

Implementation and Feedback Analysis of Jigsaw Active Learning Method

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Abstract: Engineering students are expected to be proactive, creative, confident, flexible - who can solve problems, make decisions, think critically, communicate ideas effectively and work efficiently within teams and groups. For rapidly changing world "knowing the knowledge" is not sufficient but knowledge should be applied in real time situation. This requirement is fulfilled by engineers who possess the above mentioned skill set, which are achieved by shifting to active learning methodology from traditional passive teaching methodology. The life-long learning and potential knowledge can be achieved by active learning methods, as involvement of student is ensured in these methods compared to the traditional passive teaching methods. This paper discusses some issues related to traditional teaching methods and ways to overcome these issues by adapting active learning methods. Also the result of one of the active learning method i.e. Jigsaw technique is discussed in this paper.

"Instruction begins when you, the teacher, learn from the learner. Put yourself in his place so that you may understand what he learns and the way he understands it." (Kierkegaard)

Keywords: Traditional teaching method, Active learning method, Jigsaw Activity, Soft skills.

1. Introduction

Over past several years active learning methods have come into practice in order to improve the skills of engineering students who are required to adapt to the rapidly evolving world in which we live. The basic difference between the active learning method and traditional teaching style is that: active learning methods are student centric whereas traditional teaching methods are teacher centric. The prolonged practice of traditional methods has led to the belief that teacher imparts his/her knowledge to the student rather than being a facilitator who guides students to knowledge while developing and inculcating soft skills in them. Measuring criteria for teaching is suppose to be in the amount a student learns rather than how good that teacher is able to teach. Of course teaching and learning are very closely related to each other but even if the teacher is very good at teaching, learning of all the students cannot be ensured. The reason behind this fact is that only good students take the responsibility of their learning [6]. Student attention or involvement can be achieved by adapting active learning methods to serve the purpose of learning. Gaining knowledge through learning is one of the purpose of educational system, other than that student are also facilitated to the opportunities to develop personal capabilities and effective thinking

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skills as part of their well-rounded education. This critical and complex part of well-rounded education cannot be achieved by giving same treatment to every student as they have different levels of motivation, different attitudes about learning, and different responses to specific classroom environments and instructional practices. Here the role of facilitator /guide comes into picture, which can provide suitable atmosphere for students belonging to different category. These different attributes of students are handled by adapting different active learning methods and for this purpose we need to explore different categories of students. Sensation, intuition, feeling, and thinking are four principal psychological functions which indicate how people perceive the world and make decisions. These psychological function which are known as Myers-Briggs Type Indicator (MBTI) introduced by Katharine Cook Briggs and her daughter Isabel Briggs Myers based on the typological theory proposed by Carl Jung[7].

2. The Myers-Briggs Type Indicator:

Student can be classified on the basis of Myers-Briggs Type Indicator (MBTI) according to their preferences on four scales derived from Jung's Theory of Psychological Types[8]

Table 1: Classification of Student on Basis of MBTI

Extravert student who try things out and focus on outer world	Introverts who think things thoroughly before doing and focus on inner world
Student who comes under the category sensors believes in practicality. They are more detail oriented, focuses on facts and procedure	Intuitors types of student are more imaginative. They are concept oriented, focuses meaning and possibilities
Thinker type of Students are skeptical and their decision making method based on logic and rule	Student who comes under the category feelers are more appreciative and makes decision based on personal and humanistic considerations).
Judge type of student have agenda to follow and seeks closure even with incomplete Data	Whereas perceivers type of students are adaptable according to the changing circumstances and postpone reaching closure to obtain more data

From table 1 it is very clear that learning of each

student have different orientation. In contrast to the fact that Orientation of education system is towards

" Introverts: Classroom teaching, and individual assignment rather than active learning activity and cooperative learning

" Intuitors: Impotence to the science and math fundamental rather than engineering application and operation

" Thinker: Emphasis on objective analysis rather than interpersonal considerations in decision-making

" Judgers: Focus is on completion of syllabus and assignment before deadline rather than exploring idea and solving the problem creatively

To study the role of personality type in engineering education, a association of eight universities and the Center for Applications of Psychological Type was formed in 1980. They come to conclusion that, introverts, intuitors, thinkers, and judgers generally outperformed extraverts, sensors, feelers, and perceivers in the population. In order to change the orientation of teaching/learning style, first we need to observe how the diverse types of student responds to different type of information.

