

Effectiveness of Jigsaw Active Learning Method in Promoting Knowledge Gain and Retention among Medical Students: A Quasi-experimental Study

DIVYA G KRISHNAN¹, ANUKESH VASU KELOTH², SHAIKH UBEDULLA³, PG MOHANDAS⁴

ABSTRACT

Introduction: The jigsaw method is one of the learning methods that has great potential to make students learn a large amount of information in a short period of time. It is a classroom technique where students act as blocks of jigsaw puzzle and learn cooperatively with all the participating students acting as teachers as well as learners.

Aim: To assess the effectiveness of jigsaw active learning method in comparison to conventional didactic method in promoting knowledge gain and retention among final year medical students.

Materials and Methods: This quasi-experimental crossover pretest post-test study was conducted among final year medical students of a tertiary care teaching hospital in North Kerala from June 2021 to July 2021 during the integrated sessions by Surgery and Pharmacology Departments. Students were randomly divided into two groups A and B of 28 students each. They were taught two topics i.e., hyperthyroidism and hypothyroidism, as two sessions by either a jigsaw (experimental) or didactic (control) method. The

first topic was taught by the two methods and then the same groups were later crossed over for the second topic. Knowledge gain and retention were assessed by immediate and delayed post-tests consisting of 20 multiple choice questions with a single correct response. Each correct response was given one mark and incorrect responses were given no negative marks. All data collected was analysed statistically. Statistical significance was considered at p-value <0.05.

Results: The mean age of students was 22.321±0.734 years. Mean scores of immediate post-test were significantly higher in the jigsaw group for the first session (16.64 vs 14.21, p=0.001) and the crossover session (17.61 vs 15.14, p=0.001). Mean scores of delayed post-test were significantly higher in the jigsaw group for the first session (14.32 vs 11.03, p=0.001) and the crossover session (14.85 vs 11.28, p=0.001).

Conclusion: Jigsaw method was found to be more effective than didactic method in promoting knowledge gain and retention among medical students.

Keywords: Cooperative learning, Interactive learning, Medical education

INTRODUCTION

Medical education in India is undergoing reform into a competency based system. This has led to a shift from the traditional teacher centred learning methods to innovative student centred learning methods. A number of new learning methods have been proposed that ensure the active participation of students. The jigsaw method was introduced by Aronson E et al., in 1978 and is one of the active learning methods that can be used as a tool to make students learn a large amount of information in a short period of time. This method makes students help each other learn actively in groups and then teach to their colleagues. It is a classroom technique where students act as blocks of jigsaw puzzle and learn cooperatively. All the participating students act as teachers as well as learners [1].

In jigsaw technique a particular topic is divided into subtopics. The students are divided into primary groups called jigsaw group, with each group member responsible for learning one subtopic. Temporary groups called expert groups are then formed with members from jigsaw groups having the same subtopic. The expert groups study and discuss the subtopic assigned to them and exchange ideas to gain expertise in them so that they can explain the subject to other members of the main jigsaw groups. The teacher and learners agree on a set time, and the learners then return from the expert groups to their associated jigsaw group and teach the subject thus learned to the other members of their group and are also taught all the other subjects learned by the other members of their group.

The jigsaw method facilitates cooperative learning and team work, ultimately enhancing the teaching-learning experience [2,3]. While the jigsaw method has been active and confirmed to be effective in numerous situations like elementary or primary education, nursing education, pharmacy and in other fields, to our knowledge, it has not been used much in teaching related to medical education subjects [4-8]. The present study was undertaken with an aim to assess the effectiveness of jigsaw interactive learning method in comparison to conventional didactic method in promoting knowledge gain and retention among final year medical students.

MATERIALS AND METHODS

This quasi-experimental pretest post-test crossover study was carried out among final year medical students of Kunhitharuvai Memorial Charitable Trust Group of Institutions Medical College, Kozhikode, Kerala, India. The study was conducted over a period of two months from June 2021 to July 2021. Institutional review board gave it a review exempt and consent was waived for the participants. The study was conducted as an integrated session by the Departments of Surgery and Pharmacology for two topics i.e., Hyperthyroidism and Hypothyroidism respectively.

Inclusion criteria: All students belonging to the final year of the Bachelor of Medicine and Bachelor of Surgery (MBBS) course at the college and were scheduled to attend theory sessions by the Department of Surgery in the months of June and July of 2021 were included in the study.

Exclusion criteria: All students attending the MBBS course at the college and were not belonging to the final year of the course were excluded from the study.

The final year batch of 56 medical students who attended the scheduled two hour session on the topic of Hyperthyroidism were randomised into two groups, each group consisted of 28 students. Students in both the groups were given a pre-test with 20 single response questions for the initial 10 minutes to test their basic knowledge on the topic.

