

A Case Study: Active Learning approaches to improve learning in Electrical Network

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Abstract: Active learning approach in teaching learning process is quite useful and beneficial. It provides depth knowledge of content and active involvement in the class. Surveys and studies in the field of educational technology have proved this. Many educational institutes like IITs and NITs and Engineering colleges are adopting active learning approaches for making their teaching learning methods better. In active learning teacher acts as facilitators rather than one-way suppliers of information.

In this paper teacher has tried to prove that in her subject Electrical Network by using active learning techniques students have performed better and learnt more. This has been proved by showing the results of two consecutive years.

Keywords: Active Learning, Electrical Network (EN), Think Pair Share, Pre-Learning.

1. Introduction

Active learning [1] methodology is basically a technique in which students will be able to learn by active involvement in the class like by problem solving, discussion, group study etc. this will not be only information sharing class. Active learning provides a powerful mechanism to enhance depth of learning and get learners involved with learning process instead of passively participate in it. Students are involved in more than listening. Less emphasis is placed on transmitting information and more on developing students' skills. Students are engaged in activities (e.g., reading, writing and discussing, solving problems). [2]

Every graduate in engineering is supposed to acquire attributes in knowledge, skill and attitude domain. Each program defines program outcomes (POs) which are assessed and evaluated at the end of four years of graduation. These attributes are acquired through Course outcomes (COs) defined at every course and evaluated in every semester. Hence attainment of COs is the focus of teaching learning. Course outcomes, content delivery and evaluation methods complement each other resulting in effective learning.

The main purpose of this study is to investigate and present an analysis that by using different active learning approaches students have gained more and this can be seen by Course outcome analysis [3] in a subject Electrical Network.

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The impact on students' performance is after undergoing the courses in semester III of Electronics Engineering in a self-financed autonomous engineering college affiliated to University of Mumbai, India. The goal is to improve understanding of students in the area of time and frequency domain analysis of first and second order system, Laplace transform and two ports network.

Section II discusses the experience which motivated to improve content delivery methods by using active learning techniques. Section III describes the research questions leading to steps in content delivery, active learning tools used and data gathered. Section IV presents the results of continuous assessment during the semester, followed by conclusion in Section V.

2. Motivation

The most important technical skill of an engineer is the ability to design a system, component, or process to meet desired needs.

Network analysis is the process of finding all the currents and voltages in a network of connected components. We look at the basic elements used to build circuits, and find out what happens when elements are connected together into a circuit. Students are expected to learn this subject to acquire the knowledge of analyse and synthesis actual plants and systems.

In this paper it is tried to compare the course attainment of Electrical Network in two consecutive years 2014-15 and 2015-16. During the year 2015-16 teacher has included active learning approaches to teach Electrical Network in her teaching learning technique. The effectiveness of this methodology was reflected in the course outcomes attainment of year 2015-16.

This shows that by using active learning techniques in teaching learning method students' learning can be improved [4][5].

3. Methodology

The concepts related to EN like first and second order systems, time and frequency domain analysis and two port networks are taught mainly by using active learning approaches.

In order to study the effectiveness of these approaches following research question is formed.

RQ1: Do the students learn better in areas of first and second order system and two port networks by using active learning approaches?

RQ2: Do the students perceive that learning through problem solving and simulations is useful for design and analysis of Electrical Network?

This was implemented on 150 students of second year of Electronics Engineering in Autonomous curriculum of a self-financed autonomous institute affiliated to University of Mumbai, India. The sampling is convenience sampling as the researchers are the faculties conducting the courses of EN. The groups of students used for observations are students in 2014-15 and 2015-16.

Course Outcomes

Following are the course outcomes of EN used in 2014-15 and 2015-16 which covers the curriculum and sets objectives.

This section discusses various active learning approaches used while teaching EN and their impact and improvement in course outcomes.

1. Problem Solving class

As EN is a mathematical subject so it requires a lot of practice of solving problems on some topics like mesh and nodal analysis with dependent sources, all theorems related to circuits. Teacher provides theoretical information to solve circuits during initial classes and explains a basic problem in the class,

TABLE 1: COURSE OUTCOMES OF EN

Course Outcome	After successful completion of the course students should be able to
CO1	Analyse circuits using generalized method and different network theorems.
CO2	Analyse transient response with dc excitation in time and frequency domain
CO3	Study and analyse types of special category of circuits namely Two Port Networks.
CO4	Synthesize realizable circuits in its basic forms.

then she makes group of students (Not more than three) in her class, poses a numerical problem and students try to solve that problem in a group. Meanwhile teacher moves in the class and ask each group about their understanding and methods to solve and she try to modify the techniques. Finally as a conclusion she explains various possibilities of numerical problems and tricks to solve those problems.

2. Think pair Share

In this technique Teacher poses a problem, (normally objective answer type) , She gives some time to think for the problem, then in pairing phase each student show his answer and then students discuss among them and finally teacher conclude the session by sharing exact solution and comments on the given problem. Basically concepts of two port networks are covered by using this approach. Like an example students were asked to represents the precise condition of reciprocity for transmission parameters. They were shown four options to choose. Then they showed their answers to teacher and discussed among themselves about their answer. And then finally teacher concluded this by explaining right answer.

3. Simulations based study

Some topics can be cleared by using live simulations in MATLAB/Scilab. Students were taught Transfer functions, Analysis of second and higher order systems using with different set of inputs using MATLAB Simulations. They will be able to compare theoretical and practical results. So by using this method they got more depth of knowledge and were able to analyse the responses of the circuit.

