ORIGINAL ARTICLE ASIAN JOURNAL OF MEDICAL SCIENCES

Role of JIGSAW method of teaching in improving clinical diagnosis among final year medical students – A prospective observational study

Appandraj S[1], Sivagamasundari V[2], Varatharajan Sakthivadivel[3]

[1]Professor and Head, Department of General Medicine, [2]Associate Professor, Department of Pediatrics, Melmaruvathur Adhiparasakthi Institute of Medical Sciences, Melmaruvathur, Tamil Nadu, [3]Associate Professor, Department of General Medicine, All India Institute of Medical Sciences, Bibinagar, Hyderabad, India

Submission: 21-08-2021 Revision: 11-11-2021 Publication: 01-12-2021

ABSTRACT

Background: The Jigsaw method is a form of cooperative learning, in which students are actively involved in the teaching-learning process that improves the long-term retention of acquired knowledge. **Aims and Objectives:** The objective of this study was to assess the knowledge acquired by students using the Jigsaw learning method in Internal Medicine. **Materials and Methods:** A prospective observational study was conducted with 100 students. The acute coronary syndrome was taken for 1 h as a didactic lecture, and a pre-test was conducted. The students were divided into five groups and were put for the intervention "Jigsaw." The pre- and post-test were conducted, and feedback was collected from the students. Paired t-test was used to perform analysis of pre- and post-test. Feedback evaluation was done by a 5-point Liker scale. $P<0.05$ was considered statistically significant, and the data were analyzed using CoGuide software. **Results:** The mean pre-test score was 8.44 ± 2.33 ranged (3–14) and the mean post-test score was 11.03 ± 2.07 (ranged 6–15). The difference of 2.39 (95% CI: 2.19–2.59) increase in marks post-test after the Jigsaw method was statistically significant ($P<0.001$). The satisfaction level was 50–55% on the Likert scale based on the questionnaire given. There was a significant improvement in the post-test scores of the students after Jigsaw. **Conclusion:** The Jigsaw method improved knowledge in the short-term by engaging students in group work and motivation to learn. Overall response based on the questionnaire about the Jigsaw method was positive.

Key words: Diagnosis; Internal medicine; Medical students; Programed learning; Teaching

Access this article online

Website: http://nepjol.info/index.php/AJMS

DOI: 10.3126/ajms.v12i12.39080

E-ISSN: 2091-0576

P-ISSN: 2467-9100

INTRODUCTION

The year 2019 will be marked as a year of change in the medical curriculum of all the medical universities of India. More than 20 years have passed since the existing regulations on graduate medical education, 1997, were notified, necessitating a relook at all aspects of the various components in the existing regulations and adapt them to the changing demography, socioeconomic context, perceptions, values, and expectations of stakeholders. The thrust in the new regulations is on the continuation and evolution of thought in medical education, making it more learner-centric, patient-centric, gender-sensitive, outcome-oriented, and environmentally appropriate.[1]

A good teaching method exposes the learners to challenging situations and provides them with opportunities for interaction, consultation, cooperation, discussion, and debate with themselves and their teacher so that they can develop their power of thinking and participation.[2] Cooperative learning is a method of education that has gained a lot of research interest in recent years so that it is called as one of the greatest innovations in the educational system. Cooperative learning is a method of education in

Address for Correspondence:
Sivagamasundari V, Villa No: 214, Avigna Celeste, Avigna Township, Behind Mahindra World City, Chengalpattu - 603 002, Tamil Nadu, India. **Mobile:** +91-9894503193. **E-mail:** gamapps@yahoo.com

which the learner is responsible not only for his learning but also for the learning of others. The learners work in small groups to help one another learn the educational content, carry out group projects, and master different subjects by cooperating and consulting with their peers and transferring their knowledge. The main approaches to cooperative learning used in recent decades include Student Team Achievement Divisions, Team-Games-Tournaments, Team Assisted Individualization, and Jigsaw. These methods differ in terms of their structure and the type of learners' responsibilities involved.[3]

