

Jigsaw Cooperative Approach in Professional Studies: A Case of Top Technical Institute

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Abstract

In a very dynamic environment of today's world, students face many forces destructing them from their studies like trend of internet use, other assignment of curricula, social requirements, fitness issues etc. Groups formed in a class also affect their performance. As group of good students will not allow weaker students to enter in their group. It makes the class learning very low and students less responsive/productive in writing their examinations. Cooperative approaches are supposed make them more responsive towards their performance by mixing them by breaking their informal structures. It may bring more flexibility in managing their time and effort. One such cooperative method of learning is Jigsaw method, a group based learning. This paper presents an effort to implement this method of cooperative learning to management subject taught in a top institute of INDIA. It highlights the feasibility of such approach in the professional studies. A pilot test was conducted for a topic of a subject. Evaluation of the groups and the class is done in steps. It is learnt that overall performance of each students has raised and the knowledge of the topic to each one was good. Results were exciting. Study highlights the pros and cons of this method as applied to a course of a professional program.

Keywords Cooperative Learning, Jigsaw Puzzle Approach, Class Performance

1. Introduction

Since last 50 years, cooperative learning method has been gaining interest of teachers and educational institutes because of its effectiveness over classical teaching and delivery methods. Cooperative learning is that breaks the barrier of formal structure of a class room. It focuses to develop students both socially and intellectually. Various research and case studies done on this learning method have shown that it is very effective in the learning of complex courses at the primary, middle school and the university level. This method also helps the students to develop critical thinking and their ability to express themselves by improving their communication skills. There are many such techniques available in the literature According to Marcia (2000), these techniques increase the students' involvement in the class and increase their retention power of information following the class period. He suggested many suggested meeting out goals of the class session. One such method is Jigsaw as one of the well-structured cooperative learning techniques, and proves to be exceptionally effective when applied to a wide range of academic subjects such as social studies, literature, and science (Kilic, 2008, Slavin, 1995 and Aronson and Patnoe 1997).

The jigsaw method is a cooperative learning method and a classroom activity that makes students to learn and study together in groups by discussing and helping each other. It was designed by social psychologist Elliot Aronson (1997) to help weaker racial cliques in a schools. The principle behind the approach looks similar to that of a process of solving Jigsaw Puzzle. The jigsaw method splits class into groups to work on small portion of a topic thoroughly through individual and then group study. For example, a topic to be studied is divided into sub-topics. Students are then divided into groups with one member assigned to each topic. Working individually, each student learns about his or her topic and presents it to their group. Next, students gather into groups divided by topic. Each member presents again to the topic group. In same-topic groups, students discuss their points of view and combine information on the topic. They create a final report. Finally, the original groups reconvene and listen to presentations from each member. The final presentations provide all group members with an understanding of their own material, as well as the findings that have emerged from topic-specific group discussion.

When jigsaw is used a teaching method students tend to show a decrease in prejudice and stereotyping, show higher levels of self-esteem, perform better on standardized exams, like the classroom environment more, reduce absenteeism, and mix with students of other races in areas other than the classroom compared to students in traditional classrooms.

The first experiment with the jigsaw classroom was done by Blaney et al. in 1977. The method was assessed in ten fifth grade classes across seven schools. Three fifth grade classes were the controls. Teachers for traditional classes were peer-rated as good teachers. The experimental classes worked in jigsaw groups for 45 minutes a day, three days a week, for six weeks. The jigsaw groups contained members from all ethnic groups. Questionnaires were used to assess the student's attitudes about themselves, school and toward peer teaching, cooperation and attitudes toward group members and other students in the class. These measures were used as pre- and post-intervention. Results of the experimental study showed that students in jigsaw method liked school more, and increase in liking of other students and significant increase of self-esteem. Students in traditional classroom liked school less, liked other students less and had a decrease of self-esteem (Aronso and Patnoe, 1997).