Group A (Experimental Group)

The topic on hyperthyroidism was taught by jigsaw interactive learning technique to Group A. The group was organised into seven subgroups (called as jigsaw groups) of four students each. The topic was divided into four subtopics. In each group, every student was allotted one subtopic. Then, students having same subtopic from different subgroups were regrouped together. This new group (called as expert groups) having same subtopic prepared it for 40 minutes by discussing among themselves. Each expert group was provided with relevant resource materials. Facilitators monitored and guided the discussions in the expert groups. After preparation, students returned to their jigsaw groups. Now in this group, there was one expert for each subtopic. Each student then taught the subtopic which he/she prepared while in the expert group to the other three students in his/her parent group in sequence of subtopics for 60 minutes. In this way, the whole topic was completed. The faculty guided and acted as a facilitator during the session. The detailed activities during jigsaw method is shown in [Table/Fig-1].

Jigsaw method	
Pretest	10 minutes
Instructions on jigsaw method, subgroup formation and distribution of resource materials.	10 minutes
Time spent in expert groups	30 minutes
Time spent in parent groups	60 minutes
Post-test	10 minutes
Total	2 hours
Didactic method	
Pretest	10 minutes
Lecture on subtopic 1 by faculty 1	30 minutes
Lecture on subtopic 2 by faculty 2	30 minutes
Lecture on subtopic 3 by faculty 3	30 minutes
Doubt clearing session	10 minutes
Post-test	10 minutes
Total duration	2 hours

[Table/Fig-1]: Activities during Jigsaw and didactic sessions.

Group B (Control Group)

The topic was taught by the conventional didactic method to group B wherein the subtopics were taught by three different faculties in a logical sequence. At the completion of all lectures, the students were allotted 10 minutes to clear their doubts. The detailed activities during the didactic method is shown in [Table/Fig-1].

After completion of teaching and discussion, both the groups were subjected to an immediate post-test during the last 10 minutes of the session. Four weeks after the session, a delayed post-test was conducted on the same topic to test the retention of knowledge.

A second session on the topic of hypothyroidism was conducted in a similar manner but the groups were crossed over for teaching methods to minimise the bias. The students who were in the control group were crossed to the experimental group and the students who were in the experimental group were crossed to the control group. The rest of the methodology and the assessment were same as explained above.

Data collection tools were written pretests and post-tests. The pretests and post-tests consisted of 20 multiple choice questions with a single correct response and were prepared and valued by experts for the chosen topics. Each correct response was given one mark and incorrect responses were not given negative marks. Scores obtained in immediate post-tests were used to assess the gain in knowledge and the scores obtained in delayed post-tests were used to assess the retention of knowledge.

STATISTICAL ANALYSIS

All data collection was done in a blinded manner and data was entered in Microsoft Excel and analysed using online statistical calculators [9,10]. Quantitative data was expressed as Mean±Standard deviation and compared using unpaired t-test. Statistical significance was considered at $p<0.05$.

RESULTS

All the 56 students enrolled in the study completed it. The mean age of students was 22.321 ± 0.734 years. There was no significant difference ($p>0.05$) between the groups with respect to the mean pretest scores [Table/Fig-2]. The results of the pretest were also same in the crossover group [Table/Fig-2]. These results reveal that the students in both the groups had similar academic knowledge on the topics before the interventions.

Pretest score	Group (N=28)	Mean±Standard deviation	Unpaired t-test, p-value
1 st Session	Group A (Jigsaw method)	9.75±0.799	0.313, 0.754
	Group B (Didactic method)	9.68±0.905	
2 nd Session	Group B (Jigsaw method)	9.75±0.799	1.450, 0.293
	Group A (Didactic method)	10.07±0.857	

[Table/Fig-2]: Comparison of pretest scores of the study groups. $p<0.05$ was considered statistically significant.

Authors compared the mean scores obtained in the immediate post-test of both the groups for both the sessions. The mean scores of both the groups in the immediate post-test were higher than their respective mean scores in the pretest, implying that there was a knowledge gain in both the groups during both the sessions.

When the mean scores of both groups in the immediate post-test were compared to assess the knowledge gain, the mean score of jigsaw group was higher than that of didactic group and the difference was statistically significant ($p<0.05$) for both the sessions. This is shown in [Table/Fig-3].

Immediate post-test score	Group (N)	Mean±Standard deviation	Unpaired t-test, p-value
1 st Session	Group A (Jigsaw method)	16.64±0.678	11.598, 0.001
	Group B (Didactic method)	14.21±0.876	
2 nd Session	Group B (Jigsaw method)	17.61±0.567	13.80, 0.001
	Group A (Didactic method)	15.14±0.756	

[Table/Fig-3]: Effect of Jigsaw versus didactic methods on immediate post-test scores.

