

Effectiveness of Cooperative Learning by Jigsaw Method in Understanding Biochemistry for First Year MBBS Students- A Randomised Interventional Study

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ABSTRACT

Introduction: Cooperative learning is a method of education in which the learner is responsible not only for his learning but also for the learning of others. One of the methods in cooperative learning is Jigsaw. Given the benefits of cooperative learning, the current researchers were interested to conduct teaching-learning sessions using the jigsaw method to teach "Enzymes" in Biochemistry.

Aim: To estimate the effectiveness of Cooperative learning by the jigsaw method in understanding Biochemistry for 1st year Bachelor of Medicine and Bachelor of Surgery (MBBS) students.

Materials and Methods: This randomised interventional study was conducted at East Point College of Medical Sciences and Research Centre, Bangalore, India from March 2021 to August 2021. The 150 first Year MBBS students for academic year 2020-2021 were divided into two groups (control and interventional groups). Both control and intervention groups were subjected to pretest before learning sessions. In the intervention method, the students were divided into nine home groups with eight students each. Eight subtopics from enzymes were given for self study and to discuss with other members. The control group had a learning session by traditional method. Following the learning sessions,

both groups took post-test and their feedback was taken on the likert scale. The mean and standard deviation of pre and post-tests were subjected to paired samples test and independent samples test. All the data obtained was entered into MS excel and analysed by Statistical Package for the Social Sciences (SPSS) version 20.0 using descriptive statistics. Paired student "t" test and independent test were used.

Results: Interventional group had 72 students (26 male and 46 female students) and the control group had 75 (26 male and 49 female students). Students aged between 17 to 19 years participated in the study. The mean score in pretest was 15.70±3.04 and in post-test 21.02±2.31 for the interventional group, whereas it was 15.34±4.03 and 20.78±3.22 for pre and post-test respectively in the control group. This intragroup comparison was found to be significant ($p < 0.001$). With the application of the independent samples test, no significant difference was observed in pre or post-test grades between the study and control groups ($p > 0.05$).

Conclusion: Grades between pre and post-tests of both groups implied that tutorial sessions by jigsaw method helped to improve knowledge gain. Students felt the session helped to improve their communication skills and requested to implement other topics which is the need of the hour.

Keywords: Enzymes, Self directed learning, Teaching-learning methods

INTRODUCTION

Cooperative learning is a method of education in which the learner is responsible not only for his learning but also for the learning of others. Cooperative learning is one of the greatest innovations in education in which the students learn within small groups with a common aim to be fulfilled by discussing and cooperating with their peers. In this way, each student is responsible for learning on his own along with all the group members [1].

One of the methods in cooperative learning is jigsaw [1]. The jigsaw strategy is an efficient method to learn the course material effectively in a cooperative learning style. As students work together in a group, jigsaw encourages the development of basic skills like listening and empathy amongst the students [2]. The current trend in medical education demands changes in teaching learning methods with the paradigm shift of teacher centred teaching methods to student centered learning methods such that there is a transition of students from dependency to the active, self directed, lifelong learners as directed by the Medical Council of India (MCI) [3].

One of the competencies expected from medical graduates is to be a lifelong learners who can search and critically evaluate the medical literature and apply this information to patient care [3]. The new guidelines proposed by the National Medical Council (NMC) (Earlier

Medical Council of India) expect the Indian Medical Graduate to be a good communicator as well [3]. A study by Puppalwar PV and Jambhulkar RK proved that Cooperative learning helped students score better than students learning by traditional method and concluded that teaching biochemistry by jigsaw method can make the subject more interesting than teaching by traditional method [1].

The study by Nusrath A et al., has concluded that cooperative learning by the jigsaw method can be adopted in teaching at least a few topics of clinical relevance in Biochemistry [4]. GoolSarran N et al., used the jigsaw method to teach patient safety to medical postgraduates and concluded that it is a feasible and replicable teaching approach to actively engage learners in clinical problem solving and thus proposed it to be utilised for residency programs too [5]. Bogam RR et al., used the jigsaw method to teach Type 2 diabetes mellitus to 1st year medical students and they observed that the method helped students gain significant knowledge and recommended that traditional lectures be replaced by cooperative learning to facilitate learning by medical students [6].