3. The Felder-Silverman Model:

According to Felder and Silverman [9], four questions decide the learning style of a student

1. What type of information does the student preferentially perceive: sensory (sights, sounds, physical sensations) or intuitive (memories, thoughts, insights) Students who learn through their senses tend to be oriented towards facts and hands on procedures. Sensory learners have a methodical and concrete approach to understanding and solving problems. Intuitive learners are likely to be innovative problem solvers and are comfortable with mathematical models [10]. This scale is similar to the sensing-intuitive scale of the Myers-Briggs type Indicator.

2. What type of sensory information is most effectively perceived: visual (pictures, diagrams, flow charts, demonstrations) or verbal (written and spoken explanations)?

3. How does the student prefer to method information: actively (through engagement in

physical activity or discussion) or reflectively (through introspection)? This scale is identical to the active-reflective scale of the Kolb model and is related to the extravert-introvert scale of the MBTI.

4. How does the student progress toward understanding: sequentially or globally. Sequential learners think in a linear manner and have only partial understanding of material they have been taught. Global learners think in a systems-oriented manner, and have trouble applying new material until they fully understand it and see how it relates to material they already know about and understand. Once they grasp the big picture, however, their holistic perspective enables them to see innovative solutions to problems that sequential learners might take much longer to reach, if they get there at all.

4. Active Learning Methods:

It is not possible to provide universally accepted definitions for all of the vocabulary of active learning since different authors in the field have interpreted some terms differently. However, it is possible to provide some generally accepted definitions and to highlight distinctions in how common terms are used.

Active learning is generally defined as any instructional method that engages students in the learning method. In short, active learning requires students to do meaningful learning activities and think about what they are doing [11]. While this definition could include traditional activities such as homework, in practice active learning refers to activities that are introduced into the classroom. The core elements of active learning are student activity and engagement in the learning method. Active learning is often contrasted to the traditional lecture where students passively receive information from the instructor.

Collaborative learning is an instructional method in which students work together in small groups towards a common goal [12]. This type of learning covers all group based learning methods along with co-operative learning [13]. Some authors treat collaborative learning and co-operative learning as two different learning methodologies based on their different philosophical roots [14]. Collaborative learning focuses on student interaction for learning purpose.

Cooperative learning is the approach where students work in groups towards a common goal, the

only difference is they are assessed individually [13,15]. The most common model of this type of learning is found in the engineering literature and is that of Johnson and Smith [16,17]. This model incorporates five specific tenets, which are individual accountability, mutual interdependence, face-to-face promotive interaction, appropriate practice of interpersonal skills, and regular self-assessment of team functioning. While different cooperative learning models exist [13,14], the core element held in common is a focus on cooperative incentives rather than competition to promote learning.

Problem-based learning (PBL) is an instructional method in which the problems relevant to the topic are put forth at the beginning of the instruction cycle. The problem is then used to provide the motivation as well as context for the learning that is to follow. This type of learning is always active and usually collaborative. PBL requires significant amount of self learning on the student side.

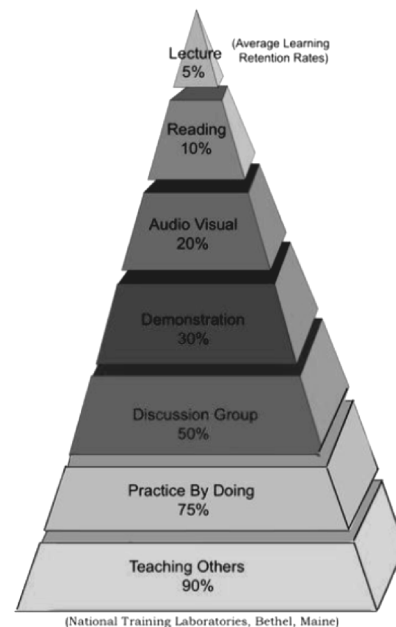


Fig 1: Learning Pyramid on Basis of Average Retention Rating in Percentage of Students

