Original Research Article

COMPARISON OF JIGSAW METHOD AND FACULTY DEMONSTRATI¬ON IN TEACHING FUNCTIONAL ANATOMY OF MUSCULOSKELETAL SYSTEM

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A B S T R A C T

Background: Aims: To evaluate effectiveness of Jigsaw method of learning over faculty demonstration in teaching functional anatomy. **Setting:** Department of Anatomy, Government Medical College Kollam. **Design:** Quasi experimental study.
Material and Methods: Study was conducted on 110 phase 1 MBBS students who were divided into two groups and were given two different teaching learning interventions – faculty demonstration and Jigsaw technique. Two Objective Structured Practical Examinations (OSPE) were conducted. Student perception regarding both methods were taken. **Statistical Analysis Used:** Independent t test.
Results: Students who were in the Jigsaw group scored better in OSPE (difference in means was statistically significant, p value 0.003). Students were more satisfied with the Jigsaw method in terms of ease of understanding and retaining the topic, being interesting and interactive, increasing critical thinking skills and improving communication skills.
Conclusion: Jigsaw method is a better method of teaching functional anatomy and can be recommended for teaching anatomy for undergraduates as it increases the student involvement and thus more effective in acquiring and retaining knowledge.
Keywords: Jigsaw, peer learning, Anatomy teaching, critical thinking.

INTRODUCTION

Use of presentation methods like storytelling and poems,[1] and body painting,[2] were tried in making Anatomy teaching interesting. With the introduction of the Competency Based Medical Education, teaching in Anatomy needs to be more practically oriented. Areas in Anatomy that require skill assessment include the functional anatomy of muscles and joints. Conventionally, these topics are discussed in lecture classes following dissection on a cadaver. Teacher centered methods have an adverse effect on students' teamwork and their ability to take decisions.[2]
The Jigsaw method put forward by psychologist Elliott Aronson (1978) was found to facilitate productive interaction among students.[3]

Studies on peer learning methods were found to be a healthy way to make learning interesting & effective.[4,5] It enables peers to work as an interdependent team in which each individual is accountable for the content and peer teaching.[6,7]
Upon searching the literature in this regard, Jigsaw teaching was found to be a beneficial way of active peer learning.[8] But data regarding application of the method in Human Anatomy teaching were limited.

Objectives
To compare the effectiveness of Jigsaw method and faculty demonstration in teaching functional Anatomy of musculoskeletal system
To determine the perception of students regarding Jigsaw method and faculty demonstration.

MATERIALS AND METHODS

Study setting: Department of Anatomy, Government Medical College Kollam.
Study design: Pauci-experimental study
Study duration: 8 months.
Study population: First year MBBS Students.
Sample size: 2 groups of 55 students each were exposed to 4 cycles of 2 different interventions.
Mean marks and standard deviations were taken from the study by Karakop in 2017. [9] The minimum sample size calculated using this data in n-master software was found to be 35 for each study group. In this study we include 55 students in each study group.
Sampling method: Whole batch of 110 students were randomly allocated to 2 groups – A and B
Inclusion Criteria: All MBBS students of 2020 admission of GMC Kollam who are above 18 years of age and give consent were included in the study.
Exclusion Criteria
1. Students below 18 years of age
2. Absentee students in any of the sessions.
Data collection Methodology:
The students were taught to work in small interdependent groups. Each person learns a part of the topic and then they share their learning by peer teaching.
After taking informed consent, phase 1 students were randomly allocated to Group A and Group B each with 55 students each. The teaching sessions for each group and Objective Structured Practical Examinations were conducted as given in Table 1
SESSION 1
Group A was taught about movements around the shoulder joint by a faculty demonstration session lasting for 40 minutes, in a classroom. All SLOs under the topic will be conveyed to the students.
Group B is further divided into 5 groups (parent groups) by lot taking method. The SLOs pertaining to shoulder joint were divided into 5 sets. (SET 1, SET 2, SET 3, SET 4, SET 5). 11 lots with a set number written on each of them were made (3 lots of SET 1 and 2 lots each of SET 2, SET 3, SET 4 and SET 5). Members of each parent group picked a lot. Thus, in each parent group, SET 1 was taken by 3 members and other sets were taken by 2 members each. All those who get SET 1 (15 students in all 5 parent groups) became the expert group for SET 1. Likewise, all those who got a set number in the lot formed expert group for that particular set. Each expert group was given their set of SLO and study materials pertaining to the SLO. They were given 10 minutes to discuss about it in the expert group. A faculty facilitator oversaw the group discussions to ensure the groups stay on task and clarified any misconceptions the students might have. By this, the members in each expert group became experts in that SLO. After that, they went back to their parent groups and interacted with others (30 minutes discussion), and all the SLO regarding the movements around the joint were shared among the members of each parent group, thus every member of the group learned all SLOs. [Articulated skeleton was made available to each group]. Scheme of allocation is depicted in figure 1.