Dollard MW et al., felt that jigsaw learning eliminates competition in the classroom and enhances cooperation a collaboration among students [7]. During the review of the literature [1,4-7], it was observed that studies regarding the effectiveness of cooperative learning by

the jigsaw method in Biochemistry are scarce in Karnataka. Also, the topic selected in the present study was one of the most important, relevant, and difficult to understand and remember in Biochemistry enzymes. With the onset of the Competency based curriculum in India from the National Medical Commission [3], the present study was an attempt to incorporate an effective teaching learning method involving student engagement.

Given the benefits of cooperative learning, the faculty of the Department of Biochemistry at a private medical college in Bengaluru, India conducted a teaching learning, Self Directed Learning (SDL) session and cooperation using the jigsaw method to teach enzymes which is one of the most important topics in Biochemistry. The current study aimed to estimate the effectiveness of cooperative learning by the jigsaw method in understanding Biochemistry by 1st year MBBS students at a private medical college in Bengaluru, India.

MATERIALS AND METHODS

This randomised interventional study was conducted in the Department of Biochemistry, at a Private Medical College in Bengaluru, India from March 2021 to August 2021 following approval by the Institutional Ethics Committee with reference number EPCMSRC/ADM/IEC/2021-22/04. The participation of 1st year MBBS students was voluntary and anonymous.

Inclusion criteria: All 1st year MBBS students, enrolled for the academic year 2020-21 irrespective of gender were included.

Exclusion criteria: Students who were absent or not willing to participate in the study were excluded.

Sample size calculation: Sample size was calculated according to the formula [4,13].

$4pq/12$

$p = 83, q = 17, I(\text{error}) = 8 \text{ percent of } p.$

$= 4 \times 83 \times 17 / (6.64)^2$

~ 130

Minimum required sample size was 130. The study was conducted on 150 students of 1st Year MBBS on the topic of enzymes. 150 students were divided into two random groups of 75 each based on their roll numbers (control and intervention). The first 75 students (Roll numbers 1-75) were considered an interventional group and the later 75 students (Roll numbers 76-150) were considered a control group.

Study Procedure

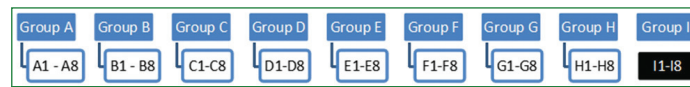
On the day of the intervention, both the groups were given pretest, after being briefed about study design. The students were assured that the grades will be used for the study purposes only and will not contribute to their academic grades. The pretest questionnaire consisting of 25 questions (16 questions in MCQ format and 9 questions as match the following) was designed by the faculty of the Biochemistry, Department and prior validated with the Medical Education Unit faculty. Every correct response was awarded one mark and every unresponded question was awarded zero [Annexure-1]. The maximum score was 25 and the minimum was 0.

Control group: The 75 students attended the tutorials by traditional method. These students had a conventional small group teaching sessions on enzymes using by traditional tutorial method with the help of the instructor and were encouraged for questions and queries at the end of the session.

Following the tutorial session on the same day, post-test questionnaire similar to pretest was administered and responses were recorded.

Interventional group: Out of 75 students, 3 students were absent and excluded. Total of 72 students in the intervention groups were divided into nine groups of eight students each and were labelled as A, B, C, D, E, F, G, H and I [Table/Fig-1]. and designated as home groups. Once the students assembled and acquainted themselves

with home groups, they were given numbers from 1-8 within the home group (A1 to A8, B1- B8 and so on). One candidate was assigned to form an expert group from each home group. Eight such expert groups were formed and were identified by a unique name based on the names of planets. The expert groups were assigned predefined specific learning objectives for the topic "Enzymes" for the learning session. The subtopics of enzymes were as follows:



[Table/Fig-1]: Formation of Home groups and numbering of students in each group.