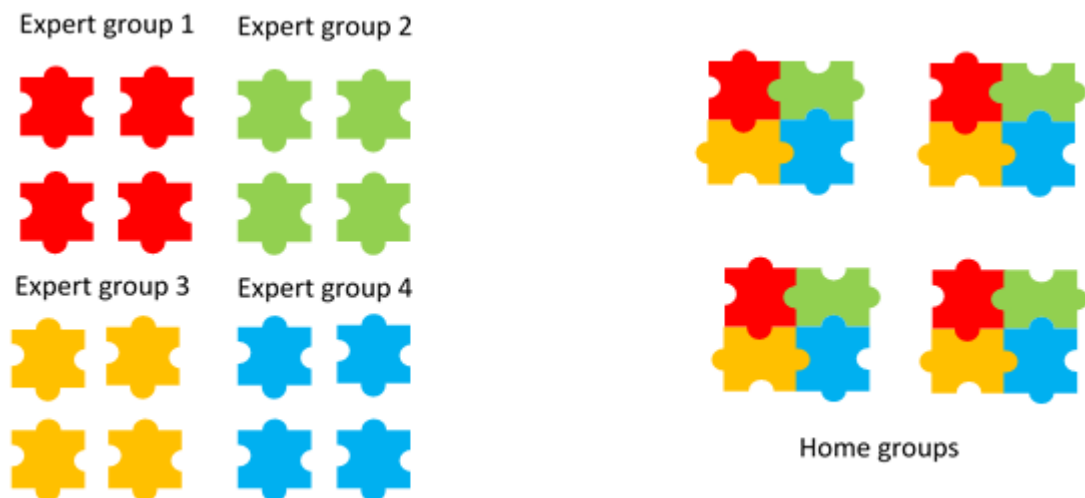


Figure 1. Jigsaw Method

In a classroom, case study was also done on fifth grade students by Bridgeman (1981) students who were taught by jigsaw method displayed greater empathy than the ones who were taught by traditional teaching method. Half of the students spent two months in a classroom where jigsaw was used as teaching method while the other half were in a traditional classroom. The children viewed cartoons to assess their empathy. Students in traditional classrooms displayed lower empathy than the students who were in jigsaw method.

Similarly, in another study on fifth grade students done by Aronson et al. (1978), jigsaw method and another cooperative method was assessed in comparison to traditional teaching methods. He assessed students' attitudes about themselves, school, and other students to compare the methods. Athletic abilities, scholastic abilities, physical appearance, family interactions and social interactions were used as pre- and post-intervention measures and the interventions lasted eight weeks. Students in jigsaw and cooperative learning method improved or maintained positive attitudes about themselves, school, peers and academic abilities and self-esteem while students in traditional teaching method demonstrated poorer attitudes about peers, themselves, and academic abilities.

Perkins and Saris (2001) assessed the jigsaw method for an undergraduate statistics course. Results of the study showed that students perceived the jigsaw procedure as being very positive especially as an alternative learning experience. In their assessment students appreciated the technique as a time-saver and viewed it as a change of pace.

In a study to identify effective teaching methods at University of South Carolina, Carpenter (2006) attempted to answer two simple questions "What teaching methods are effective in the large class environments?" and "What are students' perceptions of these methods?" He evaluated several commonly-used teaching methods such as lecture, lecture/discussion combination, Jigsaw, case study, team project by implementing them in a large class setting. Specific learning objectives were set. Test were given before and after each teaching method was applied. Then, the mean differences between the before and after test scores for all students under each teaching method were compared to assess improvement. Students' scores improved the most under the Jigsaw method, well above any other method.

Morgan et al. (2008) assessed the experience of classes of undergraduate and graduate students regarding the use of Jigsaw method as a cooperative learning method. 83% percent of graduate students and 86% of undergraduate students reported Jigsaw method of learning as positive experience and a good method to share and discuss ideas while learning. Tahir et al. (2011) conducted an experimental study in which three groups of students in three different electrical engineering courses learned the courses using Jigsaw method of University Teknologi Mara, Malaysia. Achievements of the students were compared to their class mates who went through traditional teaching method. They showed results with consistent improvement of Jigsaw groups over others in terms of both the average achievements as well as number of students attaining highest marks.

In most of the studies, jigsaw method has been used at school level. Adoption of Jigsaw method of teaching in courses of professional program is rarely visible. In INDIA, most of the technical institute follows the traditional approaches (using black board using monologue or dialogue, or even using power point presentation) to teach their subject. Low and/or moderate performers losses their focus very fast and lost in day dreaming in traditional approach. Number of such students is very large. A small change in approach may improve their performance through learning. It envisaged to implement Jigsaw approach to such a class of professional program to see if the same is fruitful in these programs or not.

