Development of ecosystem and learning spaces in effective implementation of PBL in Vishwaniketan Campus

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Abstract: Vishwaniketan iMEET is an engineering institute where Project Based Learning philosophy has been accepted and different PBL models are designed for various learning objectives. Institute has developed its unique framework for supporting PBL practice, which is named as PBL Ecosystem. This paper shortly describes each PBL practice followed at the institute with more emphasis on describing the "Frame work of a PBL Eco-System" developed for effective implementation of the Project Based Learning approach. This Eco-system is in place since the last one year and an institute's management was interested to know the effectiveness of this PBL-Eco system to influence student's learning. Thus, this paper also discuss in brief outcome of survey conducted to check effectiveness of Eco-system for one of the important PBL practice Value Addition PBL (VAPBL). Faculty experience and student's survey outcomes suggested that for effective implementation of the VAPBL, PBL-ecosystem has played crucial role. Result suggested that continuous support and collaboration with industry trainers helped to students for successful implementation of technology for which ecosystem supports. The survey also suggested that there is a need of improvement in lab infrastructure and faculty supervision..

Keywords: Project Base Learning (PBL), Eco-system, Value Addition Project Based Learning (VAPBL), Industry Project Based Learning (IPBL), International Project-Based Research Internship (IPBRI)

1. Introduction

Engineering education is a field of learning through hands in training and implementation of gained knowledge in actual practice. Professional courses run in engineering education, require technical skill competence as well as to pursue human values. To enhance technical skills and to nurture the values of social responsibilities, new approach in learning and teaching is very essential. To satisfy the complex demands of industry and society which are interlinked, education system need to be transformed. As a result there has been growing demand in recent years to introduce Project Based Learning.

The PBL originally started in the field of medical education and was originally introduced in the medical school at Mcmaster University in Canada in the late 1960s [1]. It is now essential and common curriculum component in medical and health science schools around the world consistently. Very similar to medical as a professional course, engineering is also refereed to be a professional course. Due to technological advancements and certain weak political decisions in terms of policies, engineering graduates always deals with uncertainty in Indian scenario. Professional skills demanded in industry and actual engineering graduates coming out from different institutes find very difficult to cope up with the situation. Despite these challenges, engineering education system in India remains same as that practiced in 1950's as "Chalk and Talk" with large classes and single discipline, lecture based delivery the norm particularly in early graduation years of study[2].

The PBL is a learning process towards the understanding the solution of a problem and the problem is the first encounter in the process [3]. PBL is an educational approach whereby the problem is the starting point of the learning process. It is crucial that the problem serves as the basis for the learning process. Hence Problem Based Learning has been reported by several authors although it is not fully implemented in all courses. Don Woods in chemical engineering program at McMaster University, adopted Problem Based Learning approach for certain applications[4][5]. At Monash University, Australia, Problem Based Learning has been introduced to several courses of Civil engineering through initiative of Roger Handcraft [6]. But engineering profession and academics are more familiar with the concepts of Projects in their practice than concepts of Problem Based Learning. It therefore seems that Project Based Learning (PBL) is likely to be more suitable in engineering education [7]. Annette Kolmos a faculty member at Aalborg university argues that the "idea of problem based learning and project work support each other and emphasize different aspect of learning. In the contrast to traditional lecturing method, the Problem Based Learning encourages the students search for information literacy skills and thereby increase the use of library [8].

Although, PBL has been widely accepted approach and different PBL practices have been followed; we believe that there is a need to put together a complete system which can sustain its implementation. Thus, an objective of this paper is to discuss on the "framework of PBL ecosystem" developed for effective implementation of PBL for engineering students in Vishwaniketan, India. This Ecosystem is in place since the last one year and an institute's management was interested to know the effectiveness of this PBL-Eco system to influence student's learning. Thus, this paper also discuss in brief outcome of survey conducted to check effectiveness of Eco-system for one of the important PBL practice Value Addition PBL (VAPBL).This paper is organised as follows. Section II discuss about the theoretical Framework of PBL ecosystem.