Surgical and clinical didactics have traditionally employed lecture-based teaching methods. In recent years, there has been a growing call for more "learner-centered" modalities of instruction in graduate medical education. These "learner-centered" modalities include flipped classrooms, where the learners take a more active role in the learning process. While plenty of published studies have established the effectiveness of flipped classrooms, a few studies have examined their efficacy in surgical resident education.[4] The Jigsaw classroom is one form of these flipped classrooms. Social Psychologist Aronson[5] first designed it in 1971 to help weaken racial divides in forcibly integrated schools. The Jigsaw classroom seeks to make students active participants in the learning process. This method organizes the classroom so that the students are dependent on each other to succeed by breaking classes into groups and breaking assignments into pieces.[6]

A previous study by Charlier et al.,[7] investigated the quality of peer-assisted learning using the Jigsaw method compared to direct teaching by an instructor for learning cardiopulmonary resuscitation (CPR). They have shown that peer-led laypersons' training in basic life support using this model results in a CPR performance quality that is in line with the ERC 2010 guidelines while offering advantages in terms of workload for the instructor and skill acquisition and retention for the learner. The Jigsaw method has not only been shown to build comprehension, but it also encourages cooperatively among students. It is known to improve listening and communication skills. Since 1970, the Jigsaw method has been successfully tried in various areas of education such as elementary or primary education, nursing education, pharmacy, and other fields but less so in medical subjects.[8,9]

Literature search could not yield many published articles on the Jigsaw method for clinical diagnostic teaching for medical students in India. Hence, the present study was implemented to assess the effectiveness of the Jigsaw method over didactic lectures in teaching Internal Medicine among the final year students and to assess the knowledge acquired by students in Internal Medicine after the Jigsaw method of teaching. Although the Jigsaw method can apply to many topics in medical education, we chose to apply this learning technique for clinical diagnosis since this topic highlights problem-solving techniques.

Aims and objectives

- The present study was taken to study the effectiveness of the "Jigsaw method" in combination with a lecture in enhancing cognitive skills in clinical diagnosis.
- To assess the student perception toward cooperative group activities.

MATERIALS AND METHODS

Study design

A prospective observational study.

Study setting

Lecture room of medical college.

Study population

Final year medical college students.

Study period

One month from October 2020 to November 2020.

Sample size and sampling technique

Sample 100 was selected by a convenient sampling method for the feasibility of the study.

Sample size calculation

As per the availability of students, 100 students were considered for the final study.

Ethical and informed consent

The study was approved by the Institutional Ethical Review Board, and before the study started, written informed consent was obtained from the participants.

Inclusion criteria

- Final year medical students
- Present in the class during the study
- Those who have given consent.

Exclusion criteria

- Absent on the day.

Jigsaw technique

Jigsaw learning technique or Jigsaw puzzle constitutes a well-structured cooperative learning technique that is free from many of the problems involved in other learning methods. This and other innovative teaching and learning techniques have been successfully used to improve academic achievement among students. 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. In the Jigsaw technique, learners are divided into matching groups of four or six. The lesson is then split into the number of persons in each group. Using this classification method means that the content of one part cannot be a prerequisite for any of the other parts, and each part should be independent of the other parts while also covering the lesson plan together. A number is assigned to the members of each group as well as to each subject. For example, subject one is assigned to as a group. At the same time, in other approaches, the tasks are divided among the group members, and each member works independently and only asks for help if needed. Jigsaw learning technique or Jigsaw puzzle constitutes a well-structured cooperative learning technique free from many of the problems involved in other learning methods. This and other innovative teaching and learning techniques have been successfully used to improve academic achievement among students. 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. In the Jigsaw technique, learners are divided into matching groups of four or six. The lesson is then split into the number of persons in each group. Using this classification method means that the content of one part cannot be a prerequisite for any of the other parts, and each part should be independent of the other parts while also covering the lesson plan together. A number is assigned to the members of each group as well as to each subject. For example, subject one is assigned to person one in each group, subject two to person two, and so on. Temporary groups will then be formed. All the members of each temporary group (also called an expert group) work on the same subject; for example, they all work on subject two of the class material. The expert groups consist of three to five members who study and discuss the subjects assigned to them and exchange ideas to gain expertise in them and so that they can explain the subject to other members of the main Jigsaw groups. The teacher and learners agree on a set time. 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. Using this method of teaching provokes the learners' interest in the lessons and improves the social relationship between them.[5]

Data collection

1) Acute coronary syndrome was taken for 1 h as a didactic lecture, and a pre-test was conducted.
2) Then acute coronary syndrome was divided into five parts i) types and etiopathogenesis, ii) clinical features, iii) investigations, iv) management, and v) complications.
3) Students are then divided into five groups and given one topic for each group. Each group is given 1 day time to prepare their topics.
4) Next day, four students from each group are interchanged with other groups in the Jigsaw method so that new groups had four student experts in each part of an acute coronary syndrome.
5) Since the new group has four experts in each part, they are allowed for discussion for 1 h. Experts on a particular topic were enlightening others and vice versa.
6) Post-test was conducted, and feedback was obtained from students.
    - Pre- and post-test questionnaire in the form of MCQs and feedback forms were prepared.
    - Analysis of pre- and post-test was be done by paired t-test.
    - Feedback evaluation was done by 5-point Liker's scale.

Study variables

Student performance on a knowledge-based pre- and post-test was considered as primary outcome variables. Since student perceptions tend to be more subjective, this was used as a secondary outcome.

Statistical methods

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency, and proportion for categorical variables. The association between before and after the intervention of quantitative outcome was assessed by comparing the mean values. The mean differences along with their 95% CI were presented. Paired t-test was used to evaluate statistical significance. $P<0.05$ was considered statistically significant using CoGuide software.[10]

RESULTS

A total of 100 subjects were included in the final analysis. Pre- and post-test results and feedback collected were analyzed.

Demographic characteristics and academic performance

There were 43 (43%) males and the remaining 57 (57%) females. The mean pre-test score was 8.44 in the study population. The mean post-test score was 11.03 in the study population. The improvement of marks was 2.59 in the study population. The mean improvement of percentage was 12.95 in the study population, and the mean feedback score was 40.7 in the study population (Table 1).

Student's perception

The majority of 57% agreed and 38% strongly agreed with the JS helped me to learn better; 50% agree and

22% strongly agreed with the JS covered a wide range of knowledge; 51% agreed and 43% strongly agreed for JS improved communication skills; 55% agreed and 33% strongly agreed for JS improved confidence; 52% agreed and 28% strongly agreed for JS improved clinical reasoning; 52% agreed and 40% strongly agreed with the Study conducted in a well-planned manner; 54% agreed and 33% strongly agreed for Sufficient time was given to learn. JS can be followed in medicine theory class was agree by 54% and strongly agree by 36% and 50% agreed and 33% strongly agreed for JS can be followed in other theory classes, and 41% were neutral, and 21% agreed with the traditional methods should be continued (Table 2).

The individual mean scores for feedback elements were less in JS covered a wide range of knowledge as 3.81 and in traditional methods should be continued as 3.07 compared to other elements mean score which was more than 4. The mean overall feedback scores were 40.7 ± 3.9 in the study population (Table 3).

Assessment of Jigsaw technique

The mean marks of pre-operative were 8.44 ± 2.33 and post-operative was 11.03 ± 2.07. The difference of 2.39 (95% CI: 2.19–2.59) between pre- and post-operative was statistically significant (P<0.001) (Table 4).

DISCUSSION

According to the author's knowledge, this is the first study that used the Jigsaw method to promote active learning and diagnostic reasoning in the lecture room of their medical college. The findings of the present study showed mean pre-test scores as 8.44 ± 2.33 ranged (3–14) and the mean post-test score as 11.03 ± 2.07 (ranged 6–15). The mean difference of 2.39 (95% CI: 2.19–2.59) increase in marks post-test was statistically significant (P<0.001). The students strongly agreed that Jigsaw was helpful for them in understanding the topic in detail. The satisfaction level was 50–55% on the Likert scale based on the questionnaire given. There was a significant improvement in the post-test scores of the students after Jigsaw.

In our study, we have observed that the post-test scores significantly improved after the Jigsaw technique. There was an increase in a mean difference of 2.39 (95% CI: 2.19–2.59) in marks after the Jigsaw method, which was statistically significant (P<0.001). The finding was similar to the quasi-experimental study by Swathi and Rajkumar[11] among second MBBS students where they observed that the post-test scores significantly improved after the Jigsaw technique and 28% of students scored >75% in the pre-test while 78.6% of the students scored >75% in the post-test. P-value was <0.05. Another prospective study by Oakes et al.,[12] in Australia among Medical radiation sciences students showed that marks of the Jigsaw workshop participants compared to workshop non-participants (controls) was higher and statistically significant. The findings of the present study were in contrast to a comparative study between Jigsaw learning method to traditional lecture among first professional year student pharmacists learning about medication therapy management by Wilson et al.,[13] in the United States where, improvement in post-test scores favored the traditional method (P=0.001), and the study found that students seemed to find value in the Jigsaw learning method, but performed better on the post-test knowledge questions when the material was presented using traditional didactic lecture.

In the present study, we took the student's feedback by a questionnaire and found that students had taken this interventional approach with a positive attitude. Many students (n=54, 54%) agreed to incorporate the

Table 1: Summary of the demographic parameter (N=100)

Parameter	Summary
Gender	
Male	43(43%)
Female	57(57%)
Pre-test	8.44±2.33 ranged (3–14)
Post-test	11.03±2.07 ranged (6–15)
Improvement of marks	2.59±2.1 ranged (0–9)
Improvement of (%)	12.95±10.52 ranged (0–45)
Mean feedback scores	40.7±3.8 ranged (32–49)

Table 2: Summary of the response to questionnaire using Likert's scale (N=100)

Parameter	Strongly disagree	Disagree	Neutral	Agree	Strongly Agree
JS helped me to learn better	-	2 (2%)	3 (3%)	57 (57%)	38 (38%)
JS covered a wide range of knowledge	-	13 (13%)	15 (15%)	50 (50%)	22 (22%)
JS improved communication skills	-	-	6 (6%)	51 (51%)	43 (43%)
JS improved confidence	-	-	12 (12%)	55 (55%)	33 (33%)
JS improved clinical reasoning	-	1 (1%)	19 (19%)	52 (52%)	28 (28%)
A study conducted in a well-planned manner	-	-	8 (8%)	52 (52%)	40 (40%)
Sufficient time was given to learn	-	3 (3%)	10 (10%)	54 (54%)	33 (33%)
JS can be followed in Medicine theory class	-	1(1%)	9(9%)	54(54%)	36(36%)
JS can be followed in other theory classes	-	1(1%)	16(16%)	50(50%)	33(33%)
Traditional methods should be continued	12(12%)	14(14%)	41(41%)	21(21%)	12(12%)

Table 3: Summary of mean response to questionnaire (N=100)

Feedback	Mean±SD
JS helped me to learn better	4.31±0.6
JS covered a wide range of knowledge	3.81±0.9
JS improved communication skills	4.37±0.6
JS improved confidence	4.21±0.6
JS improved clinical reasoning	4.07±0.7
A study conducted in a well-planned manner	4.32±0.6
Sufficient time was given to learn	4.18±0.7
JS can be followed in medicine theory class	4.25±0.7
JS can be followed in other theory classes	4.15±0.7
Traditional methods should be continued	3.07±1.1
Mean feedback scores	40.7±3.9

Table 4: Comparison of mean marks in pre- and post-operative (N=100)

Marks	Mean±STD	Mean difference (95% CI)	P-value
Pre-test	8.44±2.33	2.39 (2.19–2.59)	<0.001
Post-test	11.03±2.07		

material into their practice. The finding was similar to a comparative study by Goolsarran et al.,[14] in New York, where all workshop participants (100%) indicated that the workshop content was helpful. A higher percentage of the participants in the Jigsaw intervention group compared to the traditional small group (91% vs. 9%) reported that what they learned from the workshop session would impact future practice (χ^2=32.1, df=1, P<0.001).

