

# Project Based Learning in Engineering Education

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***Abstract—*** Project based learning (PBL) is a learner focused educational approach. In engineering, generally traditional teaching methods are used. This results in fresh graduates who lack practical and people skills. Nowadays engineering field is looking upon BPL to fill gap required by the industry from fresh graduates. In this paper we are focusing on integration of traditional teaching methods and PBL. An example of the same at Netaji Subhas Institute of Technology (NSIT), Delhi is also studied.

***Keywords—***Learning; Teaching; style;

## I. INTRODUCTION

The Engineering colleges impart knowledge on various engineering areas to the students. The lack of imparting hands-on field experience in engineering streams creates serious employability problems for the graduates and the industry. In other words, the graduates who come out of the colleges are not well prepared to take up jobs immediately on completion of the course. They don't have any experience and exposure to the industry world. These needs can be fulfilled through Industry Oriented Mini/major Projects.

Usually in universities for higher education traditional teaching methods (chalk and talk) are used and courses are restricted to learning and curriculum development. Too much focus is on engineering science and technical courses which are more content driven. The lack of imparting hands-on field experience in engineering

streams creates serious employability problems for the graduates and the industry. In other words, the graduates who come out of the colleges are not well prepared to take up jobs immediately on completion of the course. Some of the major difficulties fresh engineering students face are mentioned as follows:

1. Students are not able to integrate the various courses taught or relate them to industry.
2. Conventional teaching methods donot provide design experience to students.
3. Fresh graduates lack communication skill and team work experience
4. Students are not much aware of legal, economical and social issues.
5. Fresh engineering graduates are not able to relate theory with practical experience.

The solution generally proposed to overcome most of these issues involves a fundamental redesign of the curriculum in engineering programs. A program that utilizes a hybrid mode in which traditional teaching methods are used in early years of graduating to lay the foundation followed by a culminating year where the learned knowledge can be extended to a yearlong authentic problem may be optimal solution. Project based learning (PBL) was successfully used for professional training in medicine since 1960's and is nowadays suggested as solution to the above mentioned problems in engineering education. In this paper we are proposing integration of traditional teaching methods and project based learning in engineering education.

The paper is organized as follows: section 2 gives a brief overview of project based learning; section 3 explains different types of projects. Section 4 discusses project based learning applied to engineering education and Section 5 gives Proposed Teaching Technique in Engineering Education. Section 6 lists some projects done in NSIT. Section 7 and 8 give conclusion and references respectively.

## II. PROJECT BASED LEARNING

Project Based Learning (PBL) is a learner focused educational approach where the student extends previous knowledge to new problems through self-directed reflection, research and practice in solving a problem. PBL is defined as ‘integration of knowing and doing’ by Markhem (2011).[1]

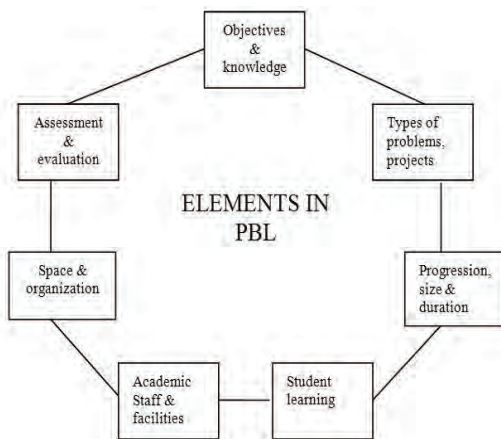


Figure 1: BPL alignment of elements in curriculum.

Figure 1 shows the basic elements in PBL which are classified as objectives and knowledge, problems and projects, progression and size, students’ learning, academic staff and facilitation, space and organization and, finally, assessment and evaluation. Change in one element will affect other elements also. [2]

Table I: COMPARATIVE ANALYSIS OF TRADITIONAL Vs PBL TEACHING APPROACH.

Curriculum element	Traditional teacher based approach	Innovative & PBL centered approach
Objectives and knowledge	Objects at disciplinary knowledge	Objects at interdisciplinary knowledge
Types of problems, projects	Narrow, Disciplined projects, study projects, Lectures determine project	Open, problem projects, innovation projects, lectures to support project
Progression, size & duration	No visible progression, minor part of curriculum	Visible & clear progression, major part of curriculum
Student learning	No supporting courses, acquisition of knowledge, collaboration for individual learning	Supporting courses, construction of knowledge, collaboration of innovation
Academic Staff & facilities	No training, Teacher controlled supervision	Training courses, process guide
Space & organization	Administration from traditional lecture based curriculum, traditional library, lecture rooms	Administration supports PBL curriculum, Library, physical space for team work
Assessment & evaluation	Individual assessment, summative course evaluation	Group assessment, Formative evaluation

Table 1 shows the two extremes – traditional teacher controlled approach and learner centered approach. The idea presented in this paper is not to implement PBL completely, but a lot can be done integrating the two approaches.

