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Jigsaw Learning Technique: Addressing Problems of Implementation

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Abstract: Cooperative learning methods have been widely used to maximize students' achievement and outcomes. Jigsaw technique, a subset of cooperative learning was considered to be effective in increasing significant educational outcomes, such as critical thinking and problem solving skills. However, the implementation of jigsaw strategy requires proper planning and management to obtain excellent results. This study shares the common problems faced in engaging this strategy and suggestions to minimize those problems. The population of study consists of 54 undergraduate students in the Department of Electrical, Electronics and Systems Engineering, Universiti Kebangsaan Malaysia. Comments made by the students were gathered at the end of the year. The findings were analysed and the reflections on the technique was discussed. It was concluded that the jigsaw technique is well received but there are weaknesses in the implementation and lecturers should pay more attention to the details at the planning stage.

Key words: Jigsaw technique, cooperative learning, educational outcomes, problem solving skills, critical thinking

INTRODUCTION

In engineering education, students need to learn and understand the fundamental concepts and progressed from the knowledge to higher levels of thinking. They would then need to apply, analyse, synthesise and evaluate these knowledge, according to the Bloom (1984) learning taxonomy to achieve the specified outcomes. As required by the Board of Engineers of Malaysia (EAC, 2012), all engineers need to complete a sequence of structured educational experience and achieve a satisfactory assessment of performance.

Teachers and lecturers need to recognize the importance of effective teaching and try to adopt different methods to help the students learn. The success of various cooperative learning methods had been claimed in many books and articles (Johnson *et al*., 1998, Sharan and Sharan, 1992; Slavin, 1990; Aronson, 1978; Cohen, 1994). They have also mentioned that learning in a group provides an environment where a wide variety of diverse outcomes could be accomplished. It is not only limited to high level thinking and cognitive development (Fig. 1) as discussed by Dale (1969) but also included social competencies, valuing differences in other races and genders, reducing prejudices, among others.

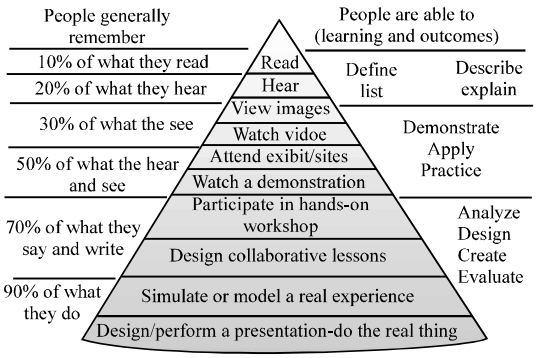

Fig. 1: Dale's cone of experience (Dale, 1969)

The jigsaw technique was first developed by Aronson (1978) to provide an environment where students work cooperatively together in a group to accomplish a common goal. Similar to other cooperative learning methods, by using this technique, each student play a very important role and would be responsible to meet the group's learning outcomes (Deutsch, 1962). In addition to other cooperative learning methods features, jigsaw is unique because it has the element of interdependence among students that encourages the students to take an active part in their learning (Aronson, 1978).

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Although, this technique has been widely practiced in all disciplines and produce higher achievement than competitive and individualistic learning, a more conceptual approaches on the attitude, culture differences and learning style of the students needed to be addressed (Husain *et al*., 2010).

This study presents the comments made by the students based on their experience on the jigsaw technique. Each phase in the implementation of the stage were analysed to give suggestions on the improvements.

Jigsaw technique: This technique emphasise on the responsibility and commitment on each student to take a serious effort to make learning a success. As the term jigsaw implies, the part of the information that each student need to master is like a piece of jigsaw. To ensure that the jigsaw is complete, all the team members need to comprehend all the parts of the information to make it a whole. The principles of jigsaw technique are described as according to its importance (Johnson *et al*., 1993):

- Individual and group accountability
- Positive interdependence
- Interpersonal skill
- Positive interaction
- Group processing

Various researches (Felder and Brent, 1994; Johnson *et al*., 1998; Millis and Cottell, 1998; NISE, 1997) have suggested some guidelines as listed as, in ensuring the success on implementation of the cooperative learning (jigsaw) technique:

