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A Case Study of Implementation of Active - Cooperative Learning Approaches Introduced through a Faculty Development Programme and their Effects on the Pass Percentage of Undergraduate Engineering Students

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Abstract: It is conventionally believed that good academic results of the institutions can be accomplished if there are more subject experts. But it is also a reality that while teacher may not know the learning behaviour of students, students themselves do not know in what way they should study to get good marks. This paper describes how classroom implementation of cooperative learning practices by a faculty member after a faculty training programme affected the pass percentage of second and fourth year undergraduate engineering students in an autonomous engineering college.

Keywords: faculty training, engineering students, learning styles, active-cooperative learning, jigsaw, flipped classroom, pass percentage

1. Introduction

The role of education is to empower a person to transform oneself and the society at large. In today's competitive world, empowerment comes more through the formal education that are being imparted in schools and colleges. In developing countries like India, it is not hard to see students going after the engineering courses which have more demand in the market rather than relying on their own interests and calibre. Due to this the aptitude level of students in a class varies a lot and a common teaching technique for all would not be effective enough for respectable pass percentage of the class. In this scenario, the responsibilities of the educational institutions increase. It is a widely accepted view that it takes a lot more than just being a subject expert to translate good teaching into higher pass percentage of students in exams. Various researches have shown that grasping capacity varies from person to person depending upon the extent of development of different regions of brain [1, 2]. The inclination of students towards studies also varies a lot in a class due to various factors like socio-economic conditions, peer pressure and impression of the institute. Therefore, one way teaching does not has the ability to bring out the best from the students [3].

In the contemporary technological world, engineering domains are no longer aloof from each other as it was nearly two decades ago. Present market dictates that to survive in this situation one should be comfortable in at least one specialized course apart from one's core branch of engineering. Due to this, now students have to prepare themselves not only with respect to their core branch but also have to be familiar with other streams of engineering. In this regard, throughout the academic year various technical/non-technical events are organized on the college campuses with the objective of all round development of students [4]. This has put additional

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load on engineering students as not all have the same capabilities and therefore many could not reason out what is best for them resulting in poor scores in the college exams. And it is here the importance of an effectively trained teacher is recognized who can address the different needs of students and motivate them to excel academically and socially.

Several researches have been done to study the effect of faculty training programmes (TP) on students' learning outcomes. In [5], professional training focused on to be an effective learner and transferring those trainings to students who in turn understood the purpose of their strategy. In [6], a comparison has been made between a group of trained teachers and their students vs. new teachers and their students without training. Positive changes were observed in the case of trained group. Authors of [7] reported low-cost, self-directed teaching learning techniques for qualitative post-secondary teaching. The general objectives of these trainings are to improve the competencies in the core area of the subjects, teaching skills, administrative know-hows and to cope up with the rapidly changing technologies. All these things ultimately affect the way students are steered in class. Effective teaching takes into account how students learn with emphasis on each individual in class.

This paper explores the effect of implementing various active learning styles [8, 9] in Electronics and Communication Engineering (ECE) classrooms for the subjects Linear Integrated Circuits and Applications (LICA), Signals and Systems (SS) etc. Comparison has been made to highlight the students' examination outcome with and without the implementation of the active-cooperative learning approaches in the classroom by the author. Although the groups of students are different for the comparative study, large differences in pass percentage can be seen for the same subject.

2. Methodology

The strategy used is mainly based on cooperative learning wherein students of second and fourth year Electronics and Communication Engineering (ECE) of SR University, Warangal, India (formerly, S R Engineering College) were engaged by the faculty in an interactive way for a semester in each subjects. The learning techniques used were think-pair-share [10], jigsaw [11] and flipped classroom [12, 13] and are discussed in the following subsections. Learning becomes easy when students involve themselves in class activities [14]. Students were encouraged to work like a team for better results. It was a golden opportunity for slow learners to learn things at their own pace with the help of their peers.

In traditional mode of lecture delivery teacher introduces the contents of the syllabus on a scheduled date as per the time table and students generally do not study them in advance. Due to this students come to know about the topics for the first time in class itself, i.e. one is unaware of it until the scheduled class. As the attention span of an individual is hardly more than twenty minutes in a lecture, it is very unlikely that student would be able to grasp the major portion of lecture content in the very first class.

Flipped classroom: Concept of flipped classroom is gaining ground wherein students go through the lecture video at home and come prepared in class to participate in further activities based on that. This enables class lectures to be less boring and students participate more actively. Also, the class time is freed up and therefore active learning and interactive sessions can be taken up by the faculty in normal class timetable schedule. Interactive class helps in cementing concepts even for slow learners. More problem solving can be carried out in class. The flipped classrooms that were conducted provided more scope to address students' questions on the topics to clarify the concepts. For example, in one of the topics students were given the URL of its video lecture with duration of 11 minutes and 51 seconds. They were given brief introduction about the video and the points to look out for. It was to be discussed in the next class the following day. The detailed observation is listed in Table 1 and discussed later.

Think-Pair-Share: For the topic 'Analog to Digital Conversion Techniques' Think-Pair-Share strategy was used by the author to address various learning styles like Reflective, Visual, Active, Intuitive and Sequential. This was the first time that such methods were adopted by the author while teaching and it was without any pre-planning. Therefore it consumed considerable amount of allocated time. But the outcomes were impressive and are detailed in the results and discussion section of this paper. Students were also affirmative that they understood things more when asked to discuss in pairs (peer learning) and with one-to-one interaction with the faculty member.

