

Project Based Learning-An Innovative approach to enhance higher order skills

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Abstract: Project based learning (PBL) is an approach of active learning in which students search real-world challenges and problems and work on it in small collaborative groups to get solution. Group of students work together to achieve common goal. During this process certain skills are developed viz. research and inquiry skills, organization and time management skills, communication and presentation skills, group participation and leadership skills, self-assessment and reflection skills and critical thinking. In implementation heterogeneous groups are formed. Through discussion and brain storming, problem statements are finalised. From circuit simulation, results are observed and checked those results using breadboard implementation. Printed circuit boards are created and all components are soldered. Circuits are tested to check results. Report is documented and uploaded on MOODLE. This is considered as one of the In-Semester Evaluation (ISE) components. The assessment is carried out using rubrics. In addition, students’ feedbacks are taken. It has been observed that there is improvement in ISE performance. Students enjoyed learning by doing. Learners have learned applying theoretical knowledge to solve practical problems. Students learnt to use simulation tools, circuit mounting and testing, troubleshooting the circuits.

Keywords: Project based active learning; higher order skills, Hardware implementation

1. Introduction

Learning is long process to develop students with number of skills. Traditional teaching is mostly reading, listening and viewing images/videos. This is not effective in changing future as students are from different environments and their learning styles are different. In outcome based education outcomes are defined first and accordingly teaching learning methodologies are decided and implemented. In this active learning is alternate option to traditional teaching learning methodology. Research claims that students learn more through active learning in comparison with traditional teaching techniques. It is applicable to any subject. Also students enjoy the class more and able to retain the information for long duration. The researchers also claimed that active learning allows students to learn in the classroom with the help of instructor, rather than learning on their own [1]. Cone of Learning shows that students learn more if they do things themselves i.e. Learning by doing [2]. To achieve active learning

number of techniques are available and day by day new techniques are experimented and tested. One of such active learning is project based learning (PBL) in which students work in group to complete certain project.

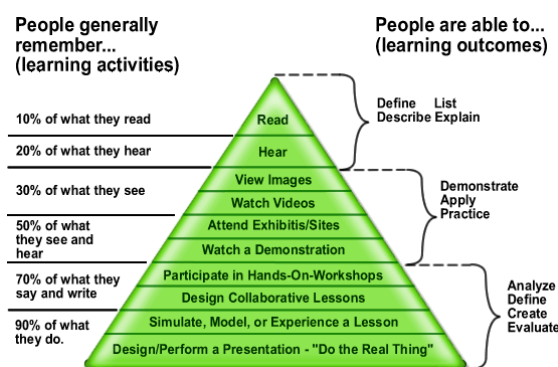


Fig.1 Cone of learning

Bloom’s Taxonomy is a framework that starts with remember and understand levels of thinking as important bases for pushing our brains to higher order levels of thinking—helping us move beyond remembering and recalling information and move deeper into application, analysis, evaluation, and creation [3].

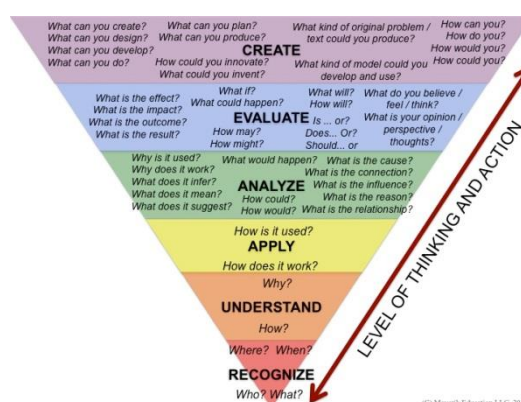


Fig.2 High level thinking approach

2. Why PBL

Research shows in learning process if hands on performance are present, learning takes place in better manner and long lasting. Learning by doing can be done by different ways such as Jigsaw, Flipped classroom; Problem based learning and many more. Project based learning (PBL) is the active learning technique which concentrates

on simulation, modelling, collaborative learning, designing and performing presentation with documentation [4]. With this students can learn and remember concepts for long time. PBL addresses upper four skills of Blooms taxonomy. Higher-order thinking involves the learning of complex judgmental skills such as critical thinking and problem solving[5]. Higher-order thinking is not easy to learn or teach but more important as these skills are more usable in various engineering problem solving situations. Through PBL higher order skills can be developed which eventually reflects in program outcomes and graduate attributes[6-9].

