

# An Interdisciplinary Project Based Learning, a case study

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**Abstract:** Outcome based learning is widely being practiced in India since it has become signatory of the Washington accord since June 2013. This has promoted different pedagogic approaches of teaching –learning especially in engineering education. Project based learning is one of them. Engineering students require the opportunity to apply their knowledge to design solutions through project-based learning rather than conventional theoretical rote learning methods that do not provide a real outcome for evaluation. This paper presents the outcome of the Project based learning activity carried out with interdisciplinary engineering students. Students groups were formed and they were given tasks to solve real life problems by preparing small working models that are based on curriculum and are possible to realize using components and tools available in laboratories.

**Keywords:** outcome based education, engineering projects, engineering education, project based learning.

## 1. Introduction

Nowadays, PBL is an abbreviation for both Problem-Based Learning and Project-Based Learning. Historically, the term PBL as Problem-Based Learning was coined at the end of the sixties at McMasters University in Canada and many institutions have used this label to identify (parts of) their curriculum (Savin-Baden, 2000; Boud, 1991; Bouhuijs et al., 1993; Evensen and Hmelo, 2000; Dutch et al., 2001). (Xiangyun Du et al. (eds.), 2009) Today, PBL also covers the project-based practice that derives from the project-organized and problem-oriented practices. Evidently these practices differ and the question arises as to how we should define PBL. Should we refer to specific practices or rather to common learning principles? What are the advantages of a narrow definition versus a more general definition? In a sense, it is surprising that the relatively new educational concept of PBL has been developed within higher education. Usually, higher education and especially universities of technology adhere to very traditional approaches to learning and curriculum development. The ruling conviction is that research qualifications include the ability to teach students. However, the new innovative universities and institutes exhibit a clear trend to try out new educational models and PBL is one of them.

In project-based learning, students work in groups to solve challenging problems that are open-ended, curriculum-based, and often interdisciplinary. Firstly, students decide how to approach a problem and look

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for a solution based on their prior knowledge. They gather information from a variety of sources and synthesise, analyze, and derive knowledge from it.

In comparison with the traditional method, PBL is good in motivating students, as they understand the need of learning. As the Chinese proverb says (Kjersdam and Enemark, 1994), “tell me and I will forget, show me and I will remember, involve me and I will understand, step back and I will act”, The knowledge gained and skills acquired through such personal experience will be easily recalled later for solving new problems.

## 2. Project Based Learning

Project Based Learning is perceived to be a student centered approach to learning. It is predominantly task oriented and the project is often set by the facilitator. The students need to produce a solution to solve the problem and are then required to produce an outcome in the form of a report. Teaching is considered as an input directing the learning process. The problem is open ended and the focus is on the application and assimilation of previously acquired knowledge. In a project the production of an end product is the focus of the students.

In many cases, the acronym PBL is also used for Project Based Learning, sometimes to emphasize a word, project that “provides a longer term, and multi-faceted problem to allow an exploration of the breadth and depth of the stimulus material” (Jorgensen and Howard, 2000)

In general it is an approach that closely reflects the professional behavior of the engineering discipline. Engineering students require the opportunity to apply their knowledge to solve the design solutions through project-based learning rather than problem solving activities that do not provide a real outcome for evaluation. The dependence on a theory based science model does not prepare students for the 'practice of engineering' is one of the greatest criticisms of traditional engineering pedagogy (De Vere, I., 2009) Self-directed study is a big part of a student's responsibility. Engineering students need an opportunity to apply their science to resolve design solutions. These can be attained through project based learning modules. After the student have engaged in self-directed study, they must collaborate with peers and teachers in a problem resolution stage (Hung., J.D., Liu.R., 2008), Projects will have varying

complexity, but all will relate in some way to the fundamental theories and techniques of an engineering discipline. Small projects may only involve one area of engineering specialization, but larger projects will be multidisciplinary not only involving engineers from different specializations but other professional and non-professional personnel and teams. Successful completion of projects in practice requires the integration of all areas of an engineer's undergraduate training (Julie E. Mills, D.F.T., 2003)

Principles of project based learning in common are as follows: (Siva Chandrasekaran et al, 2012)

1. Student's work together in groups and collaborate on project activities.
2. A real world problem that affects the life of the student's is presented for investigation.
3. Student's discuss findings and consult the teacher for guidance, input, and feedback.
4. The maturity level of student's skills determines the degree of guidance provided by the teacher.
5. Final products resulting from project-based learning can be shared with the community-at-large, thus fostering ownership and responsible citizenship in addressing real world problems.

## 3. Description of the case study

A case study has been undertaken here at SGI to observe and evaluate the outcomes of the Project based learning. It was decided to include interdisciplinary student's from mechanical engineering and Electronics & Telecommunication engineering for a Project based learning activity. The technical aptitude test involving basic questions was conducted for the said streams of engineering. The first test (pre-test) was conducted online using Moodle platform where questions order can be randomized, Questions can be drawn from a category or subcategory. Time is kept properly, answers are automatically graded and appears in the grade book automatically. The test included total 40 objective questions. 20 from Mechanical engineering and 20 from Electronics and Telecommunication engineering. Then top 20 students of each stream were shortlisted to participate in the activity. This was done to include the students with reasonable basic knowledge of the two streams as the target projects were interdisciplinary.