Jigsaw: The subject of discussion was specifications of DAC and ADC circuits for second year students. The class was divided into groups of four based on their percentage of marks obtained in previous semester and each group comprised two students with higher percentage and other two with lower percentage of marks. To encourage student discussions, the author attended to each group and made himself part of it for short durations.

Assessment design: Along with the focus on addressing the different learning needs of students, the assessment questions for internal mid-semester exams were also given in multiple parts. For example in the case of LICA subject, instead of the question "Discuss briefly about the operation of an instrumentation amplifier (5 marks)", the redesigned question that was asked comprised of three parts, viz., (a) Draw the circuit diagram of an instrumentation amplifier (2marks). (b) Discuss briefly its operation (2 marks). (c) Give its any two applications (1 mark). Multiple-part questions help students with more options and an average student can score good marks without getting stuck at a particular question. Students were made aware of the advantages of such marking scheme and were encouraged to attempt the same.

Fig.1: Students involved in 'JIGSAW' collaborative activity in class.

3. Results and Discussion

Out of the many activities conducted by the author for different subjects, observations from a survey conducted in class related to the flipped classroom in LICA subject is summarized in the following table.

From this table it is seen that the interest among students for Flipped classroom is overwhelming. These students were introduced to this technique for the first time. While the inclination to adopt this method was appreciable, the number of students who actually came prepared to class was only 60%. To find the reason for the same, one to one discussions were held with the students. The common reasons that were given by students were either they forgot/ignored the task at hand or they were unable to access the content at home. Further, out of those who came prepared to class, nearly 75% engaged themselves in asking questions for clarification. After completion of the first round of Flipped classroom, all students were counselled afresh to participate actively in all such future activities.

Table 1 :Student participation in Flipped classroom

Observation	Involvement of students in %
Showed Interest for Flipped classroom	90
Came to class prepared	60
Students engaged in doubt clearing	75 (of those who came prepared to class)
Comfort in adopting technology (overall)	80

Fig. 2 shows the variation of pass percentage of students for different subjects with average batch strength of 60. In the figure the label 'Others' denotes the results of students of other sections in the same semester who were not taught by the author. The data is from three semesters of assessments.

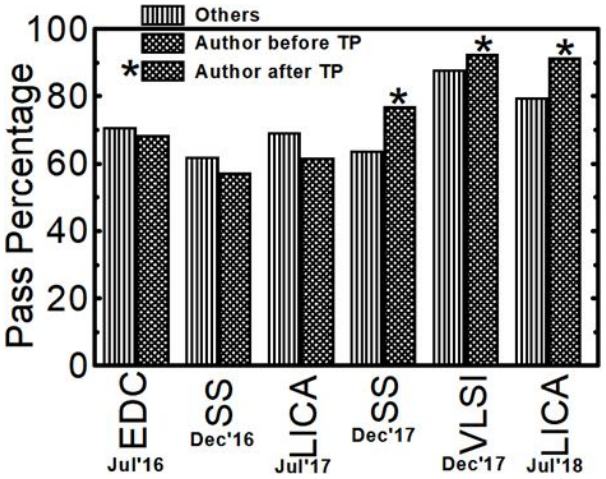

Fig. 2 : Variation of pass percentage of students for different ECE subjects (EDC, SS, LICA and VLSI)

From the figure it is observed that the pass percentage of students taught by the novice author has relatively increased over time. This can be attributed to the gradual implementation of the experiences gained by the author. The effect of faculty TP can be perceived by looking at the bar graph marked with asterisk. Before training the author followed one way teaching in general but after TP, the emphasis was on consistent one-to-one interactions with the students. Different learning styles/needs of students were identified and acted upon accordingly. In conventional teaching it usually happens that students get to answer the subject related questions only during their main exams which comes mostly in the mid or at the end of the semester. The main drawback in this situation is that students' concentration in the class duration remain very low which ultimately leads to rote learning leading to poor results. An untrained faculty unknowingly follow this conventional method of teaching. Qualitative faculty training changes the above mentioned scenario. After training, the author conducted the classes in an interactive way which included asking short questions to students after nearly every ten minutes in a class of one hour duration. This kept the students alert during the class and they were automatically forced to concentrate for a longer duration of time. To explain some critical concepts, extra classes were also conducted for those students who scored less than 50% marks in their first mid exams. The uniqueness of those additional classes was that the students were left to understand on their own and with the help of their peers after the author had explained them in that class.

Although Active learning has many advantages, its execution requires meticulous planning. Some of the major concerns associated with active learning are time constraints (due to limited time, coverage of the syllabus is an issue) and the lack of enthusiasm in students with respect to public speaking. For large class, assessment of students becomes time consuming. But all these concerns can be addressed with better time management and motivating students on the importance of active learning. Through pre-planning we can have flexible classroom to implement active learning techniques [15].

4. Conclusions

Learning can be based on sensory or intuitive, visual or auditory, sequentially or globally. Teaching should be in a way that can address most of the learning styles. Proper planning is very much essential for execution of active learning methods in a successful way. Harnessing the power of technology is getting increasingly essential when we look at the demands of society and job requirements of companies. Flipped classroom enables the possibility of getting knowledge/lecture from subject experts of different fields sitting at any corner of this planet. Through this paper it is evident that the pass percentage of engineering students improves with the implementation of active-cooperative learning practices in the classroom and that faculty training programmes are effective in introducing new faculty to strategies and methods to implement these practices in their classrooms. Faculty training helps in advancing the educational environment of the college and improves the academic performance of the students. It is very important to understand the learning needs of students for better outcomes. Interactive classroom benefits all types of learners.

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