SESSION 2
Conducted 1 week after the first session. The topic was movements around first carpometacarpal joint. Group A got a faculty demonstration and Group B followed Jigsaw learning. Timings and student allocation into parent and expert groups – same procedure as in session 1 was followed.

OSPE 1
After completion of 2 sessions, an OSPE was conducted on the 2 topics discussed in the sessions. The marks entered separately for Group A (faculty demonstration group) and Group B (Jigsaw Group). OSPE was conducted by faculty who were not involved in teaching either the sessions.
For the next two sessions, groups were crossed. Group A got the Jigsaw method and group B got faculty demonstration.

SESSION 3
Topic – movements around Hip Joint
Group A – Jigsaw method
Group B – faculty demonstration
Timings and student allocation into parent and expert groups – same procedure as in previous sessions.

SESSION 4
Topic – movements around Ankle and subtalar joints
Group A – Jigsaw method
Group B – Faculty demonstration
Timings and student allocation into parent and expert groups – same procedure as in previous sessions.

OSPE 2
After completion of sessions 3 and 4, an OSPE was conducted on the 2 topics discussed in the sessions. The marks entered separately for Group A (Jigsaw Group) and Group B (faculty demonstration group).
Perception questionnaires, as google forms, were given to students regarding faculty demonstration method and another one regarding the Jigsaw method. Students marked their responses along the Likert's scale and submitted them.

Data Analysis
Marks obtained in 2 OSPEs were tabulated. Each student had 2 set of marks – one following the faculty demonstration and one following Jigsaw learning method. Collected data was entered into Microsoft Excel Sheet and was analyzed by using SPSS version 16. Descriptive statistics such as percentage, mean and standard deviation were calculated. Independent sample t test was used to find the statistical significance, considered as significant if $p < 0.05$ and highly significant if $p < 0.01$. Responses from the perception questionnaire expressed in percentages and represented as separate divergent bar charts for each method of teaching.

RESULTS

2 groups of Phase 1 undergraduate medical students were taught 4 sessions using faculty demonstration and Jigsaw method as explained in the methodology. 2 Objective structured practical examinations were conducted for both the groups.

The mean score in OSPE obtained by students who were given Faculty Demonstration was found to be lower than the students who were included in the Jigsaw method of teaching. Upon analyzing these results using independent sample t test, this difference in scores was found to be statistically significant. [Table 1]