Rest of the paper is organized in the following manner. Section 2 specifies the material and procedure of the methods used. It also highlights the objectives of the same. Section 3 includes the results and Discussions. Section 4 highlights the conclusions.

2. Materials and Method

This case study is done at Mechanical Engineering Department, Indian Institute of Technology (BHU), Varanasi India. Jigsaw method of cooperative learning with peer intervention was applied. 36 students, enrolled in the LM course 'Operations Management' participated in this study formally.

2.1 Class Detail

27 Students from various branches of B-Tech, and 8 students from postgraduate course (M-Tech) and 1 Ph.D. scholar from Mechanical Engineering opted this subject in the odd semester of session 2017-18. B. Tech. students

were studying in their final year, M. Tech. and Ph.D. students were studying in their first year. Study was planned in two steps- first the pilot study and then main study.

2.2 Subject Detail

Topic for this Jigsaw was taken from the content of subject ME-472: Operation Management (Also known as Industrial Management). This is the only elementary subject that covers the area of Production and Operation Management. Most of the students were interested to study Operations Management for their own willingness/liking for their placement for higher education or job in a company. Historical Perspective of Management was taken as sub-topic for implementing Jigsaw approach as pilot study. This pilot study is presented in this paper.

2.3 Formation of Groups

Heterogeneous groups in five numbers were developed. Each group had number of student same as number of group. So, five groups of five students were formed. A balanced heterogeneity was maintained by keeping intelligent students with diligent and weak students. Also each group was provided at least one research scholar of either of post graduate level or of doctoral level. All the students were asked to submit their previous year grades. Based on these grades, 5 expert groups were formed in such a way that every group had at least one student with high grades, one with low grades and one post graduate student. This was done to eliminate biasness and increase fraternity leading to improved performance of the students. Number of students groups so formed was exactly equal to the number of sub-topic. Same approach was used to form home groups.

Another group of senior student known as peers/mentors was formed to supervise and help these students. These peers conducted the evaluations of these groups and were responsible to record the proceedings of discussions made by the groups.

2.4 Procedural Steps

1. A general evaluation of whole class was done by holding a test of 10 questions out of the topic selected from the subject.
2. After the general evaluation, the class was divided into expert groups and set in specific area. A 5 one-line answer question test on specific sub topic given to the students according to their expert group to evaluate their initial understanding of the sub topics given to them. They were provided with study material related to their sub-topic. Groups were asked to work on their sub topics as home assignment and to have a discussion with other members of their group in next lecture.
3. In next lecture, students discussed their sub topics in their expert group. At the end of the discussion, students took a test on the sub topic to evaluate their performance.
4. Now, these expert groups were disbanded and new home groups were formed. After rearranging the students in home group, students took a pre-test that has questions from all the sub topics to evaluate their performance in the topic.
5. In the next step, students were asked to discuss their sub topics in their home groups and as each home group have at least one student from each expert group, all topics were discussed and all pieces of the jigsaw puzzle were arranged.
6. In the last step, students took a test to evaluate their final performance in the topic.

2.5 Evaluation of groups

In all these steps of discussions and evaluation, peers supervised progress of each group for which they were mentor. For the purpose of learning about improvement at each stage, pre-test before every group discussion and post test after every discussion was conducted. General test consisted 10 objective questions; question paper for expert group before and after discussion had five one line/word answer questions. Questionnaire for home group and final performance evaluation had 20 objective questions, 4 questions from each sub topic, so to evaluate the performance of students in all sub topics equally.

33 students out of 36 students were present in the class during the briefing of the study and topic and sub topics. 30 students participated in the expert group discussions in the next class. 33 students participated in the home group discussions.

3. Result and Discussion

Table 1 shows (a) marks for general test conducted before start of this study, (b) Marks for pre-test conducted before expert group discussion, and (c) marks for post-test after expert group discussion. Table shows average marks for each group at each stage. At the initial stage, average performance of the students in general test was low as overall awareness of the class was very low. Also, performance for students in pre-test conducted before expert group discussion was very poor as students did not know about more specific sub-topic. This was due to the reason that many students were first time appeared for such a subject of management. After discussion, students of each group learnt their sub-topic through discussion and reached much higher level of knowledge as depicted by their average performance. The same is shown in the figure 2. Average marks of students in general test was 7.51 out of 20, before discussion in expert group was 1.72 out of 10 and after discussion was 7.62.

