statistically significant difference between mean pre-test (3.8±1.7) and post-test score (5.7±1.4) with p<0.001.

The [Table/Fig-2] shows the learning experiences of the students towards JCL technique in terms of mean score and percentages of the agreement/disagreement for each item of questionnaire. The statement "the activity helped in enhancing communication skills" had highest mean score of 4.59, followed by "the activity helped in overcoming shyness and hesitation in the class" with the score of 4.41. The statement "the activity enabled in depth coverage of the topic" had least mean score of 3.56 For the open-ended questions

S. No.	Statements	SD+D*	U† (%)	A+SA‡ (%)	Mean score
1	The activity was useful in comprehending the given topic.	4.0	6.67	89.33	4.18
2	The activity enabled in-depth coverage of the topic.	14.67	23.33	62.00	3.56
3	The activity helped in enhancing communication skills.	0.67	2.00	97.33	4.59
4	A thorough discussion on the topics increased analytical ability	4.0	9.33	86.67	4.11
5	The activity helped in overcoming shyness and hesitation in the class.	1.34	7.33	91.33	4.41
6	This form of exercise should be incorporated for all the topics in Biochemistry.	11.34	14.67	74.00	3.97
7	The exercise ingrained teaching skills in the participants.	1.34	8.0	90.67	4.31
8	You are confident that this knowledge could be applied in clinical practice	5.33	26.0	68.67	3.91
9	The exercise was enjoyable.	3.33	5.33	91.33	4.31
10	This is an effective way of learning.	8.0	10.67	81.33	4.01
Mean score					4.14±0.3

[Table/Fig-2]: Student response on Learning experience of jigsaw method of teaching learning expressed in percentage and mean score (n=150).

*Strongly disagree and disagree, †Uncertain, ‡Agree and strongly agree

on advantages and disadvantages of this method, 98% students had given response for the advantages of JCL of Teaching-Learning and the common advantages perceived by the students are given in [Table/Fig-3]. A large number of students (71.3%) also opined for disadvantages and the most common disadvantages cited by students are given in [Table/Fig-4].

Common themes/patterns	Frequency (n)	Percentage (%)
Communication skill is improved or enhanced	39	27
Learn the topic in depth/understanding clearly/doubts cleared/better understanding	20	14
Can overcome stage fear/hesitation/shyness/free to interact	19	13
Covers many topics in a small or limited time	19	13
Active participation/interactive learning//more fun/innovative learning/enjoyable	14	10
Retains knowledge for a longer period of time	9	6
Improves teaching skills	9	6
Learn from multiple books/resources	8	5
Increases comprehension and analytical ability	7	5
Increases confidence	6	4
Faster/speed learning/learn easily	5	3

[Table/Fig-3]: Advantages of Jigsaw technique as opined by I MBBS students expressed in both actual numbers and percentage (n=150).

Common patterns	Frequency (n)	Percentage (%)
Time consuming	16	11
In depth coverage of topic is not possible	12	8
Cannot understand the topic/confusing to learn from others	11	7
Students may not teach well/language barrier	10	7
Difficult for slow learners/can't cope up	7	5
Time allotted for subtopics was not enough	6	4
Stage fear may make us forget/lack of communication skill	6	4
Non cooperative members hence effects the group	5	3

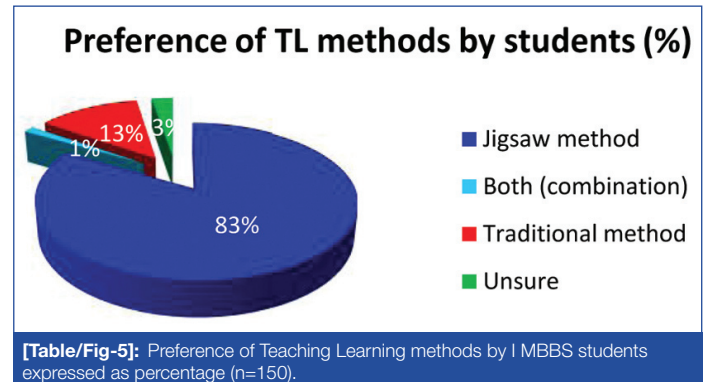
[Table/Fig-4]: Disadvantages of Jigsaw technique opined by I MBBS students expressed in both actual numbers and percentage (n=150).

DISCUSSION

In the present study, there was significant gain in post-test score following JCL method ($p < 0.001$). A study on psychology students also demonstrated a significant difference between pre-test scores (52.5%) and post-test scores (80%) following jigsaw method of teaching [12]. Similarly, a study by Philips J and Fusco J, among pharmacy students demonstrated the successfulness of this technique with high post-test score of 88% [7]. This method of evaluation may not reflect true impact of learning as most instructional approaches may increase the knowledge of students temporarily giving higher post-test scores. However, in a study among medical students, JCL method showed significantly higher improvement in post-test scores compared to conventional tutorial method of teaching (12.4 vs 9.7, $p \leq 0.001$) [13]. The improvement in post-test scores in the present study is in accordance with these previous studies [7,12,13]. Nevertheless, long-term effects on student learning and retention need to be studied to establish the effectiveness of any TL method. A study by Persky AM and Pollack GM, showed no difference in student's examination performance between jigsaw technique of teaching year and traditional method of teaching year [10].

