

# AN OVERVIEW OF PROBLEM BASED LEARNING IN ENGINEERING EDUCATION

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*Abstract –In India, every year a huge number of engineering graduates are being produced who basically have good theoretical knowledge of the subject but lacks the appropriate practical and problem solving skills which hinders in getting a good job. Engineering education in India as in past is still imparted through chalk and talk method which lays least emphasis in developing essential skills in the students. Problem based learning (PBL) method is very effectively used in the field of Medical sciences for more than four decades. To see the need and effectiveness of Problem based learning in the field of engineering a systematic review was conducted. The critical examination of the review studies revealed that Problem based learning is an productive method in the field of engineering which not only enhances the performance of students but also improves problem solving. It also develops creative thinking which helps in problem solving and further motivates the students in the process of learning which leads to long term retention of the content which is learned through collaboration.*

*Index Terms—Problem Based Learning, Engineering, Education, Problem solving skills, Review.*

## I. INTRODUCTION

Engineering colleges have mushroomed up rapidly in the last few years in India which has made India, a country producing maximum number of Engineers every year. Unlike education imparted in the field of commerce and arts, engineering education involves training in various practical skills. But the methods and ways of imparting engineering education is not much different as used in other courses. As a result, students though are able to perform theoretically well in the exams but are deficient in skills like problem solving, soft skills, leadership skills etc. which hinders in getting a good job. Moreover, many Engineering colleges lack the expertise required in a college/institute to teach the practical aspects of engineering education as a lot of efforts needs to be put on the part of the teacher to implement such type of methodology. As a result, every year large number of graduates in Engineering in India is jobless or is unable to get job according to the engineering course pursued. Industries and commercial outlets are more interested in hiring an individual who is well versant with the practical aspects and not the theoretical ones.

In the last many years there is a rapid advancement in the field of engineering as well as sciences but very few teaching methods that have been successful used in the field of education for developing student's logical thinking. The quality of engineering education not only depends upon the quality of the teachers but also on the methods of teaching used by the teacher in the classroom. Memorizing the content is not enough, we are in dire need of those teaching methods that can help learner to have better retention, enhance creativity, problem solving and soft skills. Improvement in methods of teaching will not only help in improving the effectiveness and quality of engineering education but will also enhance the practical skills. It is a matter of professional concern to apply the gained knowledge. Various concepts used in the field of Engineering and the skills which are essential in the industries and the place of work can be best examined through this problem based learning technique. Problem based learning is an informative model that has a tremendous potential in promoting the element of inquiry in the classrooms along with skills like communication skill, creative thinking skill, self-directed learning skill, problem solving skill not only needed by an individual during course of his study or a job but also needed in day to day life to cope up with real life problems. Though the use of problem based learning in medical sciences is more than 40 years old, its application in Indian educational scenario especially in the field of Engineering is at an early stage and not much research has been done in this area.

## II. PROBLEM BASED LEARNING [PBL]

In the last few decades, various developments has increased the momentum of problem based learning which focuses on producing a learner who is able to remember the theory but also have an understanding of when and how to apply it [1]. This technique certainly helps in bridging the distance between theory and practical work [2]. Problem based learning is a method in which students of certain class discusses real world, ill structured problem in groups. The group may consist of students ranging from 3-4 students each to larger groups having more than ten students. A teacher is just a facilitator who facilitates the learner in learning and does not provide direct instructions to the students as in traditional lecture method. It is a method of learning which is both collaborative and constructive. In PBL, the problem acts as a trigger and motivator for learning and discovery and students experience decides what they will learn rather than the tutor dispensing the syllabic content [3]. It is an effective technique which involves active learning rather than passive for students to learn, retain, integrate and apply information [4]. Thus, problem based learning is a technique which is student centric based on the problem which can be a trigger in the form of a video, story, presentation and has the element of arising curiosity in the students and motivating them to find answer to the problem.

## III. LITERATURE REVIEW

Although the use of Problem based learning has been reported by several researchers, but its actual application in Indian Engineering curriculum is far behind. A systematic review was conducted to find out and explore the effectiveness of problem based learning in the field of engineering education from the available online sources and a brief overview is given in table 1.