When the mean scores of both groups in the delayed post-test were compared, the mean score of jigsaw group was higher than that of didactic group and the difference was statistically significant ($p<0.05$) for both the sessions, implying that the knowledge retention was higher for the jigsaw group. This is shown in [Table/Fig-4].

Delayed post-test score	Group (N=28)	Mean±Standard deviation	Unpaired t-test, p-value
1 st Session	Group A (Jigsaw method)	14.32±0.475	17.363, 0.001
	Group B (Didactic method)	11.03±0.881	
2 nd Session	Group B (Jigsaw method)	14.85±0.931	14.950, 0.001
	Group A (Didactic method)	11.28±0.854	

[Table/Fig-4]: Effect of Jigsaw versus didactic methods on delayed post-test scores.

DISCUSSION

In medical education, there is a need to move from traditional teacher focused, didactic teaching to more student focused methods in order to better promote student achievements and produce graduates with transferable skills [11]. The jigsaw methods brings a new education tool to the medical curriculum, allowing for peer discussion of a large amount of material in a short period of time. Furthermore, students are given the opportunity to become an expert in one of the areas and are challenged to teach their topic to other students who have no prior knowledge of that topic. The Jigsaw technique is based on the philosophy that learning develops best when the subject of study is also taught to others once it is acquired [12].

The present study attempted to assess effectiveness of jigsaw active learning method in comparison to conventional didactic method among final year medical students. When the scores in the immediate post-tests of the traditional and jigsaw methods were compared, mean score of jigsaw group was significantly higher ($p < 0.05$) than the score of didactic group. This finding corroborates with the results of studies done by Azmin NH in his study on psychology students, Sannaie N et al., in nursing students and Kumar VCS et al., in their study among medical students where the achievement scores for jigsaw method was higher than the group taught by didactic method [13-15]. The higher achievement scores for the jigsaw group may be attributed to the fact that students engage in thought provoking tasks in their expert groups with eagerness because they know they have to teach the content assigned to them when they move back to their corresponding home groups.

In this study, authors also measured the effectiveness of jigsaw active learning method on knowledge retention. The scores of the delayed post-test were significantly higher ($p < 0.05$) in the jigsaw method group than the didactic method group indicating greater knowledge retention for jigsaw group. This results confirms the results of earlier studies done by Johnson DW and Johnson RT, Tanel Z and Erol M and Sahin A which substantiates that cooperative learning like jigsaw method promotes greater long term achievement than traditional didactic method [16-18]. The jigsaw process required students to read and learn the assigned learning materials, to move from jigsaw groups to expert groups to help each other to learn their assigned learning materials, and back to teach other members in the jigsaw groups what they learned from their experience in the expert groups. Higher knowledge retention scores in the jigsaw group may be attributed to the exchanging and sharing of information, and the cooperative discussion held, by students in the group. Since every student was responsible for a small part of the learning material and had to teach it to other members of the group, this feeling of having a specific responsible role enhanced students central position in the process of acquiring knowledge.

The jigsaw method employed in this study resulted in higher scores for knowledge gain as well as retention for both the topics.

However, it remains to be explored if the same remains true for other topics in medical education. Although the present findings support the effectiveness of jigsaw active learning method for knowledge gain and retention, the sample of this study is restricted to only 56 participants. Therefore, future studies should apply jigsaw method of learning with more participants to generate more evidence on its effectiveness. In order to ensure the effectiveness of this method, faculty members should be trained in this method during faculty development workshops. Instructors should make adequate preclassroom preparations, assign students to work in groups and provide appropriate resource materials to students to work with. Their oversight of group dynamics and group member responsibility is of utmost importance for better operational outcome of this method.

Limitation(s)

The limitation of this study is that the study was conducted with medical students who were permitted to attend classes as per government restrictions on professional colleges applicable in the state due to the ongoing coronavirus disease pandemic. Hence, a larger group of students could not be included in the study.

CONCLUSION(S)

The study proves that the jigsaw technique is more effective than conventional didactic method in promoting knowledge gain and retention among medical students. The findings provide medical teachers with more empirical support for adopting this method for selected topics so as to improve student learning in the current wave of educational reform in medical education.