Expert group 1: Definition and classification of enzymes

Expert group 2: Mode of action of enzymes

Expert group 3: Enzyme kinetics

Expert group 4: Factors influencing enzyme activity

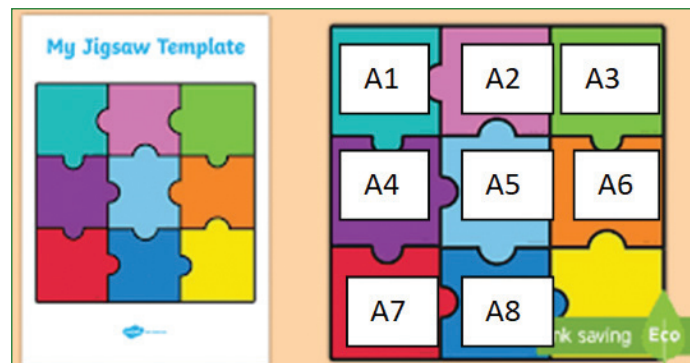
Expert group 5: Enzyme inhibition

Expert group 6: Specificity of enzymes, Coenzymes, Metalloenzymes

Expert group 7: Isoenzymes

Expert group 8: Applications of enzymes

The students were given one hour to study the given subtopic, discuss with peers, clarify doubts and become experts in the same under the guidance of facilitators and the available resource material. At the end of one hour, each member of the expert group returned to their home groups. They were given another hour to present their topic learnt from the expert group to other members of the home group in the order, so that the entire group had complete information on all subtopics of the enzymes topic [Table/Fig-2].



[Table/Fig-2]: Expert groups contributing to complete the jigsaw puzzle.

At the end of the intervention on the same day, post-test questionnaire, similar to pretest was administered. Feedback and perceptions regarding various aspects of the sessions were taken on a likert scale designed by the Biochemistry faculty and validated by the Medical Education Unit faculty. There were eight close ended questions and one open ended question in the feedback questionnaire. Close ended questions were graded from strongly disagree =1 to strongly agree=5 and for tabulation Open ended question was analysed thematically [Annexure-2].

To ensure unbiased uniform learning sessions, the control group were later subjected to the cooperative method using the jigsaw technique. On the day of study, three students were absent in the intervention group out of 75. However, to have the entire class experience a cooperative learning session, they were also exposed to the study when the control group had a cooperative learning session on a different day. Feedback was taken from the control group as well as those absent from the intervention group which makes a total of 150 students.

Formation of Expert group:

Expert group 1: A1, B1, C1, D1, E1, F1, G1, H1, I1

Expert group 2: A2, B2, C2, D2, E2, F2, G2, H2, I2

Expert group 3: A3, B3, C3, D3, E3, F3, G3, H3, I3

Expert group 4: A4, B4, C4, D4, E4, F4, G4, H4, I4

Expert group 5: A5, B5, C5, D5, E5, F5, G5, H5, I5

Expert group 6: A6, B6, C6, D6, E6, F6, G6, H6, I6

Expert group 7: A7, B7, C7, D7, E7, F7, G7, H7, I7

Expert group 8: A8, B8, C8, D8, E8, F8, G8, H8, I8

STATISTICAL ANALYSIS

All the data obtained were entered into MS excel and analysed by Statistical Package for the Social Sciences (SPSS) version 20.0 using Descriptive statistics. Performance in pre and post-test for students from study group and control groups was calculated as mean±standard deviation and compared by paired student “t” test. An independent test was used to compare pretest scores of the test and control groups as well as post-test scores of the two groups. The $p < 0.05$ was considered statistically significant. Responses on the likert scale with regards to all eight close ended statements were analysed in number and percentage and one openended feedback of each student was interpreted thematically.

RESULTS

Interventional group had 72 students (26 male and 46 female students; one male and two female students were absent out of a total 75) and 75 students attended as the control group (26 male and 49 female students, a total 75). Students aged between 17 to 19 years participated in the study with mean age of 17.76 ± 0.79 years.

Significance difference was observed between pre (15.70 ± 3.04) and post-test grades (21.02 ± 2.31) of the interventional group ($p < 0.001$) as well as the control group [15.34 ± 4.03 and 20.78 ± 3.22 in pre and post-tests respectively ($p < 0.001$)]. But, no significance was observed between pretest grades of the interventional group and control group (15.70 ± 3.04 and 15.34 ± 4.03 ; $p = 0.616$) or post-test grades of the interventional group and control group (21.02 ± 2.31 and 20.78 ± 3.22 ; $p = 0.670$) [Table/Fig-3].

Type of group	Pretest	Post-test	p-value (paired t-test)
Study group (mean±SD)	15.70±3.04	21.02±2.31	<0.001*
Control group (mean±SD)	15.34±4.03	20.78±3.22	<0.001*
p-value (independent t-test)	0.616 [#]	0.670 [#]	-

[Table/Fig-3]: Pre and post-test scores of students in study and control groups. * $p < 0.05$ is taken as statistically significant; [#] $p > 0.05$ and hence not statistically significant

The feedback and the results were taken following the intervention for both the groups on their respective day of the intervention. Eighty one students (54%) at the end of the intervention agreed cooperative learning helped understand enzymes topic better, 93 students (62%) strongly agreed the session helped develop skills in working as a member of the team, 78 students (52%) strongly agreed the session helped to learn the specific learning objectives of enzymes better, 78 students (52%) strongly agreed that session helped improve interpersonal communication skills, ninety six students (64%) strongly agreed that the session was more enjoyable than learning in conventional classroom teaching, 84 students (56%) strongly agreed that teaching by cooperative learning can be extended to all major topics in biochemistry [Table/Fig-4]. Responses to closed ended questions were grouped based on the themes like improvement in communicative skills, their perception of the session, and peer involvement and engagement.

Response asked	Strongly disagree (1); n (%)	Disagree (2); n (%)	Neutral (3); n (%)	Agree (4); n (%)	Strongly agree (5); n (%)
Helped you understand the topic of enzymes better	0	0	6 (4)	81 (54)	63 (42)
Helped you to learn and appreciate the wholeness of the topics on enzymes better	0	0	18 (12)	81 (54)	51 (34)

Helped you feel confident and improved your competency to face assessment	0	0	15 (10)	69 (46)	66 (44)
Helped you to develop your skills in working as a member of the team.	0	0	3 (2)	54 (36)	93 (62)
Helped you to learn the specific learning objectives of the topic clearly	0	0	15 (10)	57 (38)	78 (52)
Helped you to improve your interpersonal communication skills	0	0	12 (8)	60 (40)	78 (52)
Was more enjoyable than learning in conventional classroom teaching	0	0	15 (10)	39 (26)	96 (64)
Teaching by cooperative learning can be extended to all major topics in biochemistry	0	3 (2)	15 (10)	48 (32)	84 (56)

[Table/Fig-4]: Responses on likert scale (N=150). n=Number of students giving response; N=Total number of students in class

Regarding feedback given by students for the open ended questions, students had commented that it was a productive and fun activity to learn by their peers and friends, helped in active discussion, taught teamwork and helped in searching for their doubts themselves, and was a really good session overall and helped to improve the concept. Students acknowledged that this was an interesting method of learning where there is no fear of teachers and enjoyed teaching fellow students as well as helping in revising, was a useful session as in one hour they got to revise the entire topic which was enjoyable as well and helped understand the topics and improve communication skills. There were a few concerns raised by students regarding the method, like the time period of two hours was insufficient and requested to conduct such sessions for longer durations. Also, it was opined that during the expert sessions, since non interested students make the session less interactive, the outcome of learning the topic as a whole was jeopardised.

DISCUSSION

Cooperative learning is one of the methods used in self directed learning sessions. The current study was an attempt to use cooperative learning through the jigsaw method for teaching Biochemistry. Traditionally tutorials are conducted as students learn the material themselves and get their doubts clarified at the end by the facilitators. Using the jigsaw method, cooperative learning was encouraged during tutorial hours under the observation of facilitators, where specific learning objectives for the learning session were addressed and achieved.

In the present study of cooperative learning, it was found that there was no difference in grades of interventional and control groups between their pre and post-test scores, which was also observed in the study by Pai KM et al., who concluded that Self Directed Learning (SDL) sessions could cover a few topics from the total content areas in the 1st year MBBS curriculum and have suggested that since independent SDL sessions are equally effective as lectures, it is not necessary to supplement one instructional approach with the other and can be considered as an alternate form of learning in knowledge acquisition. By doing so, it is proposed that some of the topics can be learnt by students independently without requiring lectures by faculty. This could help faculty utilise their time for other activities in the Department like effective teaching learning activity planning, looking for better resources and considering effective assessment activities as well as concentrating on fruitful, relevant research activities [8].

Since, faculty in Indian Medical Colleges are overburdened with academic, administrative, patient care, assessments, accreditation activities, and meetings in addition to others, considering a few topics exclusively for SDL can help to decrease

the burden. The same is evident in the current study, wherein researchers have found no significant difference when pretest scores or post-test scores of study with control groups were compared, thus signifying that irrespective of the method used to reinforce the study material, the grades improve. However, it is the other aspects of SDL sessions which have to be considered beneficial with regard to both students and teachers. This is also supported in the current curriculum, wherein some of the topics proposed by the University are exclusively learnt by students on their own as part of SDL sessions, with faculty just facilitating the learning process as a guide by the side instead of teaching as sage on the stage, thus helping faculty spare their time in other constructional activities of the Department. Since SDL can add the same effect on learning topics compared to learning by lecture, the current researchers propose administering the jigsaw method for SDL sessions to teach non core topics, so that students can learn on their own in gaining knowledge. This is proposed in a study by Sreenivasulu K et al., [9]. The same study has also emphasised the short, intermediate and long term benefits of SDL by jigsaw to improving positive attitude thereby improve academic performance, improving communication skills and ultimately makes students lifelong learners.

In the study by Fernández-Santander A, it is concluded that better academic results were generated when informal activities of cooperative learning were used with short periods of lecturing for the biochemistry. Students had also expressed greater satisfaction and had a better attitude toward the subject. The study also observed that initiative, teamwork and communication were better developed by students in cooperative learning than only when lecturing was used and concluded that students felt more difficult topics were easier to learn by cooperative learning than by traditional learning [10]. In their study, Sharma S et al., have concluded that cooperative learning by jigsaw method improves understanding of boring topics and makes the topics more interesting which helps appreciate all important topics in Biochemistry [11].

The feelings of students in the current study are on the above findings [10,11] wherein 54% agreed cooperative learning helped understand enzymes topic better which is one of the difficult topics in the syllabus of Biochemistry. Also 52% strongly agree that sessions helped to improve interpersonal communication skills, which adds to that seen in the study by Fernández-Santander A [10]. Since 56% of students in the current study strongly agreed that teaching by cooperative learning can be extended to all major topics in biochemistry, the authors are enthusiastic to try using cooperative learning by the jigsaw method to some of the difficult topics in Biochemistry like metabolism and molecular biology which might help remove the stigma about biochemistry that it is a very difficult, volatile and boring subject.

In a study by Bhandari B et al., where jigsaw was used to teach respiratory physiology, students had stated cooperative learning by jigsaw enhanced their communication skills, enabled indepth coverage of the topic, enjoyed, agreed it was an effective way of learning and requested to incorporate the same teaching learning method for all topics [12]. Studies by Nair DR et al., and Nusrath A et al., to evaluate the effectiveness of the jigsaw method as an active teaching strategy in Physiology and Biochemistry respectively, have concluded that it is an effective method for increasing student-student as well as student-teacher interaction and proposed to apply the concepts of Physiology and Biochemistry in various clinical scenarios by this method. Applying the jigsaw method in routine teaching in the long run could help students to become proficient in early and correct diagnosis, which in turn will help to reduce morbidity and mortality rates in the society due to various diseases, especially in the situation of COVID-19 pandemic [4,13]. Walker S et al., have concluded in their study that the jigsaw method of teaching would bring a new education tools to the medical curriculum and allow peer discussion

of a large amount of material in a short period of time. They have also proposed that by this method students get an opportunity to become "experts" in the area and are challenged to teach the same to others, thereby helping promote active student centred learning, which is the most important requirement proposed in the new curriculum by the National Medical Commission [14]. The current study proposes that, since Biochemistry is a vast and volatile subject which requires frequent revisions, having peer discussions during regular teaching hours might promote retention, help cover a large amount of material in a short period of time and promote expertise in the topics.