**Table 1 Overview of the research studies based on Problem Based Learning in Engineering Education**

Sr. No.	Name of the Researcher	Year	Contribution	Outcome of the study
1.	Laplaca <i>et al.</i>	2001	Study of Problem-based learning in curriculum of biomedical engineering.	PBL is an effective method for material retention, instruction and introduction of topics necessary for professional development.
2.	Awang and Ramly	2008	Study of creative thinking skill approach in the classes of engineering through problem-based learning.	There is enhancement of creative thinking and technical abilities through PBL.
3.	Hsieh & Knight	2008	A comparative study based on evidence on the Problem based learning for engineering students.	There is improvement in learning styles of engineering students with the application of PBL.
4.	Mantri <i>et al.</i>	2008	The study of design of a course of analog electronics and its evaluation through problem based learning.	PBL students performed better in skill test.
5.	Mantri <i>et al.</i>	2008	Study of cognitive and pedagogical issues in relation to designing problems for PBL courses in analogue electronics.	PBL group performed better in knowledge and skill test.
6.	Mantri <i>et al.</i>	2009	Application of PBL in delivering course in Digital Electronics.	Practical skills of students taught by PBL were more as compared to students taught by traditional teaching.
7.	Grolinger	2011	Study how the application of PBL in engineering education is meeting the needs of industry.	PBL prepare students for industry by removing gap between classroom and workplace problems.
8.	Mohamed, Jubadi & Zaki	2011	Study of implementation of project oriented PBL on analog electronics subject of faculty of Electrical and Electronic Engineering.	PBL students were better in using circuit design and simulation software tools. They had better professional and ethical responsibilities and enhanced problem solving skill.
9.	Yadav <i>et al.</i>	2011	Study of influence of PBL on students studying in an Electrical engineering course.	Students taught through PBL had twice the learning gains than the students taught by traditional lecture method in an Electrical engineering Course.
10.	Harun <i>et al.</i>	2012	Study of Motivation in the implementation of problem-based learning.	Facilitator's systematic motivation can encourage deep learning in students and can increase motivation level in students taught by PBL in undergraduate chemical engineering course.
11.	Masek	2012	Study of effects on knowledge acquisition, thinking skills and natural motivation of electrical engineering students through PBL.	PBL enhanced students' knowledge acquisitions and intrinsic motivation.
12.	Masek and Yamin	2012	A Comparison between Problem Based Learning and existing Learning method based on Students Knowledge Acquisition.	PBL helped in improving knowledge acquisition of students in the electrical engineering course as compared to the use of conventional approach using multiple choice questions administered as pre test and post test.

13.	Mokhtar <i>et al.</i>	2013	Study of effect of PBL in developing Motivation and Performance in Learning.	PBL motivate students of engineering in teaching and learning.
14.	El-adaway, Pierrakos & Truax	2014	Study of PBL on sustainable construction education and service learning methods.	PBL makes student to take ownership so that he can complete complex activities and hence increases the performance of students.
15.	Johnson & Hayes	2016	A comparative study of problem based and instructional learning methods with respect to an electronics engineering course.	PBL offers significant advantages in an electronic engineering setting as compared to traditional didactic method.
16.	Patil	2016	A case study of comparison between Problem Based Learning and existing Lecture Delivery system.	PBL students scored better than the students taught through lecture method.
17.	Sada <i>et al.</i>	2016	Study of use of Problem-Based Learning in improving thinking skills of Students of technical colleges in Nigeria.	PBL leads to improvement in the Critical thinking skills of students of technical institutes.

PBL is an effective vehicle for material retention, instruction and introduction of topics necessary for professional development in biomedical engineering curricula [5]. Significant difference on the basis of knowledge gain of the PBL group and the students taught through lecture method in internal written theory papers and end-of-semester exams was found and PBL group students were performing better in both knowledge and skill test in the subject of analog electronics [6,7, 21]. Practical skills of students learning through PBL were better as compared to students taught by traditional teaching method in Digital Electronics [8]. Students taught through PBL had twice the learning gains than the students taught by traditional lecture method in an Electrical Engineering Course [9]. Facilitator's systematic motivation can encourage deep learning in students and can increase motivation level in students taught by PBL in undergraduate chemical engineering course [10]. PBL acts as motivator in teaching and learning for engineering students [11]. PBL offers significant benefits in an electronic engineering setting as compared to traditional dictation method [12]. Students of first year Analog Electronics course taught through project oriented problem based learning were better in using circuit design and simulation software tools, enhanced problem solving skills, professional and ethical responsibilities along with presentation skills and improvement in technical report generation [13]. PBL enhances student's knowledge acquisitions and intrinsic motivation in electrical engineering [14, 15]. The responsibility of the teacher was moved to a facilitator from a "content delivery- man" in PBL. The students of PBL and traditional teaching was compared using a 100 marks knowledge test based on Embedded System Design, and students taught by PBL depicted higher mean scores [16]. PBL builds up critical a thinking skill that is why it is applied to all areas of learning of student's life [17]. PBL leads to improved learning of engineering students [18]. The combination of skills of creativity and technical knowhow developed using PBL for learning Mechanics of structure will help students in industries [19]. PBL makes student industry ready by reducing the gap of classroom and workplace problems [20].

## CONCLUSIONS

On examining the review of studies related to need of problem based learning in the field of engineering education, it can be concluded that PBL has great impact on the performance of students along with enhancement of problem solving, high order thinking skills, logical reasoning, creative thinking, motivation, soft skills, cognitive and practical skills which is required by an individual in day to day life and at the work place. Thus, Problem-based learning (PBL) is generally regarded as an advanced and productive method for engineering education. Although majority of studies has favored application of PBL in Engineering education but few studies have also revealed that negative and no effect on students. This could possibly be due to the fact that PBL is a time consuming method and requires an effective subject expert for designing the problem accordingly which can effectively trigger the curiosity amongst the students. In problem based learning a learner is responsible for his own learning which self directed, collaborative and constructive with problems which are practical and ill structured in nature and associated with real world.

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