4. Pre Learning

Students were asked to see the some videos shared with them before coming to the class. As shared video was basic theoretical information of the topic so she directly starts a think pair share activity in the class. So this method saves time for information sharing only and teachers can more emphasis on problem solving approaches for the topic.

5. Project based Learning

Students were divided into small groups(not more than 5) and then they were instructed to make a RL or

RC element based first order system as a plant on bread board only and provide any type of input (Step, Ramp, and Sinusoidal). Then they were told to see the actual response and analyse the actual result and also they are instructed to simulate in MATLAB and compare their practical and simulation results.

4. Data gathered:

The following data was gathered for analysis at the completion of the study.

A. The Marks obtained by students of EN in 2015-16 and 2014-15 during end semester exam and in internal tests conducted during semester.

B. CO assessment of EN in 2014-15 and 2015-16.

5. Results

It was our focus to improve the learning of students by using these approaches and, if we see the efforts taken and the results of the analysis then this shows the continuous improvement.

Figure 1 and 2 shows the improvement in CO2 and CO3 attainment. CO2 is related with transient response with dc excitation in time and frequency domain in which active learning approach like Pre-learning and project based learning was applied. CO3 is related to study and analysis of Two Port network where active learning approach like Think Pair Share was used. This shows continuous improvement in the learning of Electrical network.

Fig. 3 shows that the overall performance was improved by using active learning methodology.

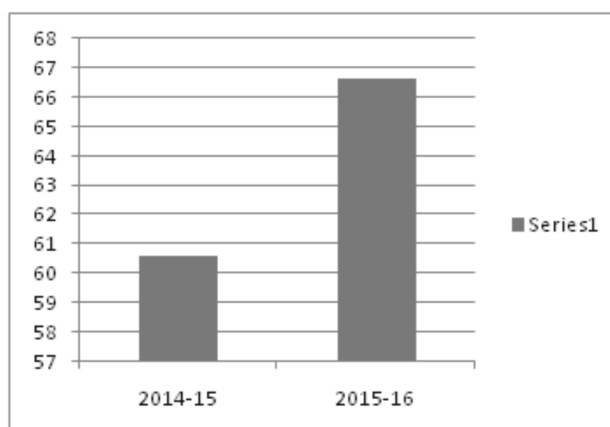


Figure CO2 attainment in year 2014-15 and 2015-16

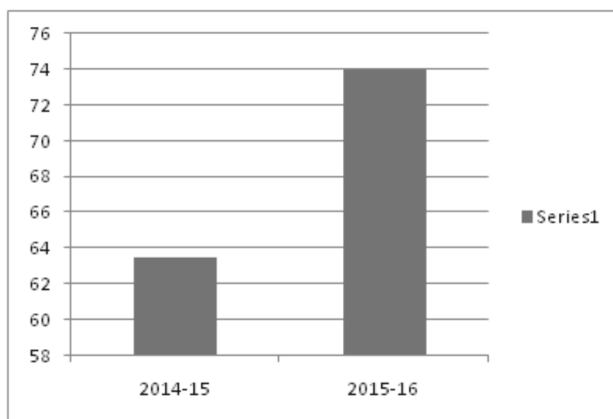


Figure 2 CO3 attainments in year 2014-15 and 2015-16

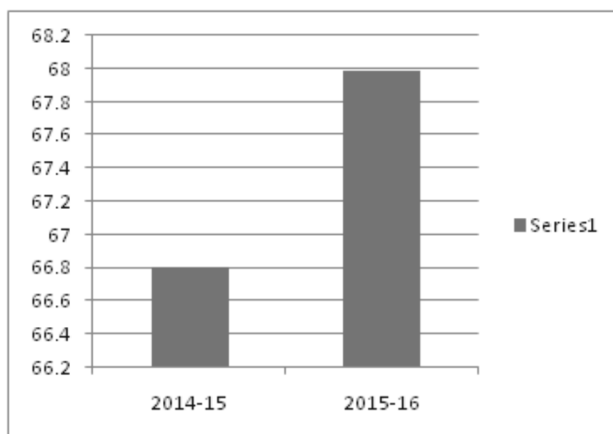


Figure 3 Overall Performance comparisons for two consecutive years.

The impact of applying active learning approach improved performance of students and it was reflected in the CO attainment of the year 2015-16.

6. Discussions and Conclusion

Through this study we try to find answer to the following research questions

RQ1: Do the students learn better in areas of first and second order system and two port networks by using active learning approaches?

From the evaluation of work during the year it is found that the learning experience is better with appropriate prerequisite knowledge, problem solving and simulations.

For teaching First and second order system Simulation based learning and Project based learning

approach was used and for teaching Two port network Think Pair Share and Pre learning method was applied. The effectiveness of these active learning approaches can be seen by comparing CO attainments of both the years.

RQ2: Do the students perceive that learning through problem solving and simulations is useful for design and analysis of Electrical Network?

Some topics like two port networks were taught using problem solving and Think Pair Share approach and continuous improvement is reflected in the CO attainment of this module. Topics related to first order and second order systems are taught by using simulation based learning method. These topics are related to CO2 and CO3, effectiveness of Active learning approach can be seen by comparing CO attainments.

This can be concluded that Active Learning techniques can serve as a tool to improve the quality of teaching as well as to promote deeper and more meaningful student learning.

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