- Lecturers need to proceed gradually when using the jigsaw technique for the first time
- The number of students for each team should be enough to generate an effective discussion on the topics given
- The teams should be selected by the lecturers such that the team is heterogeneous in ability and homogeneous in interests
- Students should be taught on how to work effectively in teams
- Lecturers should take measures to provide positive interdependence
- Lecturers should impose individual accountability
- The teams should be assessed regularly
- Lecturers should not assign course grades on a curve
- Lecturers should gather feedbacks from the students on the effectiveness of the technique

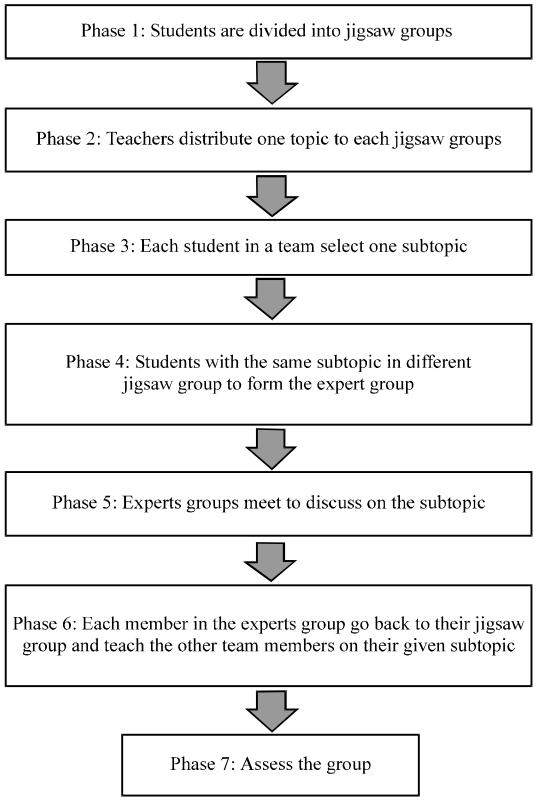

Fig. 2: Phases of the jigsaw technique

- Lecturers would need to expect some students to be initially resistant or hostile to the learning strategy

Figure 2 illustrates the phases in the implementation of the jigsaw technique.

MATERIALS AND METHODS

The jigsaw learning techniques have been implemented on 54 students enrolled in digital system design course in semester 1 academic session 2010/2011 and microprocessor and microcomputer course in the following semester. The distribution of students based on the race, gender and academic achievement is described in Table 1. The strategies used in the implementation during the first semester.

Forming of the jigsaw group: In the beginning of the semester, the lecturers divided the class is into a group of 4 (only two groups with 5 students). Each group will consist of different race, gender and academic achievement. These groups are maintained until they have finished the second course at the end of the year.

Learning strategy: For each session of jigsaw learning, each group is given a topic with 4 subtopics for each team member. There will be two students mastering one subtopic for the groups with 5 students.

Forming of the expert group: The lecturers advised the students from the jigsaw groups with the same subtopics to form expert groups and to convene for discussions on regular basis and record the minutes of discussions.

Group accountability: To ensure that each group member work together effectively, the students were informed that the test marks for the group will be divided equally. This is to remind the students that if one of the team members achieve low marks for the test, he/she is responsible for the lower collective mark that the group is getting. Similarly, if anyone in the group is getting very high mark and he/she is not helping the other group members then the collective group mark will still be lower.

Table 1: Distribution of students

Categories	Quantity	Percentage
Gender		
Male	38	70.4
Female	16	29.6
Race		
Malay	31	57.4
Chinese	21	38.9
Indian	2	3.7
CGPA		
3.00-4.00	21	38.9
2.00-2.99	30	55.6
1.00-1.99	3	5.5

RESULTS AND DISCUSSION

At the end of the first (pre) and second semester (post), the students were asked to give feedbacks on the effectiveness of jigsaw learning technique and the findings are illustrated in Table 2.