### III. TYPES OF PROJECTS

#### A. University Projects

In this type of projects students generally make a written report in form of dissertation by acquiring facts from library / internet or data empirically. Doing this, students learn team work, problem solving and hands on design techniques. Topics generally deal with real world problems.

#### B. Industry Projects

Industry projects are project-based activities in partnership with an industry organization

Students work mostly independently on their selected topics in partnership with an industry organization. Students work under supervision of industrial client and university academic supervisor.

#### C. Community projects

Students work with other students from different departments and universities to develop meaningful projects. The key emphasis in community project learning is that of shared benefit and interchange for the student, the University, and the community agency or enterprise. It helps students in developing networks for career development and a broader understanding of social and cultural needs of community.[3]

### IV. PBL IN ENGINEERING EDUCATION

PBL is being implemented to various individual courses or a series of courses in traditional engineering program more due to interest of faculty who teaches them. But, for full scale implementation of PBL in engineering it requires interest, co-operation and integration of faculties from engineering, mathematics, science and business/ management departments of the institute.

Professional problem-solving skills in engineering require the ability to [4] reach a solution using data that is usually incomplete and satisfy demands from clients, government at least possible cost. In engineering projects are usually combined with traditional teaching in which students focus

on application of theoretical knowledge and integration of various courses. Projects may be carried out by an individual student or a group of students under supervision of a teacher/ teachers. Time period of projects may vary from few weeks to an academic year.

1. PBL are central and not peripherals to curriculum.
2. PBL are focused on questions or problems that derive students to encounter with basic concepts of a course.
3. PBL are to some extent more students driven.
4. PBL are more realistic.

### V. PROPOSED TEACHING TECHNIQUE

We propose a teaching technique that combines advantages of traditional teaching methods and innovation based teaching methods. It is suggested that teacher controlled study method (chalk and talk) is to be followed in first three semesters of the eight semester graduation program. This will help students in strengthening their fundamentals in basic subjects like applied sciences. Third semester onwards students are introduced to core subjects in the present curriculum. Then onwards students should start working on mini projects under guidance of their teachers. From fifth semester students should aim at complete industrial projects which require inter disciplinary knowledge. This will help students in interlinking various core subjects taught to them. In the last year of engineering it should be made mandatory for students to do some industry/ community project. These projects can be carried out in institute laboratories or in research centers. Students can avail sponsorship for their projects from industry or technical bodies like IEEE, IEE etc. Good projects can also add to the income of the institute.

## VI. PROJECTS AT NSIT

Many universities report in literature its use of PBL in individual courses but only a handful integrates PBL throughout its program. At NSIT, we try to follow the integrated system of classroom study and PBL in a following way:

The project evaluation is carried out in three stages. Students are expected to make one presentation at the end of the sixth semester, which is worth one credit, and two presentations in the seventh semester, worth one credit each. At the end of seventh semester, they have to submit a short report on the progress of their work and their future plan for work to be carried out during the last semester. Two presentations are held in the last semester, worth five credits. At the end of the eighth semester, each group is assessed on their original contributions and report writing. Each student is asked to describe his or her own contribution toward the project. The assessment of the group work is conducted through PowerPoint presentations where each student has to speak about the work he or she did throughout the year. A team of six to seven examiners and an external examiner evaluate the projects. Each member of the committee separately fills out an evaluation form. The final grade is a weighted average of all the evaluations. The grading for the evaluations is divided as follows: literature review (10 points), technical report writing (20 points), design and engineering approach/problem analysis (25 points), implementation, simulation and results (25 points), project presentations/ conclusions (20 points). Additional Marks are given to the group in which students have worked with some industry. The project scheme has been modified recently due to problems encountered during earlier student performance evaluations, including:

- 1) Poor report writing by the students;
- 2) Poor presentation skills because there had only been one midterm evaluation;

- 3) Inadequate knowledge of the subject;
- 4) Non-availability of components due to shortage of time;
- 5) Inadequate interaction between the supervisor and project group;
- 6) No interaction between Industry and Institute

Some of the good projects done in Instrumentation and Control Engineering department at NSIT are:

1. Collection of Multi-Environment speech dataset with application in the analysis of speaker identification.
2. Biometrics based applications.
3. Design of intelligent controller for blood glucose system for type 1 diabetes patient.
4. Natural language processing using web technologies.
5. Speaker recognition using student –T mixture model.
6. Facial expression recognition using Gabor features and support vector machine.
7. Modeling and control of twin rotor MIMO system.
8. Optimal control of coupled motors using PAM signals in the presence of stochastic noise.

Most of these are hardware –software co-design and some of these are done in conjunction with Industry people at different stages.

## VII. CONCLUSION

A program that utilizes a hybrid mode where the early part of the program is taught in a traditional setting to lay the foundation followed by a culminating year where the learned knowledge can be extended to a yearlong authentic problem may be optimal. Students should be encouraged by the faculty to do mini projects of elementary courses in the primitive years. Later these students depending upon their

area of interest should be sent to industries for some time so that they learn about the work and culture of the Industry and bring some work from it . This will result into gaining a good experience, gaining hands on experience and also bringing some resource generation to the Institute.

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