Responses from perception questionnaires based on Likerts scale regarding Faculty demonstration and Jigsaw method are depicted using bar diagrams (figure 2, figure 3). It clearly shows that student satisfaction is more for Jigsaw method when compared to Faculty demonstration. Table 2 shows the median and interquartile range of the responses to each question regarding the two teaching learning methods. The table also shows the most common response obtained for each question. The responses point that the participants found Jigsaw method more interesting, thought provoking and improved their communication skills.
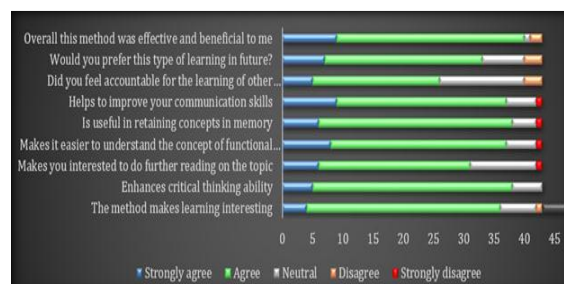
A few notable comments and suggestions which were given by the participants as answer to an open question are given in table 3.
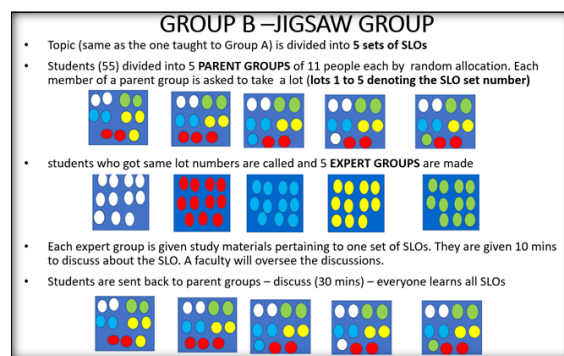
Figure 1: Scheme of allocation of students in Jigsaw group
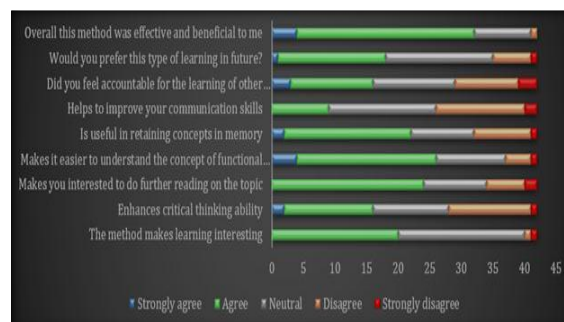
Figure 2: Students Perception - Faculty Demonstration

Figure 3: Student perception - Jigsaw method

Table 1: Teaching sessions and Assessments conducted

	Topic	Intervention
Session 1	Movements around shoulder	Group A-Faculty Demonstration Group B – Jigsaw method
Session 2	Movements of the thumb	Group A-Faculty Demonstration Group B – Jigsaw method
OSPE on the topics dealt in session 1 and session 2		
Session 3	Movements around hip joint	Group A– Jigsaw method Group B-Faculty Demonstration
Session 4	Movements around ankle and subtalar joints	Group A– Jigsaw method Group B-Faculty Demonstration
OSPE on the topics dealt in session 1 and session 2		
Perception of participants regarding the two methods		

Table 2: Comparison of OSPE scores following Faculty Demonstration and Jigsaw Method

	Group	N	Mean	SD	Independent sample t test	p value
Marks	Faculty Demo	110	7.27	1.89	3.015	0.003
	JIGSAW	110	7.93	1.26		

p value was calculated by independent sample t test, $p<0.05$ considered as statistically significant.

Table 3: Median and interquartile range of student responses for perception questionnaire

	FACULTY DEMONSTRATION			JIGSAW METHOD		
	Median	IQR	Most common response	Median	IQR	Most common response
The method makes learning interesting	3	1	3	4	0	4

Enhances critical thinking ability	3	2	4	4	0	4
Makes you interested to do further reading on the topic	4	1	4	4	0	4
Makes it easier to understand the concept of functional anatomy	4	1	4	4	0	4
Is useful in retaining concepts in memory	3	1	4	4	0	4
Helps to improve communication skills	2	1	2	4	0	4
Did you feel accountable for the learning of other members in your group?	2	1	2	4	1	4
Would you prefer this type of learning in future?	3	1	3	4	0	4
Over all, this method was effective and beneficial to me	3	1	4	4	0	4
key:5 – strongly agree,4 – agree,3 – neutral,2 – disagree,1 – strongly disagree						

Table 4: Comments and suggestions from participants

Representative comments from participants	Suggestions from participants
It was an interesting way of learning We were thorough with the topic we were presenting I could overcome my shyness to present Interaction between friends were very effective We were involved more and thus the topic percolated better Would like to have more such sessions	More topics should be dealt using this method It would be more effective if the topic allocation was done earlier The final discussion in parent group needs more time