In Section III actual methodology that required to support the framework is described. Section IV contain the results and discussion.

2. Theoretical Framework:

2.1 Different PBL Approaches:

Vishwaniketan institute has organised many PBL workshops in the recent past. So, faculty has been trained on PBL principles, philosophy and practice. Through this workshops and deliberation, its faculty has developed different PBL models. All PBL models uses following PBL principles (Kolmos et al 2004); Cognitive principle which state that problem is driver for the learning process and students are expected to solve it during entire semester. Content principle depicts exemplary practice adapted to achieve learning objectives and puts problem in the contextualised setting. Social principle puts an emphasis on learning in team setting where cooperative and collaborative learning is principles used for learning. These principles are effectively used to develop four models listed below.

A. Value Addition PBL (VAPBL):

In VAPBL model a training is given a students to a 6070 hours on a future technology which is not included in curriculum and the trainer is a person from an industry. After training students are divided into groups and topic for a project is given throughout the semester. After completion of that project is exhibited by the industry person.

B. Course level PBL (CLPBL):

This model is implemented in our institute in the Second Year and the Third Year students. Every semester one subject and a staff members were involved in PBL practice. Faculty allocate projects to the students project topics were selected in such a way that course content also learned with real life problems solutions which is need of engineering education.

C. Industrial PBL (IPBL):

Depending upon the student's interest some of the groups are allotted the real industrial problems and this model provides industrial problem solving experience to students.

D. International Project-Based Research Internship (IPBRI):

Every year the students are send to the foreign universities which has been collaborated with our institute. Due to which the students gets an opportunity to explore the foreign universities courses and also gets to learn innovative things. The aim of this model is to help students to get exposure in international universities. We believe only modal design will not make PBL effective so, we need to develop PBL eco-system. Different components of PBL Ecosystem are discussed in following section in detail.

2.2 PBL Eco-system Components:

The different components involved in PBL Eco-system can be represented as given in following figure 1.

Fig. 1: PBL Eco-System Components

In this section, each component of this system discussed in the brief.

1. Management Vision/ Institute Vision:

Our management vision is to employ Project based Learning approach (PBL) and life skill activities to transform students into design Engineers, industry ready professionals and entrepreneurs for a successful career based on strong moral and ethical foundation. Without their support it is rather impossible for any institute to practice PBL. To our experience, we found that institute management including principal and Vice-president are supportive for PBL practice.

2. Quality of Undergraduates:

Student Admitted for engineering courses in the institute are mix of higher percentage to lower percentages. To succeed in PBL environment, considerable time has to be invested to promote and motivate students for PBL activities. This is usually done by PBL core committee which motivates students for doing projects. Regular counselling sessions are conducted to inform incentive of PBL to the students. As a result, PBL practice is been rooted deeply into institute culture.

3. Quality of VAP Training:

As selection of recent technology that helps the students, to narrower the gap between industry and academics selection of VAP Training along with Trainer is very crucial in the PBL. While helping students for the projects he is expected to guide students with several reviews taken during semester. For VAPBL training is arranged from the industry people who have expertise in that technology. Content of training is scheduled as per requirement of updated knowledge in that field. In general, it is understood that quality of the trainers and teachers involvement will have impact on the outcomes of the model.

4. Infrastructure Facilities:

Library: As compared to traditional lecturing method the PBL model encourage the students to search information in research papers, books, e-content, thereby increase the use of library. As per requirement of problem statement they have to search particular information so the library is a very effective resource. So we designed a network in such a way that student can access the library around the globe. Apart from remote access, all reference books, hands books, ebooks, project black diaries are made available in the library for reference.

Laboratory: PBL model demands for well-equipped laboratories to get acquainted with various technological

advancement in current technologies. In Vishwaniketan every department has well equipped labs to support regular academic activities. Some of students select interdisciplinary projects, for them, other department labs are made available for the use as per their project requirement.