5. Jigsaw Active Learning Method

It is shown in fig 1, students can retain 90% of their knowledge when they use it immediately after learning or teach it to their colleagues. All the teaching community is evident for this fact that they understood and retained the concept thoroughly when they taught it to students rather than when they learned

it as a student. The Jigsaw activity basically depends on the phenomenon explained in last stage of the learning pyramid. This a group activity in which the student learns through material provided and discussion of particular topic or concept while keeping in mind the fact that they have to teach or explain it to their colleagues. Hence the Jigsaw activity also fulfills the 5th and 6th stage of learning pyramid in which average retention percentage is 50% to 75% respectively (refer fig 1). This activity also takes special care of student comfort, students are very conscious and afraid to explain or present the concept in front of their teacher or person who is more knowledgeable in that field than them. But when the students have to explain or present the same concept to their colleagues in their group, they feel very comfortable and also other students are not afraid to ask the question to student who is explaining. This activity performed in three steps (refer fig 1) as follows

- Home group
- Expert group
- Home group

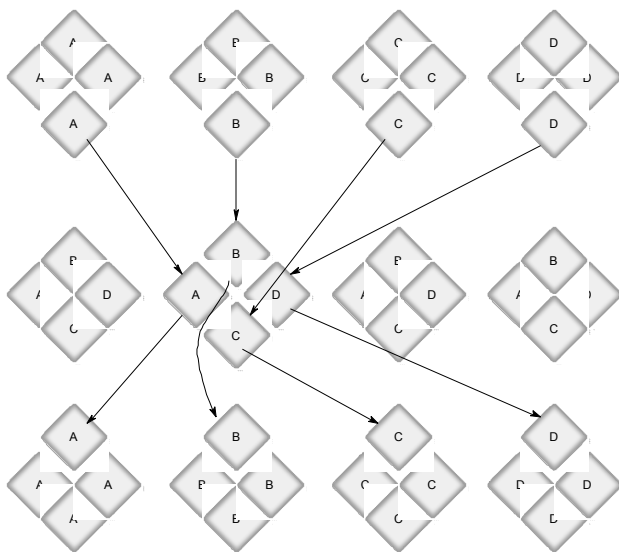


Fig 2: Working Protocol of Jigsaw Activity

The Jigsaw activity for third year students of Electronics & Telecommunication Engineering department at Rajarambapu Institute of Technology, Islampur was conducted. This activity was performed as In Semester evaluation which comes under the category of assessment by teachers. Students were assessed on the basis of six parameter i.e.

participation, leadership, team-work, use of resources/creativity, relevance to the topic, problem solving skill. The reason behind the selection of this criteria is that, our traditional assessment policy focuses only on knowledge, and disregards application, presentation, creativity, problem solving ability, required to survive in vastly growing world. Third year class was of 72 students and hence assessment of student was not possible simultaneously. Two batches of 36 students were created in two different shifts and 36 students of each group were further divided into six groups which are called home groups.

Home group: Six groups were allotted with the different topics from same course which were inter-linked to each other for discussion. All material required for discussion had already been uploaded on MOODLE server provided by the institute which is accessible to all students. Before conduction of this activity, the students were instructed to carry required books (same as done in open book test), in addition to this handouts of all the topics and sub-topics to be covered were provided to confirm proper direction to discussion. This activity was conducted in well equipped lab so that student can have computer for creativity and internet access for more information.

Each group was provided with 30 minutes for discussion, they had been instructed with fact that each of the group members had to explain the same topic to other groups while covering all sub-topics. Co-operative learning strategy was adopted to improve the ability to face common problems. One more important advantage of this learning method through discussion is that students come to know other perspectives of same topic from different angles. Through the interaction with other students, they explored a whole new methodology, logic developing ability, different techniques adapted to solve the problem, different tools, and different way of presentation. This group discussion type of active learning also helped students to develop the skill set required with knowledge as discusses earlier.