DISCUSSION

With the Competency Based Medical Education envisaging a shift from teacher centric to learner centric methods of teaching, innovative teaching learning methods are being probed to increase student involvement and interest. Small group learning methods hold the key to increased student participation.[10] Peer learning combined with self-directed learning can bring about excellent results.[11] Jigsaw method is a form of peer learning where each member of the study group is responsible for the learning of the whole group. Each child in a Jigsaw classroom has to become an expert on a single topic that is a crucial part of a larger academic puzzle. When the whole process is finished, the students fit their pieces of subject area together to complete a 'Jigsaw' picture.

The Jigsaw method attempts to overcome the limitations of a traditional classroom like monotony, lack of interaction and short attention span and also evokes a sense of responsibility and involvement in those learners who are otherwise uninterested in a conventional lecture class.

In previous studies, most students expressed that jigsaw learning improved their understanding of the subject as well as helped in retaining the information better and helped them in clinical application of concepts of basic subjects.[12,13]

The results obtained in the present study suggest that the Jigsaw method is better than faculty demonstration in terms of OSPE scores, student involvement as well as student perception. We shall discuss the effectiveness of Jigsaw learning method under the following headings – knowledge acquisition, learner participation, interest and communication skills, peer/ cooperative learning and disadvantages of the method.

Knowledge acquisition

As discussed in the introduction and review of literature section, a wide variety of teaching learning methods were tried in teaching anatomy by many researchers. Any method that makes the student think and discuss about the topic is sure to produce excellent results. In the present study, the scores in OSPE exams were more for the group that got Jigsaw method of learning. [Table 1] Similar effect on post-tests following Jigsaw teaching were obtained by few other researchers.[11,14]

Learner participation, interest and communication skill improvement

As opined by one of the participants in the study, "anything that involve our friends circle is valuable to us and we tend to give in our best for our friends. Jigsaw gave us a feeling of being responsible for the learning of others in the group. This made us put in our maximum effort and vigour into it". Most participants in the study agreed that they felt responsible for others in the group and the method made them interested in the subject so as to do extra reading on the topic. [Figure 3]

Bhageri et al compared the student satisfaction levels of Jigsaw method against learning by feedback method and found that Jigsaw method is significantly better in terms of time required, skill development and interest motivation.[15] In an article by Rishika Singh, the author opines that Systematic implementation of Jigsaw classrooms in an ethnically diverse group of students can significantly improve academic and social outcomes. The author also points out that it is time to think of unconventional methods in teaching so as to break the monotony of the classrooms and increase student participation.[16]

Peer/ cooperative learning

Johnson and Johnson classifies the ways to achieve learning goals into three – Cooperative, Competitive and individualistic.[17] Cooperative learning makes use of the differences between students turning them into learning opportunities. Studies involving cooperative learning have become an internationally important area of social and educational research.[18]

Cooperative learning methods have been found to positively impact the cognitive as well as the affective outcome of learners and retention of knowledge.[19] Jigsaw learning effectively utilize the cooperative learning concept.

Disadvantages

Time is a major limiting factor. The allotment of parent and expert groups and allocation of time for discussion in each group are crucial in time management. Jigsaw technique needs thorough planning and proper student sensitization so that confusions are avoided and time is not wasted. All said and done, the effort would be worth it.

Limitations of the study

There was a gap of more than 2 weeks between the second session and the first OSPE, as the students were sent home due to covid. It is difficult to demonstrate a generalizable effect with a study of short duration. Also, regarding the student satisfaction, the perceptions of students are something abstract and subjective and hence is difficult to measure in a short span of time.

CONCLUSION

Demonstration by a faculty and Jigsaw learning are both good methods of teaching functional anatomy of musculoskeletal system to phase 1 MBBS students. Jigsaw method of cooperative learning is definitely a better method of the two. It can be recommended as a method of teaching other aspects of anatomy as well.

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