3. Methodology of implementation

PBL has been implemented for Linear Integrated Circuits course of second year B. Tech. Electronics and Telecommunication engineering branch. Total students were 72. Following are the phases of implementation.

- a. Group formation
Groups are formed considering two heterogeneous students per group which. Details are uploaded on Moodle.
<http://210.212.171.173/moodle/course/view.php?id=3202>
- b. Project title selection and discussion
From the curriculum 36 separate project statements are found out through discussion with each group. E.g. Instrumentation amplifier, Temperature controlled fan using 741, etc.
- c. Simulation
Circuits are designed and simulated using softwares:- Proteus, MultiSim, TINA and DipTrace. Simulation results are uploaded on Moodle.
<http://210.212.171.173/moodle/mod/assign/view.php?id=56506>
<http://210.212.171.173/moodle/mod/assign/view.php?id=55180>
- d. Breadboard implementation
Components are selected and mounted on breadboard and circuits are tested.
- e. PCB layout and fabrication
PCB artwork has been generated using softwares and then PCB is fabricated in PCB lab.

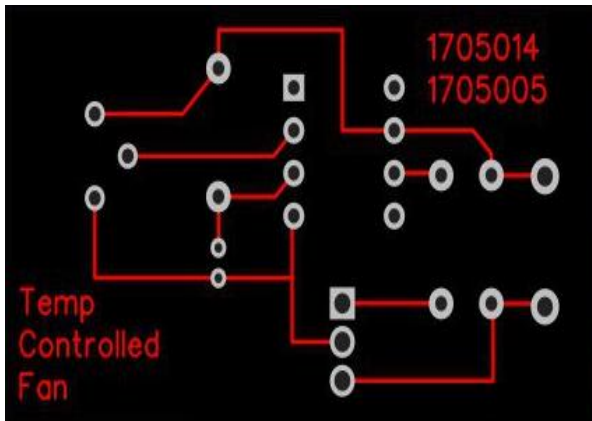


Fig 3.Sample PCB layout

- f. As per circuit PCB layout fabricated and drilled.
Component mounting creation and testing of circuit

Components are soldered and circuits are tested. Some connectivity and dry soldering issues were found out and troubleshooted.

g. Documentation and presentation.

Reports are prepared, uploaded on Moodle and presentation is done in front of the S.Y. B. Tech Electronics and Telecommunication Engineering class.
<http://210.212.171.173/moodle/mod/assign/view.php?id=53770>

4. Assessment

Project based learning is considered as In Semester Evaluation (ISE) component. For grading rubrics are defined. For grading four dimensions were defined with three levels of grades as excellent (4-5), good (2-3) and average (0-1) as Problem definition & literature survey (5M), Methodology and Simulation (5M), Results and Implementation (5M) and Report (5M).

Table 1. Rubrics sheet

Dimensions	Grade Points			Roll No.	
	Excellent (5-4)	Good (3-2)	Average (1-0)		
Problem definition & literature survey (5M)	Excellent knowledge of problem and relevant material	Good knowledge of problem and relevant material	Basic knowledge of problem but lack of details and lack of relevant study		
Methodology and Simulation (5M)	Accurate circuit simulation with PCB artwork	Accurate circuit simulation with no PCB artwork	Partially working circuit simulation with no PCB design file		
Results and Implementation (5M)	Accurate results with glass epoxy PCB implementation	Moderate results with general purpose zero PCB implementation	Poor results on zero PCB or breadboard implementation		

Report (5M)	Report with proper component specification & accurate result	Report with proper component specification & moderate results	Report with proper component specification & poor results		
Marks out of 20					

5. Simulation

The designed circuits are simulated to test their performance using simulation softwares before actual implementation. Some of sample simulation circuits have been depicted in figures 4 and 5. Also students got knowledge of using different simulation tools.