Class-rooms: Systematic arrangement of benches in class room also help students to work in team and improve their professional and ethical skills. In Vishwaniketan arrangement of Class room in steps really help them to develop inter personal skills.

5. Systematic Time Approach:

To build bonding between student and mentor for their project, teacher should have more contact hours with student groups. So, time table is customised by providing two hours in which student and staff will work for the project. Activity hours is also provided for project reviews, group discussion and presentation.

6. Finance:

To fulfil the vision, management always supports to the students in form of sponsoring projects as well as for encouragement of students prizes are given to the winner of the Innovative projects. We believe that prizes at right platform motivate students towards PBL practice. Every year institute keep budget for the projects.

7. Learning Elbows:

Along with the infrastructure facilities another approach of learning elbows is essential component of PBL. It contain PBL Huts and Self Learning Session (SLS) type rooms.

PBL Huts: To support PBL approach PBL huts help students to discuss project related stuffs with open and healthy atmosphere. In Vishwaniketan PBL huts are built in garden areas where students with different streams can discuss on project related issues.

SLS Rooms: Specially designed SLS rooms where students can work together with systematic planning and completed tasks and tasks coming ahead on the walls of room really help them to complete the targets within stipulated time periods.

8. Industrial Exposure:

Some of students select interdisciplinary projects, for them, other department labs are made available for the use as per their project requirement. Along with conventional labs, there are four industrial labs which support the PBL activities in Vishwaniketan.

Table 1 Components of PBL eco-system and their influence on success of PBL

Model	Vision of Institute	Quality of Undergraduates	Quality of Training	Infrastructure Facilities	Systematic Time Approach	Finance	Learning Elbows	Industrial Exposure
	1	2	3	4	5	6	7	8
CLPBL	High	Medium	High	Medium	Low	Medium	Low	Low
VAPBL	High	Medium	High	High	Med.	High	Low	Medium
IPBL	High	High	Medium	High	High	Low	Not Required	High
IPBRI	High	High	High	High	High	High	Not Required	High

3. Methodology

The goal of any PBL model to implement successfully is, to develop PBL eco-system framework and proper specific implementation method to adopt. Following flow chart steps give the glimpse of any PBL practice to embrace.

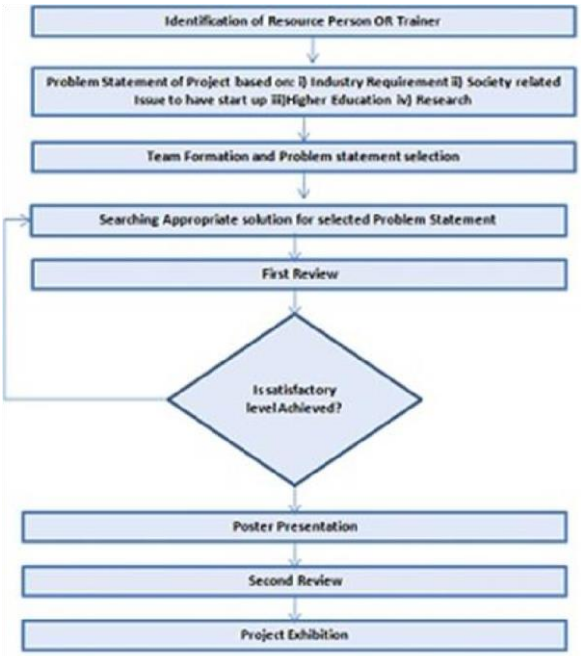

Fig. 2 Flow Chart of adopting PBL Model with Predefined Framework

In Vishwaniketan, implementation of VAPBL follows the above methodology. To support all specified steps suggested in above chart require the all framework components to act together. Identification of technology and to train the undergraduates on selected technology, selection of trainer is very vital. To manage the gap between actual industry requirement and academics along with the vision of management or Institute, value added training plays a very crucial role. Before to start with actual training problem statements refereed to different mindsets of undergraduates, trainer should manifest. