Research article

Jigsaw technique as an active learning strategy in Physiology for I MBBS StudentsK. Soundariya¹, M. Senthilvelou², Shivayogappa S. Teli³, V. Deepika⁴, K. Senthamil Selvi⁵, S. Mangani Mangalavalli⁵¹Professor, ³Professor and Head, ⁴Associate Professor, ⁵Assistant Professor, Department of Physiology, Sri Manakula Vinayagar Medical College and Hospital, Puducherry, India²Assistant Professor, Department of Physiology, AIIMS, Mangalagiri, Andhra Pradesh, India

(Received: December 2020 Revised: August 2021 Accepted: September 2021)

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ABSTRACT

Introduction and Aim: Innovative learning strategies may be introduced along with the conventional methods to enhance active learning by the students. Jigsaw technique is a co-operative learning method, where students play a dual role as an active learner and teacher. Hence the present study aimed to introduce and assess the acceptability of the Jigsaw technique as an active learning strategy in Physiology for first year medical undergraduates.

Methods: Five parent groups were formed from 30 first year medical undergraduates with six members in each group. Each member in the parent group was allotted a sub-topic in "Immunity". Members with the same sub-topic joined to form the expert groups. After three sessions of face-face and asynchronous online discussions spanning a duration of three weeks, facilitated by faculty, the students returned to their parent groups for peer teaching and presentation. The content of the presentation was evaluated by faculty with help of a checklist. Feedback questionnaire was administered to both the students and the faculty to assess their perceptions and acceptability of Jigsaw technique.

Results: Jigsaw method was addressed as an innovative method that favored active participation, high interaction and promoted communication skills and referral habits among the students. However, it was time consuming, and students expressed difficulty in adapting to the technique.

Conclusion: Students consider the learning process enjoyable and effective with Jigsaw technique in Physiology. However, owing to the time consumption and its complexity it may be sparingly used in routine curriculum.

Keywords: Active learning; jigsaw technique; medical education; physiology.

Introduction

Active learning strategies enhance student participation and learning process compared to the traditional didactic lectures (1,2). Designing of student-centered teaching learning methods, has been emphasized in the directives of undergraduate medical education by the Medical Council of India (3). Student motivation and performance improves when the instructions are adapted to student learning preferences (4).

The Jigsaw technique is a cooperative learning technique where each student is made to play an essential role by active participation (5). Jigsaw technique is unique in promoting peer teaching as well as learning as here the students work towards the mastery over a particular concept and become an expert in sharing the obtained knowledge with their peers (6).

Physiology is a constantly evolving subject; hence it demands an active participation from the students for an effective learning. Understanding of the concepts and retaining the information plays a major role in learning physiology. Active learning techniques that improve student participation, concept understanding, and long-term retention need to be integrated with the traditional teaching methods in Physiology.

Hence the present study aimed to introduce and assess the acceptability of "Jigsaw technique" as an active learning strategy in Physiology for I MBBS students.

MATERIALS AND METHODS**Study participants**

About 30 first year medical undergraduate students were randomly selected for the study, comprising of 15 boys and 15 girls. Informed consent was obtained from all the study participants. The objectives and the implications of the study was clearly explained to them. Institutional Ethics committee clearance was obtained prior to the conduct of the study.

Description of the Jigsaw technique

A physiological concept is chosen. It is divided into sub-topics. The students are divided into parent groups, where each student in the parent group is assigned a sub-topic of the chosen concept. Then expert groups will be temporarily formed by having one student from each parent group join other students assigned with the same sub-topic. After discussion among the expert groups, the students will return to their original parent groups. Each student in the parent-group will give a presentation of their concerned sub-topic. As a result, every student will get a holistic view of the chosen physiological concept.

Finally, there will be a presentation to the entire batch of students.

Steps carried out in the implementation of Jigsaw technique

Selection of the topic

The protocol of the study was discussed in the departmental meeting and around 11 topics were chosen from the entire physiology with consensus from the faculty members of the department. The selected 30 students were assembled in a demonstration room, all the 11 topics were projected, and a poll was taken from all the 30 students. The topic "Immunity" received maximum number of votes and was finally decided to be considered for the "Jigsaw Technique". By the time of conduct of the study, the whole batch had already been exposed to the topic in didactic lecture.

Sensitization of the faculty and the students

Owing to the complexity of this new teaching-learning method, two sessions (one for faculty and the other for

students) were conducted for sensitization to the Jigsaw method. In the sensitization session, the faculty and the students were clearly explained with the objectives and the process of the Jigsaw technique. The faculty members were encouraged to serve as facilitators. The students were explained about the process of Jigsaw technique and were encouraged to show an active participation.

Formation of groups

The 30 students were divided into five parent groups with six members in each group. The topic "Immunity" was divided into six sub-topics as follows: Introduction and Classification of Immunity, Introduction to Lymphoid Organs, Cell Mediated Immunity, Humoral Immunity, Role of Immunity in Organ transplantation and Applied Immunity. Every student in a parent group was allotted a sub-topic. Students with the same sub-topic in every parent group joined to form an expert group. So five parent groups were named from A to E and the expert groups were addressed with their respective sub-topics (A1, B1, C1, D1, E1) to (A6, B6, C6, D6, E6).

Figure 1 : Formation of Parent groups and Expert Groups in the Jigsaw Technique

Interactive sessions

Interactive sessions were carried out in three stages, with one week interval between every session. Each face-face session was planned to be a two-hour session, during the tutorial sessions organized every week in the department. whats app groups and google

groups were created, with one faculty as facilitator in each group. Students were instructed to use the interval period of one week between each face-face session for sharing of ideas, resources and presentations in their respective whats app groups/Google groups.

In the initial part of first face-face session, the parent groups were formed, sub-topics were allotted, and some time was allowed for ice-breaking, and the students got oriented to one another and also to the technique. In the second half of the first session, expert groups were formed, and they communicated with one another and planned for the search of resource material, mode of presentation etc. This was followed by a week of asynchronous online discussion.

The second face-face session was exclusively between the expert groups, where there was a great exchange of information between the students. The facilitator guided the students to finalize their presentations on the sub-topic. This extensive discussion seriously helped them to gain expertise over the allotted sub-topic. This was followed by a week of asynchronous online discussion.

The final face-face session was again organized with the parent groups, so all the students from the expert groups returned to their respective parent groups. There was a presentation of the sub-topic by each expert in the parent group. Inputs were given by the facilitator.

The students utilized face-face two-hour session and asynchronous online discussion forums for getting a complete understanding of the topic.

Final presentation

As all the five groups were assigned the same topic in “Immunity” and to assess the effectiveness of the technique, final presentation was decided to be done in small groups. So, the whole 150 students were divided into five groups of 30 students, with a faculty in charge. So, each parent group had an opportunity to present their content to a small group of 30 students. This facilitated the presentation by all the six members

in each parent group and all the 150 students in the entire batch had an exposure to the new information presented by their peers. The faculty assessed the content using a checklist and instant feedback was given to the students.

Assessment of the acceptability and effectiveness of the technique

The reaction of the learners (Kirkpatrick’s evaluation – Level 1) towards the Jigsaw technique was assessed using a five-point Likert scale feedback questionnaire and using an open-ended questionnaire.

Acceptability of the “Jigsaw technique” by the faculty was assessed using an open-ended questionnaire.

Statistical analysis

The frequency (% distribution) of responses under each category of the Likert scale feedback questionnaire was analyzed and tabulated using SPSS version 20. Manual Content analysis was done for open ended questions for interpreting students’ and faculty responses.

RESULTS

Table 1 represents the percentage distribution of student responses obtained under different categories of the Likert Scale Feedback questionnaire. Considering the responses, most of the students accepted that Jigsaw method generated interest, enabled in depth understanding, enhanced the communication skills and considered it as an effective way of learning. However only 30% of the students preferred this method to be applied to other topics in Physiology. Only 13.3% of the students expressed easy adaptability to Jigsaw technique.

Table 1: Student responses on feedback questionnaire, towards the acceptability of Jigsaw technique

S. No	Statements	Strongly Disagree + Disagree (%)	Neutral (%)	Agree + Strongly Agree (%)
1	This new method generated interest in learning Physiology	0	33.3	66.7
2	This method enabled in depth understanding of the desired topic	3.3	23.4	73.3
3	This method enhanced my referral habits	6.7	26.7	66.6
4	This method helped me to improve my communication skills	3.3	23.4	73.3
5	This method creates opportunities for team members to share their information	16.7	33.3	50
6	This method can be applied for other concepts for physiology in future	26.7	43.3	30
7	This method improves my analytical ability	13.3	26.7	60
8	This method is an effective way of learning	0	23.3	76.7
9	I could easily adapt to this technique	46.7	40	13.3
10	This method improves teaching skills in the participants	20	33.3	46.7

Table 2 represents the students’ perception on Jigsaw techniques, as analyzed from the responses to open ended questions. Table 3 represents the faculty perception on the acceptability of Jigsaw technique.

Table 2: Students' perception of jigsaw technique

Questions	Comments by the students
Share your learning experience	Favoured long term retention (2) Innovative (6) Interesting and easy learning (3) Quick learning (4) Interactive learning (10)
What were the new qualities acquired by you in this learning process?	Concept understanding (5) Referral habits (10) Teaching habits (3) Categorization of the topic under study (5) Self-realization (2) Self-confidence (2) Communication skills (10) Team work, Gentleness, Responsibility (5) Integration of learnt information with other subjects (4)
Share your experience while working as a team	Listening to others (4) Gained new information on same topic (8) Needed good co-ordination (4) Quick learning (4)
What were the merits?	Hard ideas learnt easily (7) Elaborate understanding of a topic (3) Ignites self- learning (8) Motivating (6) Enjoyable (5) Innovative (6)
What were the demerits?	Time consuming (15) Took time to adapt to this technique (10) Needs interest and dedication (10) Despite good understanding, if presentation is poor, difficult to reach the audience (6) Difficult to listen to others (3)

Numbers in the parentheses represent the number of responses in the patterns generated