Expert group: After the home group exercise all the students were reshuffled in such way that the new groups were formed having students with different topics in their home group. The name itself explains that groups are formed in such a way that everyone is expert in their own topic. Each expert has to explain their topic to other students who can ask question to clarify their doubt. The very important last stage of the

learning pyramid is achieved in this step that is immediate use of learning which helps the students to retain 90% of content. The topic learned by the student in the previous 30 minutes is immediately applied in the form of teaching. Also the presentation skill is tested or otherwise developed during these steps and as comfort zone (explaining or teaching to their classmates only) has been maintained, it was easy to develop the presentation skill of student in this case.

The problem solving ability of students was enhanced, as they faced questions and doubts asked by other students. One precaution was taken to channelized sequence of discussion, since topics were interdependent to each other. The expert groups were instructed to maintain the sequence or flow of the topics since all the topics were part of one unit. Time given for this second step was greater than time given for the home group stage, as the students had to discuss the entire topics altogether (in our case we had provided 45 minutes). As a result of expert group, now all students in a particular group possessed information on all topics and were expected to understand these topics thoroughly.

Home group: Last step is very important to assure the complete learning of topics. In this step all the groups were reshuffled in such way that each student will went to their original home group. One may ask the question why we need this stage as all the students are already aware of all the topics. Very strong reason behind this stage is, it may happen that during this method some expert might not have provided complete information related to the topic or may have provided incorrect information. In this case there must be some rectification required to alleviate this undesirable possibility and returning to their home group will provide a way to solve this problem. After returning to home group, every group is instructed to discuss the understandings of all the topics in detail. So even if one of the expert had failed to elaborate his topic correctly, the other expert group member can help him understand that topic correctly. After the discussion in the last stage of all the topics by the students, complete learning of students is assured.

Report writing: During this method all the topics were revised twice, hence learning efficiency was improved. Learning took place by participative discussion, immediate use of learning, different perspective for the same topic, solving the doubt after returning to home group, and also rectification of

wrong or incomplete knowledge of the topic. Further learning can be improved by writing report on the entire topic either in expert group or home group. We allowed the students to choose the group in which they were willing to write a report. For this purpose instant poll was taken, as result of that first batch selected expert group to write report whereas second batch chose home group to write the report. Emotional bonding and unity is observed in home group and hence it is possible that every student will contribute in report writing equally with same interest and zeal. Whereas in case of expert group, advantage is that everyone is expert in their own topic which will be very helpful in covering every details of the topic. Both the choices are advantageous in one or other way.

6. Recommendations

For the active participation of students in discussion the pre-requisite of all the topics must be already fulfilled. If the pre-requisites of the topics are not fulfilled in that case instructor need to take some introductory classes on these topics, so that students will be in position to discuss the topics. Some groups may fail to take proper direction toward achieving the goal of learning of that particular topic, in that case interruption and help might help the students to take proper direction towards achieving the learning goal. This is very important because if that particular group completely misunderstands their own topic in home group, same wrong information will be passed on to other students in respective expert group. By doing this teacher or instructor becomes the facilitator who guides and gives proper direction for achieving the learning goal. If this activity is taken for the purpose of assessment, then each student needs to be given unique identification, so that each student can be assessed without any ambiguity.

7. Feedback Through Survey

To see the impact of this active learning activity on students, feedback (refer table 2) was taken in the form of questions and ratings. It is observed that students were happy and excited to adapt this active learning method for further topics (refer fig 3). This activity was conducted as In Semester Evaluation and students were assessed on the basis of six parameters i.e. participation, leadership, team-work, use of resources/creativity, relevance to the topic and problem solving skills.