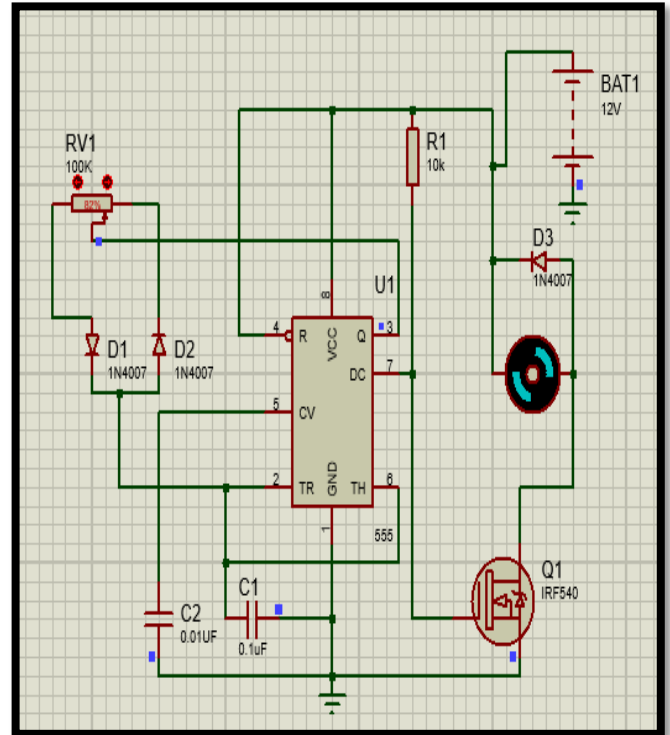


Fig 5. Sample simulation circuit 2

6. Hardware implementation

The simulated circuits are actually implemented on PCBs. Their performance is tested for respective applications. Some of the sample projects have been shown in figures 6 and 7.

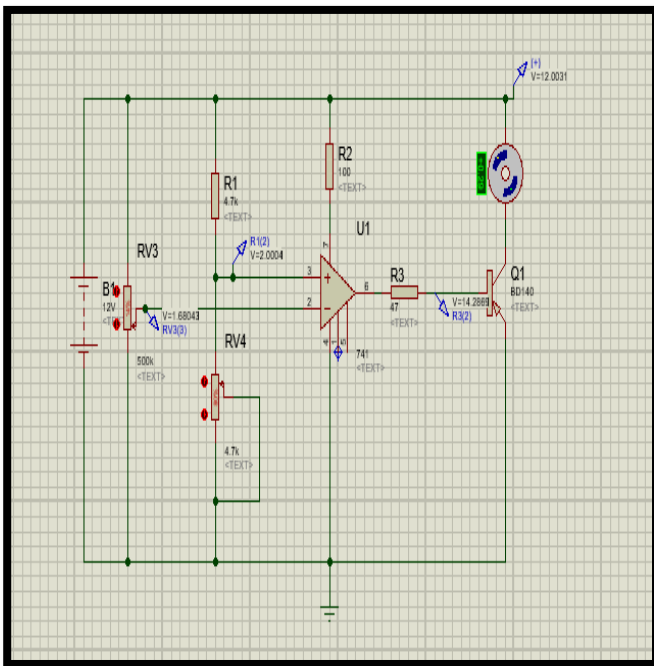


Fig 5. Sample simulation circuit 1

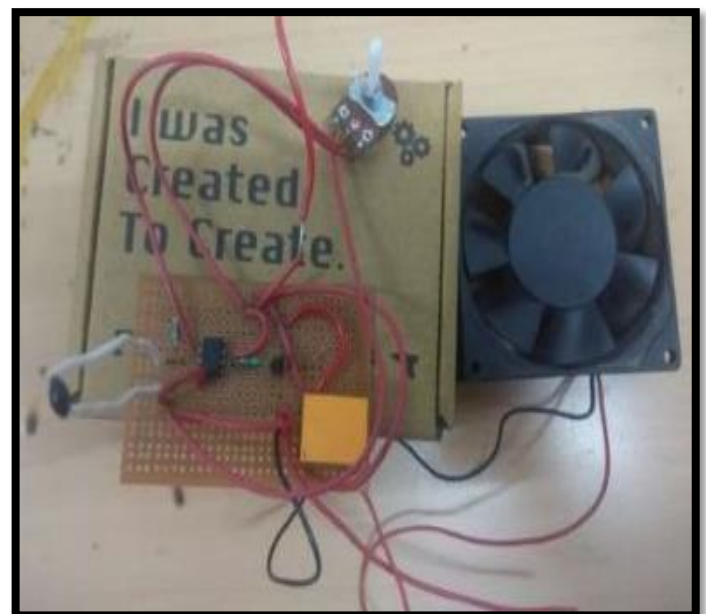


Fig 6. Sample Project 1(Temperature controlled Fan)