In the present study, most of them were (n=57, 57%) female. Females tend to have a more positive attitude than males and are also more willing and more motivated to participate. This finding is in contrast to an educational intervention using the Jigsaw Cooperative-L technique among dental students by Suárez-Cunqueiro et al.,[15] in Spain, where when gender was considered, it was noted that most of the students who did not attend the examination were females, reaching a value of 86% (6 of 7 students).

In the present study, students were divided into five groups and given one topic for each group. Each group is given 1 day time to prepare their topics. The next day four students from each group are interchanged with other groups in the Jigsaw method so that new groups had four student experts in each part of an acute coronary syndrome. Since the new group has four experts in each part, they are allowed for discussion for 1 h, and experts of particular topics enlightened others and vice versa. This same strategy was seen in an interventional study among medical students by Uppal and Uppal[16] in Delhi, which had shown that the students learned more things when they worked in groups compared with working individually. Through the group activity, the students not only gained academic knowledge but also learned how to work in collaboration in a group and how each student functions as an individual member of the group, and how other members behave and work in groups. Another quasi-experimental study among nursing students by Sanaie et al.,[17] in Iran concluded that the Jigsaw method provided an opportunity for students to acquire skills such as lecturing in the classroom, time management, setting goals for learning, using examples and teamwork, which increased the self-regulated learning and academic motivation of nursing students.

The Jigsaw classroom is a structured, task focussed class that introduces a lot of material in a short space of time. The caveat for participants is that they learn much more about one element of the topic in the session. Consequently, to balance their understanding across all elements, learners have additional work to do outside the class. The method is suitable as the face-to-face element in a blended learning approach. This is because it allows for discussion and application of the material, so usefully paired with independent reading and reflection.[18]

Limitations of the study

The sample size of the study is small as only half of the batch was involved. The study was conducted on only one topic, and hence the findings should be used cautiously in other fields. The study did not have a control group from the same classroom that was not subjected to the Jigsaw technique, which could hinder the generalizability. The Jigsaw technique is time-consuming and hence requires proper methodology in learning a topic. The efficacy of the Jigsaw method in terms of long-term retention of knowledge acquired needs to be evaluated by further studies among different postgraduate and undergraduate students of other branches.

CONCLUSION

The present study demonstrates that a Jigsaw cooperative learning approach can be an effective instructional method in learning concepts related to clinical diagnosis. Our results suggest that the Jigsaw method is a valid teaching technique as didactic lectures. It emphasized peer teaching, holding each individual accountable for the learning materials, and uses fewer resources while also focusing on the importance of teamwork. Therefore, it can be utilized regularly where faculty time for teaching is limited. It could also be used as part of a library induction, to evaluate resources, or to facilitate a journal club for clinicians or students. Further, research is needed to determine if a combination of didactic teaching and the Jigsaw method enhances increased "soft skills" and retention.

ACKNOWLEDGMENTS

We acknowledge the technical support in data entry, analysis and manuscript editing by "Evidencian Research Associates."