Response of students to the question no 8 is excellent (refer question no. 8 in table 2). This proves that active

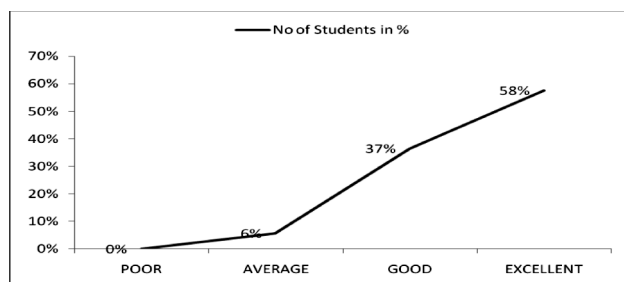


Fig 3: Cumulative Feedback Rating Given By Students to Jigsaw Activity (Refer Table 2)

learning activity increases awareness among students about other soft skills which are requirements

of vastly growing world. As published in The Hindu on 7th November 2007 according to NASSCOM report 75% engineering students in India are unemployable. It is also suggested by education experts that the Indian higher education system must give skill building and practical training along with academics to give them an edge. This soft skill requirement expected from engineering students can be accomplished by creating awareness of it among them and providing platform to achieve it. This can be attained by adapting active learning through various techniques or activities and Jigsaw is one of them.

From the statistics given in the feedback report, it is also evident that students agreed to the fact that not only the Jigsaw activity helps to fulfill the learning objective but also it motivates to study the same topics in depth (refer question no. 4 and 6 of table 2).

Students were asked to rate Jigsaw activity in order to

Table 2: Feedback of Students in the forms of Rating Given to the Questions Asked

Sr no	Feedback Questions		Rating given by students for Jigsaw learning activity in percentage of students			
			Poor(1) ←-----→Excellent(4)			
			Poor (1)	Average (2)	Good (3)	Excellent(4)
1	Rate the Jigsaw active learning activity		0%	0%	32%	68%
2	Rate this learning style over traditional teaching style		0%	7%	39%	54%
3	Do you think each step in this activity is important? Rate it accordingly. (home group→expert group→home group)		0%	4%	30%	67%
4	Does this activity motivate to study the entire topic in detail? Rate it accordingly.		0%	4%	37%	60%
5	Have you developed some skills or enhanced skills you already possessed due to this activity? Rate it accordingly		0%	2%	46%	53%
6	Rate this activity in terms of fulfilment of learning objectives		0%	9%	46%	46%
7	Rate this activity according to the understanding of topics were developed.		0%	11%	39%	51%
8	Rate this activity in a way it helped you to realized the importance of these skills	Participation	0%	0%	23%	77%
		Leadership	0%	0%	26%	74%
		Team work	0%	4%	21%	75%
		Creativity / resources	0%	0%	26%	74%
		Relevancy to topic	0%	2%	37%	61%
		Problem solving skill	0%	0%	33%	67%
		Time management	0%	4%	37%	60%
		Proper planning /strategy	0%	4%	21%	75%
9	Rate this activity good enough to perform on regular basis.		0%	11%	26%	63%

conduct this activity on regular basis and 63% students rated this activity as excellent as shown in fig 4. Only 11 % student rated activity as average and no students gave the rating as poor whereas as 26 % student rated this activity good enough to conduct on regular basis. This statistics not only shows that the Jigsaw method is effective but also the students are willing to adapt the active learning method on a regular basis.

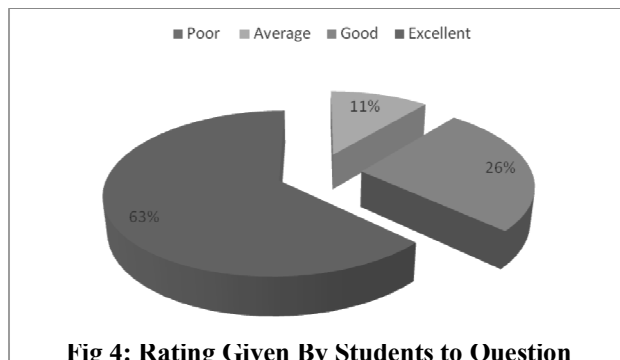


Fig 4: Rating Given By Students to Question No. 9 (Refer Table 2)

8. Result and Analysis

Performance of the students in Jigsaw activity was evaluated by giving grades as low, average, high to all six parameters: participation, leadership, team-work, use of resources/creativity, relevance to the topic, problem solving skill. This alternative assessment was intentionally adapted over traditional assessment where only writing skill and memorizing data is tested which comes under lower-level thinking skills according to blooms Taxonomy. Maximum engineering Students always tend to focus only on lower-level thinking skills than high-level thinking skills, because we assess the students on the basis of that skill only. Student will focus on higher- thinking level if we will start assessing them on that skill and this is the reason behind selection of six parameters which will encourage the students to improve their higher-thinking level skill.