Table 3: Faculty Perception of Jigsaw technique

Questions	Comments by the students
What was the impact of this method over the learning habits of the study participants?	Improved in depth understanding of the subject, Motivated self-study, Organization of content. Involvement in group discussion Referral habits
What were the merits of this technique?	Promoted self-study, group discussion, increased in depth understanding of the topic Increased self-confidence among the students Enhanced communication skills of the students Enhanced leadership skills of the students
What were the demerits of this technique?	Time consuming Choice of inappropriate topic may hinder the success of the technique
How far it is feasible during regular academic sessions?	Time consuming, hence may be sparingly used, to break the monotony
What are the possible solutions to overcome the difficulty in implementation?	May be planned out of academic hours Semester duration may be increased Smaller, applied topics may be chosen

DISCUSSION

The present study aimed to introduce and assess the acceptability of Jigsaw technique as an active learning strategy in physiology for I MBBS students. Though Jigsaw technique has been actively used in primary, nursing (7) and pharmacy education (8) for more than two decades, the use of Jigsaw technique in medical education has gained momentum in the past five years (9-12).

Jigsaw technique has acted as a common platform in enhancing active learning, peer teaching and communication skills of the students (9, 10). Jigsaw technique generates interest in the learning process, as it favors high interaction among the students, increases self-confidence and promotes referral habits of the students. These were evident from the responses of the students to feedback questionnaire. About 66.6% of the students acknowledged that this

technique enhanced their referral habits. Again 73.3% of the students considered that, it promotes in-depth understanding of the concepts. Similar results were reflected in studies by Swathi (11) and Bhandari (12).

In Jigsaw technique, while the students return from their expert groups to the parent groups, they play an active role in delivering their content to their peers. In this way this innovative technique imparts teaching skills to the students. This was evident from the feedback where 46.7% of the students felt an enhancement of their teaching skills by this method. Walker reported that it can be considered an effective instructional strategy for medical undergraduates in clinical phases (6).

Jigsaw method being a co-operative learning technique, enhances teamwork among the students. In the present study both the students and the faculty have addressed the impact of this technique in improving the group dynamics. The students felt that they acquired leadership qualities in coordinating the group discussion, learnt to listen patiently to others, gained new information from others. About 73.3% of the students opined that it enhanced their communication skills. Similar results were reported by other studies (9-12).

In our study, about 76.7% of the students have accepted the Jigsaw technique as an effective way of learning. Jigsaw technique has been acknowledged as an effective way of learning by the 81.33% of medical students in Biochemistry (9, 10) and 89.3% of medical students in Microbiology (11), as quoted by other studies. 88.6% of the students accepted it as an effective way of learning in Physiology, in a study quoted by Bhandari *et al.*, (12). While many studies proved the effectiveness of Jigsaw technique with the traditional didactic lectures, (13,14) Mankar and his colleagues quoted it to be more effective than another innovative “snowball” method in Physiology for first year medical undergraduates (15).

Any innovative teaching learning method has its own advantages and disadvantages. Jigsaw technique was no exception for that. It was reported as a time-consuming procedure by both students and the faculty. Similar results were shown by Lalit and Piplani in their attempt to induce active learning in anatomy using Jigsaw technique (16). Apart from the time constraints, complexity of the method also added to the demerits. About 46.7% of the students expressed difficulty in adaptation to the technique. Further all the students may not be effective in delivery of content, which would impede the success of the method, as peer teaching forms a major component of Jigsaw technique. Non-cooperation from the team members and inappropriate selection of topics were other factors that were considered to interfere with the successful implementation of the method. These results are supported by a review over Jigsaw technique by Karimi *et al.*, (17). Our faculty suggested

the implementation of this method out of the academic hours with choice of small topics, to overcome the demerits of this technique.

Though few studies have flooded up with the implementation of the Jigsaw technique in medical education in the past few years, our study stands unique in applying blended learning with incorporation of e-learning (asynchronous discussion forums using google groups) during the interactive sessions that happened outside the working hours, which maintained the spirit of learners.

Limitations of the study

This is a cross sectional study that assessed the faculty and learners’ perception (Kirkpatrick’s Level 1) over the implementation of the Jigsaw technique. Though the participants were assessed for their learning (Kirkpatrick’s level 2) during their presentation by the faculty, we did not do a statistical comparison. Though we adopted blended learning using google group discussion, we did not attempt to obtain feedback exclusively on that learning experience. Further longitudinal study that tests the long-term retention of knowledge would appropriately reveal the effectiveness of the technique.

CONCLUSION

As an innovative method, Jigsaw method highly motivates and induces referral habits, in-depth exploration of the concepts by the learners, transforming them to active learners. It also enhanced the communication skills of the students. However, owing to its demerits of high time consumption and difficulty in adaptability to the technique, it may be sparingly used in the curriculum to break the monotony.

ACKNOWLEDGEMENT

We would like to thank the Medical Education Unit of the Nodal center, Sri Ramachandra Medical College, Porur, Tamil Nadu, India, for providing necessary guidance in carrying out this educational project under “Advanced Course in Medical Education”.

CONFLICT OF INTEREST

Authors declare that there is no conflict of interest for this study.

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