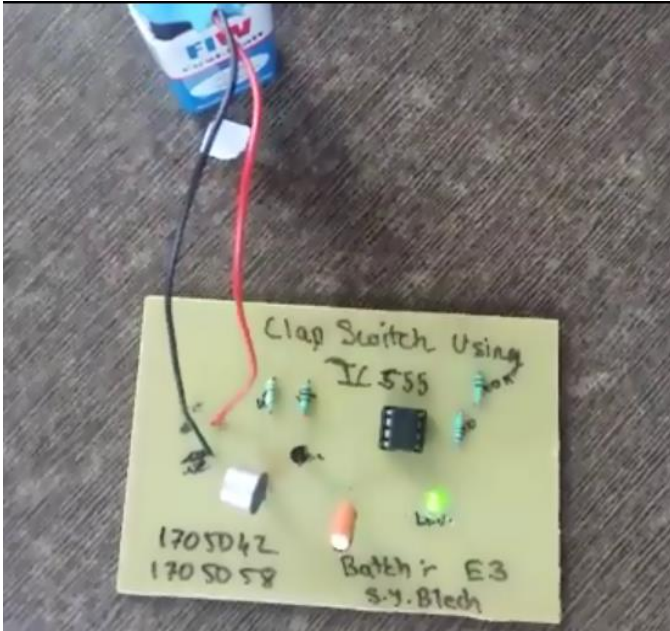


Fig 7. Sample Project 2

7. Results

Results are compared on the basis of Course Outcomes (CO) attainment of the course Linear Integrated Circuits (LIC). Figure 8 shows ISE attainment after implementation of PBL. Figure 9 shows survey representation of higher order skill viz. time management, critical thinking, self-assessment, communication skills and team work that students has achieved. Details are as follows.

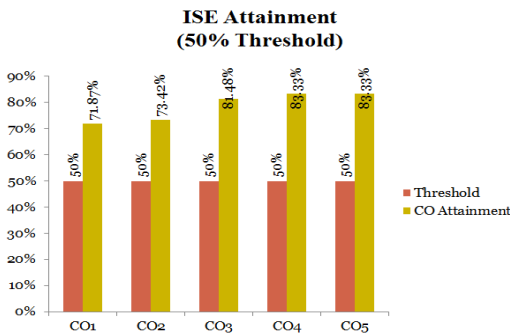


Fig 8. ISE attainment after PBL implementation

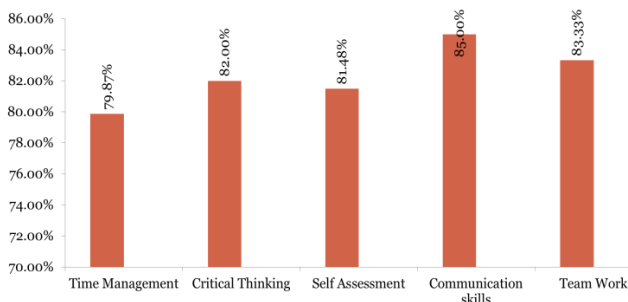


Fig 9. Analysis of higher order skills feedback

Also student feedbacks were taken by using MOODLE on following basis and shown in figure 10. Detail are

uploaded on MOODLE <http://210.212.171.173/moodle/mod/feedback/analysis.php?id=56363&courseid>

- Up to what extent students liked this activity
- Ability to analyze the linear integrated circuits
- Ability to test and design linear integrated circuit
- Ability to simulate circuit using simulation tools.
- Ability to work in team with joy and enthusiasm