Assessment sample of 57 students was selected to plot graph as shown in fig 4 in which assessment of students in percentage is calculated in terms of six parameters as mentioned. This graph shows that our students are lacking creativity and problem solving ability. Also they need to work on their leadership quality. It is also observed that number of students actively took part in Jigsaw activity is more than 50 %. The number of student that were contributing relevant information to the topic is also more than 50% hence it can be conclude that the discussion was

going in the right direction aiming to achieve the learning goal.

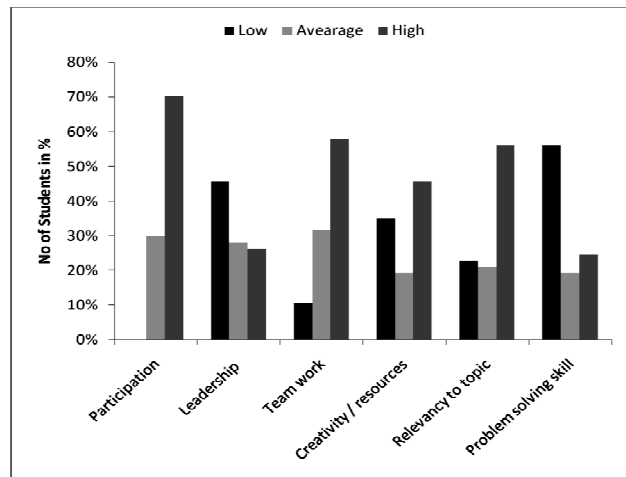


Fig 5: Assessment of Students on Basis of Six Parameters

As earlier discussed, if we want to shift the focus of students from lower-level thinking skills to high-level thinking skill then we also have to adapt assessment tools which will test the required high-level thinking skills. As per the requirements, we conducted the activity to test required soft skills and result is shown in fig 5. In the feedback, students were asked to rate Jigsaw activity as how this activity helps them to realize the importance of six selected soft skill parameters. Rating given by students shown in fig 6 proves that awareness about the importance of these soft skills was increased.

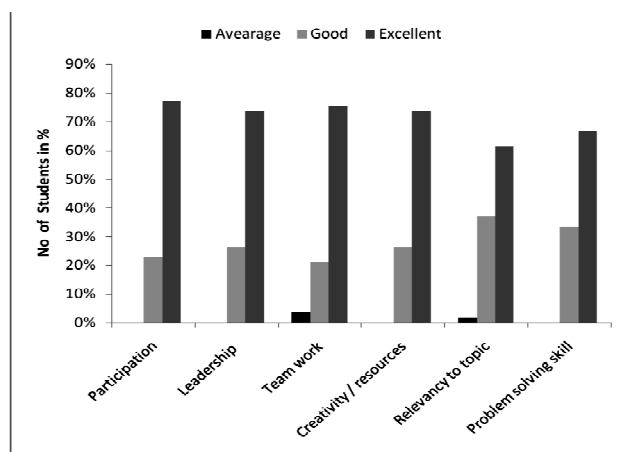


Fig 6: Feedback of Student on the Basis of Six Parameters

9. Conclusion:

Through the Jigsaw activity the most important learning goal is achieved simultaneously with development of other soft skills. By comparing assessment graph with feedback graph depending on

six soft skill parameters for same set of sample students(refer fig 5 and 6), it is observed that even though number of students who possess these soft skills are less but after performing this activity the awareness and importance of these soft skills increased. Outcome of the Jigsaw active learning method which is proposed in this paper was measured in terms of awareness developed among engineering students about the importance of soft skills simultaneously with the technical knowledge. Once the awareness is created among the students, they will only require platform to polish their skills or to develop new soft skills. The proposed Jigsaw active learning technique is capable of providing both, awareness and well as platform to build these skills. Bonding between the students is also observed to be increased which is very important key factor required for encouraging the students to participate in extra-curricular activity, which in fact plays crucial role in developing soft skills in students.

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