REFERENCES

1. Ananthakrishnan N. Competency based undergraduate curriculum for the Indian Medical Graduate, the new MCI curricular document: Positives and areas of concern. J Basic Clin Appl Heal Sci. 2018;1(1):184-92.
   https://doi.org/10.5005/jp-journals-10082-01149
2. Wolff M, Wagner MJ, Poznanski S and Schiller J, Santen S. Not another boring lecture: Engaging learners with active learning techniques. J Emerg Med. 2015;48:85-93.
   https://doi.org/10.1016/j.jemermed.2014.09.010
3. Shabani H. Educational Skills (Methods and Techniques of teaching). Tehran: Samt Press; 2014. p. 347-62.
4. Chen F, Lui AM, Martinelli SM. A systematic review of the effectiveness of flipped classrooms in medical education. Med Educ. 2017;51:585-97.
   https://doi.org/10.1111/medu.13272
5. Aronson E. The Jigsaw Classroom. Available from: https://www.jigsaw.org [Last accessed on 2021 Aug 20].
6. Aronson E. Cooperation in the Classroom: The Jigsaw Method. 3rd ed. London: Pinter and Martin Limited; 2011. p. 160.
7. Charlier N, Van Der Stock L and Iserbyt P. Peer-assisted learning in cardiopulmonary resuscitation: The Jigsaw model. J Emerg Med. 2016;50(1):67-73.
   https://doi.org/10.1016/j.jemermed.2015.04.002
8. Buhr GT, Heflin MT, White HK and Pinheiro S. Using the jigsaw cooperative learning method to teach medical students about long-term and postacute care. J Am Med Dir Assoc. 2014;15(6):429-34.
   https://doi.org/10.1016/j.jamda.2014.01.015
9. Sagsoz O, Karatas O, Turel V, Yildiz M and Kaya E. Effectiveness of jigsaw learning compared to lecture-based learning in dental education. Eur J Dent Educ. 2017;21(1):28-32.
   https://doi.org/10.1111/eje.12174
10. BDSS Corp. Released 2020. coGuide Statistics Software, Version 1.0, India: BDSS Corp. Available from: https://www.coguide.in. [Last accessed on 2021 Aug 05].
11. Swathi A and Rajkumar HR. An interventional approach "Jigsaw method" in combination with a lecture to improve the understanding of clinical microbiology for second MBBS students. J Educ Res Med Teach. 2017;5(2):25-30.
12. Oakes DJ, Hegedus EM, Ollerenshaw SL, Drury H and Ritchie HE. Using the Jigsaw method to teach abdominal anatomy. Anat Sci Educ. 2019;12(3):272-83.
   https://doi.org/10.1002/ase.1802
13. Wilson JA, Pegram AH, Battise DM and Robinson AM. Traditional lecture versus jigsaw learning method for teaching Medication Therapy Management (MTM) core elements. Curr Pharm Teach Learn. 2017;9(6):1151-9.
   https://doi.org/10.1016/j.cptl.2017.07.028
14. Goolsarran N, Hamo CE and Lu WH. Using the jigsaw technique to teach patient safety. Med Educ Online. 2020;25(1):1710325.
   https://doi.org/10.1080/10872981.2019.1710325
15. Suárez-Cunqueiro MM, Gándara-Lorenzo D, Mariño-Pérez R, Piñeiro-Abalo S, Pérez-López D and Tomás I. Cooperative learning in "Special Needs in Dentistry" for undergraduate students using the Jigsaw approach. Eur J Dent Educ. 2017;21(4):e64-71.
   https://doi.org/10.1111/eje.12221
16. Uppal V and Uppal N. Flipped jigsaw activity as a small group peer-assisted teaching learning tool in biochemistry department among Indian medical graduate: An experimental study. Biochem Mol Biol Educ. 2020;48(4):337-43.
   https://doi.org/10.1002/bmb.21355
17. Sanaie N, Vasli P, Sedighi L and 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.
   https://doi.org/10.1016/j.nedt.2019.05.022
18. Woods HB. Expediting learning through peer teaching: Experiences with the Jigsaw technique. Health Info Libr J. 2019;36(4):378-82.
   https://doi.org/10.1111/hir.12283

Authors Contribution:
SV- Concept and design of the study, prepared first draft of manuscript; **AS-** Interpreted the results; reviewed the literature and manuscript preparation; **VS-** Concept, coordination, statistical analysis and interpretation, preparation of manuscript and revision of the manuscript.

Work attributed to:
Melmaruvathur Adhiparasakthi Institute of Medical Sciences, Melmaruvathur - 603 319, Tamil Nadu, India.

Orcid ID:
Appandraj S - https://orcid.org/0000-0001-9650-5924
Sivagamasundari V - https://orcid.org/0000-0002-2105-8709
Varatharajan Sakthivadivel - https://orcid.org/0000-0002-5691-670X

Source of Funding: None, **Conflicts of Interest:** None.