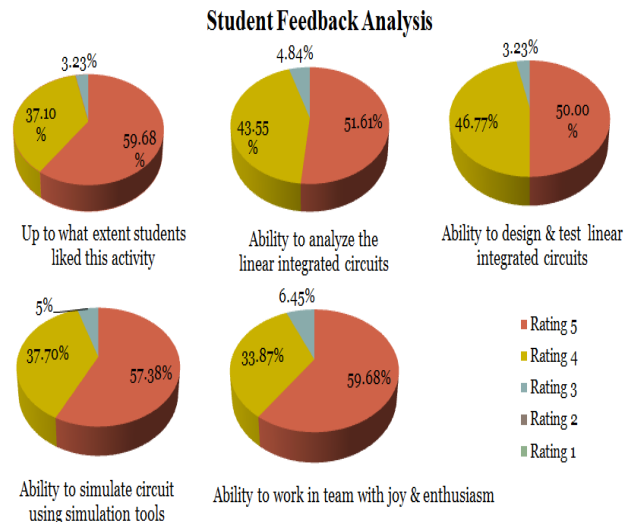


Fig 10. Analysis of feedback

Figures 11 and 12 shows feedback of course and feedback given for PBL by students.

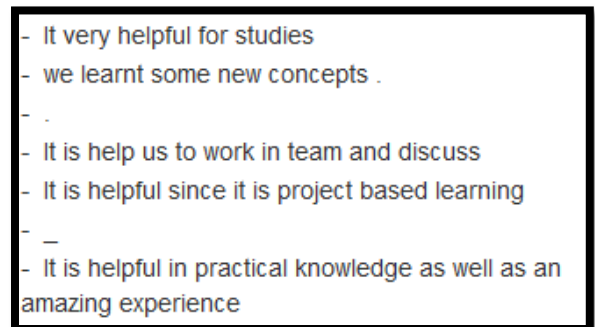


Fig 11. Analysis of feedback

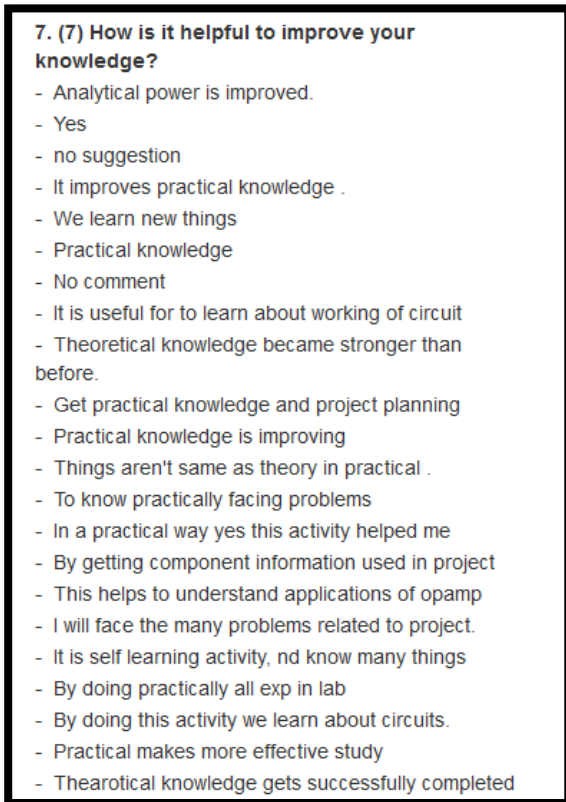


Fig 12. Analysis of feedback

Figure 13 shows the actual presentation of PBL in classroom.



Fig 13. Classroom presentation

Figure 14 shows demonstration of the project.

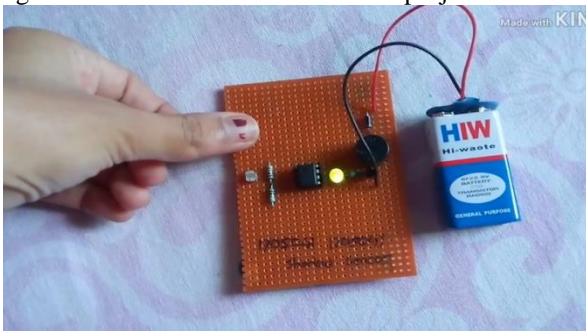


Fig 14. Demonstration of the project

8. Conclusions

PBL active learning technique has been implemented. After implementation it is observed through feedback and interactive communication that students have improved in terms of knowledge, problem solving skills, interpersonal skills, self-directed learning and motivation to work in team. This is experiential learning techniques where students are learning through experience. Students enjoyed learning by doing. They have learnt to apply theoretical knowledge to solve practical real life problems. The performance in ISE has been improved.

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