#### 4. Results and Observations

The result of the test for shortlisting before project allotment is shown in the following Pi chart.

Then the actual activity was started. A mini project competition was organized at Institute level. The students form Mechanical and Electronics and Telecommunication engineering were mixed and allowed to form a groups of students. Each group was containing some students form Mechanical and some students from E&Tc department. Total eight groups were formed.

An interdisciplinary Mechatronics subject was chosen for the task. Each group was allowed for discussion and told to bring new ideas for Mechatronics Project.

Students had brainstorming session with the both department teachers.

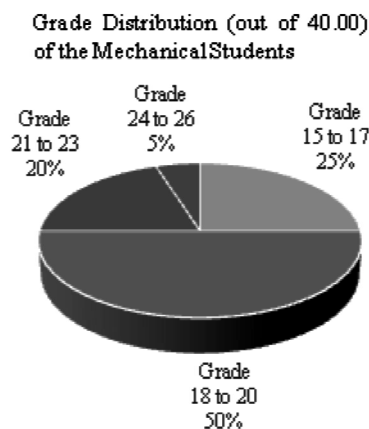


Fig. 1. Mechanical Students Shortlisted

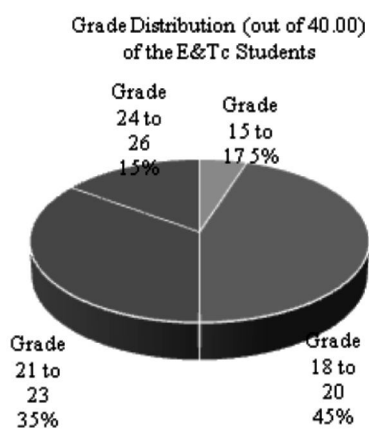


Fig. 2. E&Tc Students Shortlisted

Each group had with some fantastic idea. Ten projects titles were finalized. All the projects were using mixed ideas about mechanical as well as electronics. A time of two weeks was provided for the students and proper guidance was given.

The projects themes for the Project Based Learning activity/mini project competition were as follows:

1. Electronically Controlled Hydrophone.
2. Automatic Board Cleaner/Duster.
3. Tidal-Power Generator Prototype.
4. Automatic Room Light Control.
5. Wheel Chair Motion Using Head Motion.
6. Agriculture Multipurpose Spraying System.
7. Work Piece Counting Machine.
8. Magnetic Chip Collector.

During this period of actual building of the projects, students had to refer many resources which resulted in gaining of the knowledge of the both, mechanical and E&Tc streams.

Each project group is supervised by faculty members and were self-selected groups. "The teacher has the responsibility of guiding students to complete the project work in time, and in defensible way according to Methodological and scientific requirements" (Kjersdam and Enemark, 1994)

Teachers must adopt a new role as coach/facilitator, and sometimes this can be difficult (Woods, 1996). They must avoid being the only reference for the students, the expert always available. In a way, the best teacher could be a non-expert in the subject although it is necessary someone to keep the right technical level.

The second test (post-test) was conducted online using Moodle platform to find out the actual outcome of the PBL. The second test was also had same difficulty level as that of first test. Again the same group of the students were asked to appear for the test. This test was of same syllabus but questions were different. The knowledge gained during the project phase could be checked by using this test. The results of the task are shown here.

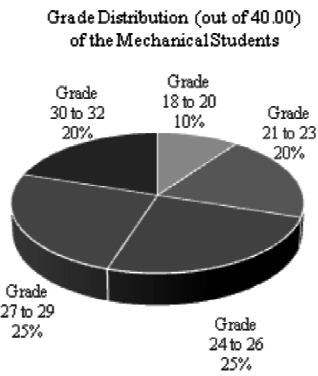


Fig. 3. Mechanical Students Result after Project

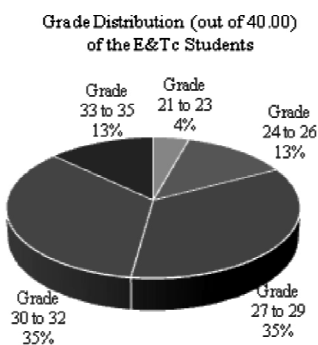


Fig. 4. E&Tc Students Result after Project

If we compare the both results we can see that there is lot of improvement in the results of the both streams. Number of students who were in the range of grades 15 to 17 were shifted to higher level.

Mechanical students gained knowledge of E&Tc terms and vice versa.

Following graphs are showing the result in comparison between results before and after of the project.