Table 1. Marks in Expert Groups

	Average marks				
	E1	E2	E3	E4	E5
General test (20)	3.5	1	4.3	5	4.7
Before implementation of Jig Saw					
Before discussion (10)	1	1.5	3.125	.714	2
After discussion (10)	8.4	6.4	6.57	8.6	8.28

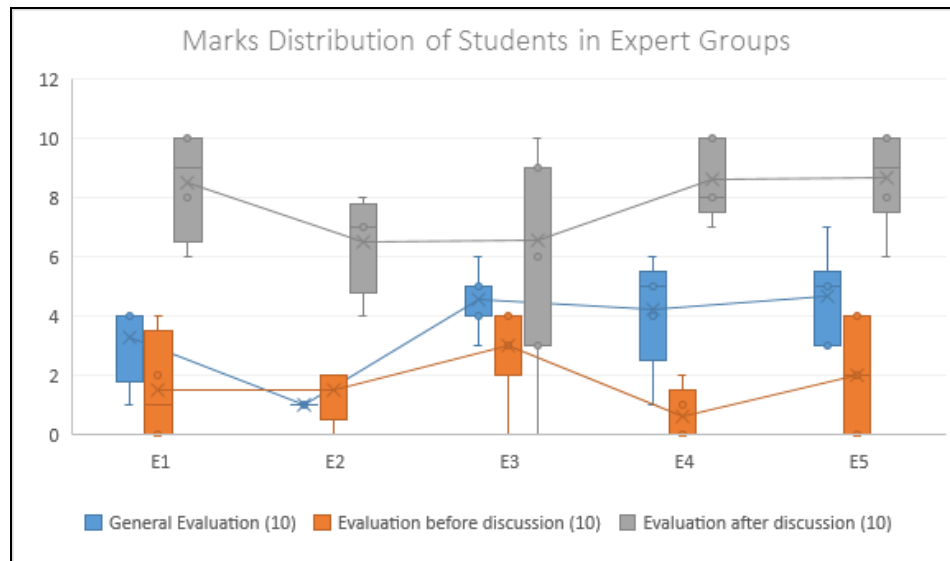


Figure 2. Marks Distribution of Students in Expert Groups

Average performance of Expert Group E3, E4 and E5 was almost same in general evaluation. Average performance of group E1 was less than them and E2 has the least. Spread of the boxes in box and whisker plot shows that students in group E1, E4 and E5 has variation in performance while in E3 variation in students' performance was less and in E2 all the students performed same in general evaluation. Performance of Expert Group E1, E4 and E5 improved significantly after group discussion and performance of group E3 improved the least. After expert group discussion performance of Expert Groups E1, E4, and E5 was almost at similar level and better than E2 and E3. In Expert Group E3 students' performance varied in the group more than other Expert Groups.

Table 2 shows 1. Marks for pre-test conducted before home group discussion, and 2. marks for post-test after home group discussion. Table shows average marks for each group at both stages. Performance for students in pre-test conducted before home group discussion was not very good as students did not know about all the sub topics and have only knowledge about their specific sub-topics. After discussion, all the students learnt all the sub-topics through discussion in home groups and reached much higher level of knowledge.

The same is shown in the figure 3. Average marks of students in test before discussion in home group was 20.60 out of 40 and after discussion was 30.42 out of 40.

Table 2. Marks in Home Groups

	Average marks				
	H1	H2	H3	H4	H5
Before discussion (40)	22.57	22	20.28	22.85	14.67
After discussion (40)	31.43	31	31.14	35.43	22