As the results indicated, there was a slight increase in the students' approval of the jigsaw technique. However, some of them were still unconvinced on the ability of the technique to enhance their confidence and self-esteem. Students also acknowledged that jigsaw strategy provide a positive environment for effective learning but some of them are apprehensive about the commitment and the ability of their team members to comprehend the course contents and share the knowledge with the others in the team. Initially, the students were also sceptical on the implementation of the strategy and proposed that it should be improved. Some of the students were also prejudiced and was opposing the strategy but eventually a few from the group admitted that they have gained more understanding on the concepts compared to working alone. The improvements shown in Table 3 were made by the lecturer on planning

Table 2: Students perception on the jigsaw strategy

	Agree (%)		Disagree (%)		Others (%)	
Student perception	Pre	Post	Pre	Post	Pre	Post
Do you think the jigsaw strategy helped you to understand your course contents better?	57	63	32	30	11	7
Do you think the jigsaw strategy helped you to interact better with your friends?	48	52	39	37	13	11
Do you think the jigsaw strategy increases your confidence and self-esteem?	30	38	42	37	28	25

Table 3: Improvements on the technique

Concerns	Findings/Improvements
Not a good strategy and it would be better to learn directly from the lecturer-the expert does not have enough understanding and could not provide effective discussion with the other group members and he/she will again need to refer to the lecturer	**Problems:** Some students did not take the learning strategy seriously and did not take the effort to prepare their part sufficiently to accomplish the given task. This resulted in missing pieces of knowledge not efficiently conveyed to the other members and thus not meeting the goals set **Improvements:** The students were educated to recognize the need for them to be responsible and accountable to achieve the set goal for their team. The lecturer informed the class that the group with the highest accumulative marks will get additional bonus marks. In addition, the expert groups were made smaller for better interaction and the lecturer allocated more teaching time for these expert groups
Not everybody can effectively teach others and therefore information are not conveyed efficiently to the other group members	
The expert might lose some of the information when they tried to convey them to the other group members. This will cause the other group members not getting the full knowledge on the topic	
Better to study on our own and ask the lecturers or good students when facing difficulties	**Problems:** Some students have formed a misconception on the strategy due to their lack of knowledge on the technique **Improvements:** After the first semester, some of these students were more receptive due to better grades that they have achieved. The lecturer further encouraged them by showing the progress they have made and show how this strategy actually helped the weak students to get better grades
Although, this is a good strategy, the fact is different student have different learning pace/rate and thus this strategy might not be able to work	
Students are more comfortable when they can have discussion among thier friends	
It is difficult to allocate time for group discussions because the group members have different laboratory and tutorial hours	**Problems:** The flaw in forming the group. The students were not comfortable with their team members. The lecturers do not address the homogeneity in the interest of the group. Some of the tasks were too comprehensive and the time given were inadequate for effective discussions **Improvements:** Students select their own team members with the condition that they fulfilled the following criteria, different races, genders and academic achievement. The tasks given were carefully planned so that enough time is allocated for successful execution
An added burden to the students because they are too busy with their assignments and laboratory works and this in turn will make them tired and having a conflict in the group	

Table 4: Summarised the students' acceptance to the technique based on their attitude and motivation and also the benefits

Attitude and motivation	Benefits
Students	
Promote positive attitudes towards self-development and enjoyable learning through working together as a team	The group discussions provide positive interaction and interdependence between the team members and one's accountability to successfully complete a given task
Recognizing the need for better understanding on different races, gender, social background and academic achievement	Provide an environment for students from other various backgrounds to work cooperatively together as a team in one group
Enhancing the affective outcomes	The students exhibit better social skills and higher self-esteem
Lecturers	
Recognizing the need for proper planning and implementation of the jigsaw strategy, for example in forming the jigsaw group, providing support to the expert groups	The positive outcomes using the strategy could effectively be achieved

and implementation of the technique to address the concerns raised by the student. However, some students, as indicated by their comments at the end of the second semester were still not convinced of this cooperative technique (Table 4).

CONCLUSION

The benefits of the jigsaw technique could be successfully achieved based on these two conditions: The planning and the implementation of the method by the lecturers are appropriate and properly organised and the students themselves are ready and receptive to the principles of the technique. Even though this technique initially requires tedious and demanding preparation, nevertheless, it was observed that these students exhibit better social skills and could interact better with one another. More studies would need to be accomplished to further improve the implementation of the technique and study the performance of these students.

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