REFERENCES

- [1] Aronson E, Bridgeman DL, Geffner R. The effects of a cooperative classroom structure on students' behaviour and attitudes. In D. Bar-Tal, & L. Saxe, Editors. *Social Psychology of Education: Theory and Research*. Washington, DC: Hemisphere; 1978:257-72.
- [2] Zakaria E, Iksan Z. Promoting Cooperative Learning in Science and Mathematics Education: A Malaysian Perspective. *EURASIA J Math Sci Tech Ed*. 2007;3(1):35-39.
- [3] Norintan AM. Learning through teaching and sharing in the Jigsaw classroom. *Annual Malaya dent University*. 2008;15:71-76.
- [4] Voyles EC, Bailey SF, Durik AM. New pieces of the jigsaw classroom: Increasing accountability to reduce. *Social Loafing in Student Group Projects*. *The New School Psychology Bulletin*. 2015;13:11-20.
- [5] Charania NA, Kausar F, Cassum S. Playing jigsaw: A cooperative learning experience. *J Nurs Educ*. 2001;40(9):420-21.
- [6] Ofstad W, Brunner LJ. Team-based learning in pharmacy education. *Am J Pharm Educ*. 2013;77(4):70.
- [7] Charlier N, Van Der Stock L, Iserbyt P. Peer-assisted learning in cardiopulmonary resuscitation: The Jigsaw Model. *J Emerg Med*. 2016;50(1):67-73.
- [8] Phillips J, Fusco J. Using the jigsaw technique to teach clinical controversy in a clinical skills course. *Am J Pharm Educ*. 2015;79(6):90.
- [9] Calculator Soup, 2021. Standard Deviation Calculator. Available from: <https://www.calculatorsoup.com/calculators/statistics/standard-deviation-calculator.php>. Accessed August 2 2021.
- [10] Social science statistics. 2021. T test calculator for 2 Independent means. Available from: <https://www.socscistatistics.com/tests/studentttest/default.aspx>. Accessed August 2 2021.
- [11] Gülpınar MA, Yeğen BC. Interactive lecturing for meaningful learning in large groups. *Med Teach*. 2005;27(7):590-94.
- [12] Shabani H. *Educational Skills (Methods and Techniques of teaching)*. Tehran: Samt Press; 2014. Pp. 347-362.
- [13] Azmin NH. Effect of the Jigsaw-based cooperative learning method on student performance in the general certificate of education advanced level psychology: An exploratory brunei case study. *International Education Studies*. 2016;9(1):91-106.
- [14] Sanaie N, Vasli P, Sedighi L, Sadeghi B. Comparing the effect of lecture and Jigsaw teaching strategies on the nursing students' self-regulated learning and academic motivation: A quasi-experimental study. *Nurse Educ Today*. 2019;79:35-40.
- [15] Kumar VCS, Kalasuramath S, Patil S, Kumar RKG, Taj SKR, Jayasimha VL, et al. Effect of Jigsaw co-operative learning method in improving cognitive skills among medical students. *Int J Curr Microbiol*. 2017;6(3):164-73.
- [16] Johnson DW, Johnson RT. New developments in social interdependence theory. *Genet Soc Gen Psychol Monogr*. 2005;131(4):285-358.

- [17] Tanel Z, Erol M. Effects of cooperative learning on instructing magnetism: Analysis of an experimental teaching sequence. *American Journal of Physics and Education*. 2008;2(2):124-36.
- [18] Sahin A. Effects of Jigsaw III technique on achievement in written expression. *Asia Pacific Education Review*. 2010;12(3):427-35.

PARTICULARS OF CONTRIBUTORS:

1. Associate Professor, Department of Pharmacology, Kunhitharuvai Memorial Charitable Trust Group of Institutions Medical College, Kozhikode, Kerala, India.
2. Associate Professor, Department of Surgery, Kunhitharuvai Memorial Charitable Trust Group of Institutions Medical College, Kozhikode, Kerala, India.
3. Professor, Department of Pharmacology, Kunhitharuvai Memorial Charitable Trust Group of Institutions Medical College, Kozhikode, Kerala, India.
4. Professor, Department of Surgery, Kunhitharuvai Memorial Charitable Trust Group of Institutions Medical College, Kozhikode, Kerala, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Anukesh Vasu Keloth,
Department of General Surgery, Kunhitharuvai Memorial Charitable Trust Group of Institutions Medical College, Post Manassery, Kozhikode-673602, Kerala, India.
E-mail: anukesh@gmail.com

PLAGIARISM CHECKING METHODS: [[Jain H et al.](#)]

- Plagiarism X-checker: Sep 16, 2021
- Manual Googling: Nov 05, 2021
- iThenticate Software: Nov 22, 2021 (20%)

ETYMOLOGY: Author Origin**AUTHOR DECLARATION:**

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? No
- Was informed consent obtained from the subjects involved in the study? No
- For any images presented appropriate consent has been obtained from the subjects. No

Date of Submission: **Sep 15, 2021**Date of Peer Review: **Oct 25, 2021**Date of Acceptance: **Nov 08, 2021**Date of Publishing: **Dec 01, 2021**