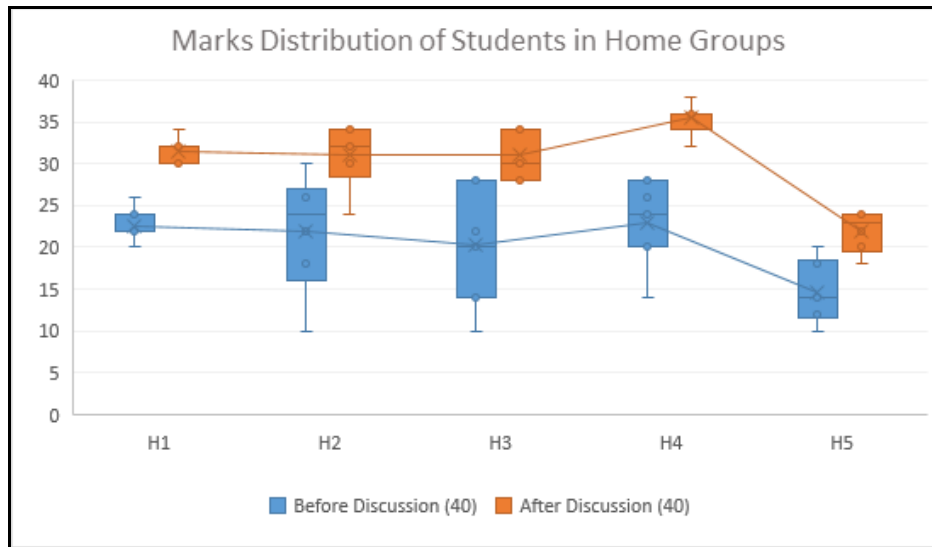


Figure 3. Marks Distribution of Students in Home Groups

Evaluation in Home Groups shows that groups H1, H2, H3 and H4 performed better than H5 in both after and before discussion evaluation.

Table 3. t test values

	Null Hypothesis	t value	p value	Hypothesis Accepted/ Rejected
In Expert Group				
E1	No difference in mean before and after Expert Group discussion	-7.0602	0.00106	Rejected
E2	No difference in mean before and after Expert Group discussion	-5.36339	0.002917	Rejected
E3	No difference in mean before and after Expert Group discussion	-9	0.000141	Rejected
E4	No difference in mean before and after Expert Group discussion	-25.2982	0.00	Rejected
E5	No difference in mean before and after Expert Group discussion	-11.5	0.00	Rejected
In Home Group				
H1	No difference in mean before and after Home Group discussion	-9.20837	0.00	Rejected
H2	No difference in mean before and after Home Group discussion	-5.31562	0.001576	Rejected
H3	No difference in mean before and after Home Group discussion	-5.72872	0.000614	Rejected
H4	No difference in mean before and after Home Group discussion	-6.04386	0.000464	Rejected
H5	No difference in mean before and after Home Group discussion	-5.5	0.001358	Rejected
Class	No difference in mean before and after the study	-4.15471	0.00	Rejected

These results were tested statistically using t test with null hypothesis as ***“there was no significant difference in the performance of students in groups after and before discussion evaluation and also there was no significant difference between the performance before and after the study”***. Student t test was performed to see if there was any significant difference between the performance of the groups before and after discussion performance in expert and home groups. This test was performed on SPSS software on a CP having windows 10 with intel R CORE i 5 with RAM 4GB. p values from student t test were less than 0.05 for all the groups and class, so null hypothesis was rejected for every case. p and t values from t test are summarized in table 3. t test results showed that there is significant difference in performance of students after and before discussion in both Home Groups and Expert Groups. Also there is significant improvement in performance of students after the completion of the study.

4. Conclusion

Result of the study show that the performance of students improved significantly during each step of the study. Increase in average performance of students after expert group discussion was 59%. Individual expert group performances were increased by 74%, 49%, 37%, 78.8% and 62.8% for Expert Group E1, E2, E3, E4 and E5 respectively. Increase in average performance of students after home group discussion was 24.55%. Individual Home Group performance increment was 22.15%, 22.5%, 27.15%, 31.45% and 18.32% for Home Group H1, H2, H3, H4 and H5 respectively.

In conducting this study, few problem were faced. (A) decision of allowing students to discuss their topics at their residence was not correct and led to more time consumption. (B) Absetesm was another problem as students were participating in some cultural function and did not attend the class missing the respective part of the study. Overall increased cumulative time was a great disadvantage. All peers with the instructors believed that this study must be planned well and designed for time. Else, tudents were enthused with this type of approach and performed well, general. This study can be extended to remove the barrier of time and inclusion of complex topics of management.

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