Limitation(s)

The time period of two hours was insufficient and sessions need to be conducted for longer durations. Also, it was opined that during the expert sessions, since non interested students make the session less interactive, the outcome of learning the topic as a whole was jeopardised.

CONCLUSION(S)

Significance in grades between pre and post-tests for both study and control groups implies that tutorial session of any type helps improve knowledge gained. However based on feedback regarding jigsaw method, maximum of the students felt the session helped them improve communication skills and requested to implement the same to other topics in Biochemistry as well which is the need of the hour. With the students giving good response towards learning Biochemistry by jigsaw method, the researchers strongly propose this be incorporated into routine teaching learning activities of the subject. It is recommended for future research workers to well orient the research methodology of the jigsaw method to the facilitators as well as the students before the learning session. It is also recommended that the facilitators monitor and encourage the students for their active participation throughout. Motivating all students to be present for tutorials is also recommended.

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REFERENCES

- [1] Puppalar PV, Jambhulkar RK. Jigsaw technique-A novel method of teaching biochemistry to medical undergraduates. *International Journal of Medical Science and Public Health*. 2019;12(8):1052-56.
- [2] Schreyer Institute for Teaching Excellence, Penn State, 301 Rider Building, II University Park, PA 16802. Available from: <http://www.schreyerinstitute.psu.edu>.
- [3] Medical Council of India, Vision 2015 booklet. [Accessed on 20/08/2018]. Available from https://old.mciindia.org/tools/announcement/MCL_booklet.pdf.
- [4] Nusrath A, Dhananjaya SY, Dyavegowda N, Arasegowda R, Ningappa A, Begum R. Jigsaw Classroom: Is it an Effective Method of Teaching and Learning? *Student's Opinions and Experience*. *J Clin Diagn Res*. 2019;13(2).
- [5] Goolsarran N, Hamo CE, Lu WH. Using the jigsaw technique to teach patient safety. *Med Educ Online*. 2020;25(1):1710325.
- [6] Bogam RR, Khan AS. Jig saw technique: An interactive approach to sensitize medical students in Saudi Arabia about type 2 diabetes mellitus. *Journal of education technology in health sciences*. 2016;3(3):107-10.
- [7] Dollard MW, Mahoney K. How Effective Is The Jigsaw Method When Used to Introduce New Science Curricula in Middle School Science?. *Ontario Action Researcher*. 2010;10(3).
- [8] Pai KM, Rao KR, Punja D, Kamath A. The effectiveness of self-directed learning (SDL) for teaching physiology to first-year medical students. *Australas Med J*. 2014;7(11):448-53.
- [9] Sreenivasulu. K, Nightingale S. S, Sarada D, Sree Y. S, Ravi, Ramesh A. Effectiveness of Jigsaw technique in addition to lecture for teaching medical undergraduates. *Int J Med Sc Educ*. 2020; 7(6): 8-11.
- [10] Fernández-Santander A. Cooperative learning combined with short periods of lecturing: A good alternative in teaching biochemistry. *Biochem Mol Biol Educ*. 2008;36(1):34-8.

- [11] Sharma S, Chauhan S, Kaur M. Introduction and Assessment of Jigsaw Method of Teaching on Challenging Topics in Physiology for First Year Medical Students. *International Journal of Physiology*. 2019;7(4):238-45.
- [12] Bhandari B, Mehta B, Mavai M, Singh YR, Singhal A. Jigsaw Method: An innovative way of cooperative learning in physiology. *Indian J Physiol Pharmacol*. 2017;61(3):315-21.
- [13] Nair DR, Bagade AH, Bhonde MS, Patil SS, Shetty PM, Kini SG. Evaluation of Jigsaw learning methodology as an active teaching strategy for first year Indian Medical students. *Eur J Mol Clin Med*. 2020; 7(10): 4105-4110.
- [14] Walker S, Olvet DM, Chandran L. The jigsaw technique of peer teaching and learning: An efficient and enjoyable teaching strategy in medicine. *Med Ed Publish*. 2015;6:14.

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