The present study also recorded the learning experiences of students with students acknowledging the benefits of JCL with mean score of 4.14 ± 0.3 . Majority of the students agreed to the various statements of positive learning experience and benefits of JCL method as shown in [Table/Fig-2]. Similar satisfaction index has been demonstrated in an earlier study performed on 1st year MBBS students on a physiology topic [11].

In the present study, 83% students preferred JCL similar to a study by Varma SR, who reported 90% of the participants being comfortable with this method [14]. However, 13% of the students preferred traditional method as shown in [Table/Fig-5]. A higher level of dissatisfaction has also been reported in other studies [10,15]. In the study by Persky AM and Pollack GM, 55.4% of the participant felt, they learnt less during this technique [10]. Further another study among nursing students reported preference of traditional methods especially in older students [15].



[Table/Fig-5]: Preference of Teaching Learning methods by I MBBS students expressed as percentage (n=150).

Nevertheless, majority of the students (98%) opined many advantages of the JCL technique. Around 27% of the participants opined that the JCL improves communication skill, helps to overcome shyness/hesitation and stage fear. The method has shown to foster communication skills with a transition of students from passive learners to active learners [7]. As per MCI 'vision 2015' document, one of the competencies required by Indian medical graduate is communication skill [1]. This TL method helps to overcome stage fear and hesitation due to peer interactions and presentations as evident by following statements of the students

"The best method where we get to overcome the shyness and build our communication skill and understand the topic well"

"We could learn things not only by reading books but by communicating with peers. It helped communicating skills and overcoming stage fear"

Similarly other studies have also demonstrated that this technique improves the communication skill [11,12,16]. The students also viewed this method, helped clear understanding of the topic as reflected in the following student statements.

"We could understand the teaching skills of our friend which will be in a simple manner than the teachers"

"There is a lot of peer interaction, allows eased understanding of points as the member of the group have similar thought process"

JCL has been reported as more effective technique in students understanding compared to other cooperative learning approaches.

The students also perceived that this method improves analytical and comprehension skills, and retains knowledge for a longer period of time as inferred from following statements.

"Helped in increased analytical ability"

"Can cover all the topics, the topic we teach will always remain in our head, the doubts get cleared"

"We gather maximum knowledge on a topic and remember them for a longer time because we enjoyed learning"

Few studies have demonstrated higher knowledge retention in 3-4 weeks delayed post-test scores in jigsaw group compared with traditional teaching [13,17].

To learn the complex subject such as biochemistry, it is equally important for student to be actively involved and enjoy the learning process. Few students have stated that they enjoyed this method and the learning process was fun

"Learning from and with friends is more fun and understanding is better, increases confidence"

Enjoyment in learning increases the interest in subject improving the scholastic performance. In a study among school children, the difficult subject mathematics was perceived as interesting and enjoyable with improved performance following JCL [4]. Similarly, other studies have also reported JCL to be innovative teaching method with student proactive engagement [11,12,18]. Overall the authors also noticed all the students were actively participating, with good interaction, healthy competition compared to the traditional tutorial class.

However, 71.3% of students gave opinion on disadvantages of JCL. The most common disadvantage cited by the participants was it is time-consuming process and in-depth coverage of the topic is not possible.

"A lot of time is wasted. Instead we could learn all the topics by ourselves and present it randomly"

Similar disadvantages have been pointed out in some studies, even though these studies had hybrid approach where students worked outside classroom atmosphere for expert group discussions [10,13,16]. Another pitfall pointed in these studies is, all the members in the group did not do their part or because of lower performance of these students, it affected the success of the group [10,13]. In the present study also a small percentage of students echoed similar drawbacks.

Non-cooperation of some members, every member don't put much effort into teaching

Another major concern of the students was the method is difficult to cope up for slow learners as evident from the below statements

"Some of us are slow learners and it is hard to learn things with this speed"

"All type of students can't cope up with this method"

On the other hand, the advanced learners may feel, it is waste of time and the task is less challenging [12].

Overall the JCL has shown to be a highly successful TL method not only at the level of elementary schools but also in medical science field, effective in teaching cognitive skills [13], clinical skills [14], critical thinking skills especially in pharmaceutical sciences [10,18], solving clinical controversy in clinical situations [7], long-term and post-acute care [19].

In the present study, majority of the students had positive attitude towards JCL with most of the students acknowledging the benefits of JCL especially the communication skill, even though few disadvantages were also pointed which should not be disregarded.

LIMITATION

The limitations of the present study are, the study did not have control group with traditional teaching and long-term outcome of students learning with JCL was not measured.

CONCLUSION

In a nutshell based on student's preference, positive acceptance of the method and students performance, authors recommend that this interactive and proactive technique can be adopted in teaching at least few selected topics of clinical relevance in Biochemistry. It

is also important that faculty should be sensitised and trained to effectively implement this method. To overcome the disadvantage of time-consuming process the topics can be priorly intimated to the students for the step of expert group preparation as has been followed in some studies.

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