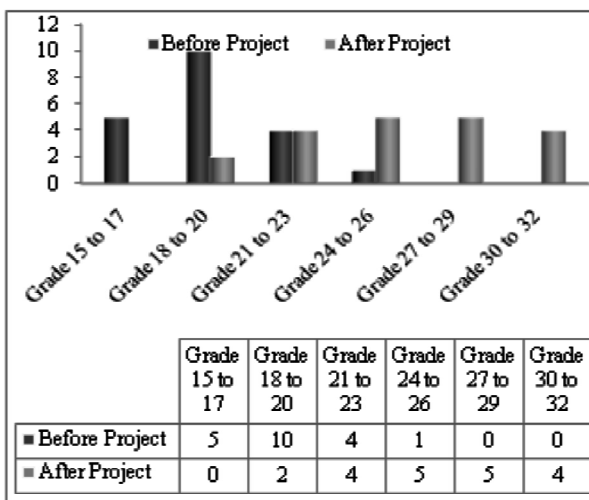


Fig. 5. Mechanical Students Result after Project

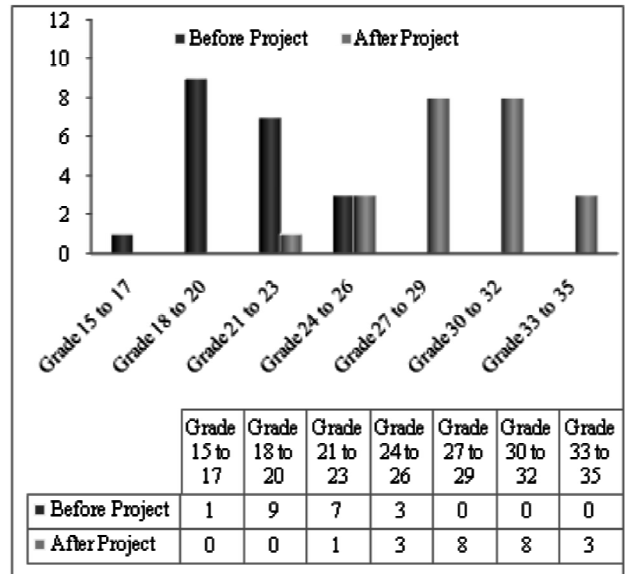


Fig. 6. E&Tc Students Result after Project

It was observed that in case of mechanical engineering students the average grade marks before the project activity were 19 marks. This result was improved to average grade marks of 26.

Same improvement can be observed in case of E&Tc students. The result was shifted from average grade marks 20 to improved average grade marks 30. This result is shown in the graph below.

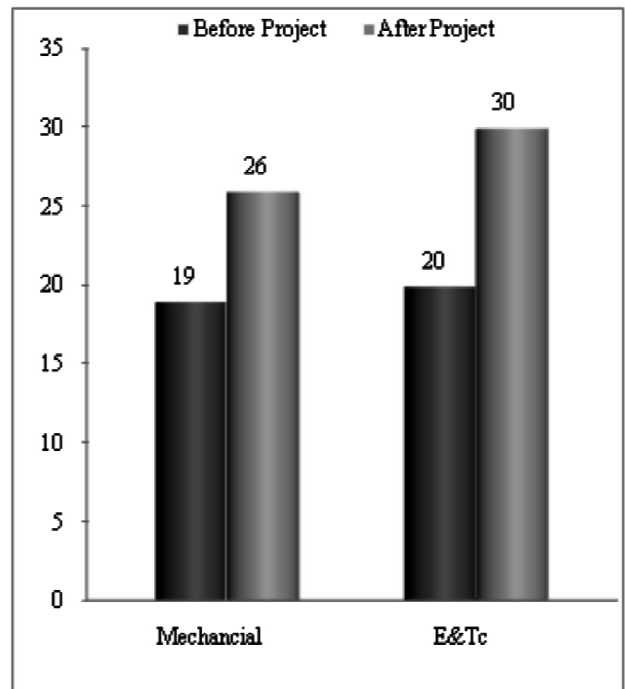


Fig. 7. Average improvement in the result.

## 5. Conclusion.

The study carried out with the third year engineering students presented over here shows that there is a distinct improvement in the knowledge of the student especially in interdisciplinary subjects. The project was focused on student learning by their own, where they got chance to develop skills such as critical thinking, problem solving, and self-management. During project work students were engaged in an extended process of asking questions, finding resources, and applying information. Students got guidance of the teachers which results in increase of the effectiveness of project activities, the quality of student work, obstacles and how to overcome them. After completing a project, students understood interdisciplinary content more deeply. Students can remember what they learn and retain it longer than is often the case with traditional instruction. We can conclude that, students who gained subject knowledge with project based learning are better able to apply what they know and can do to new situations. If we count the other outcomes, now students make their project work public by presenting it to people beyond the classroom, which results in the increased skill of presentation. Finally we can conclude that with this project based learning activity students were familiar with and enjoy using a variety of technical tools. Teachers and students can not only find resources, information, and creativity but also collaborate more effectively and connect with outside world more effectively. In the project, students learned how to take responsibility, build their confidence to solve problems, work in teams, communicate ideas, and manage themselves more effectively.

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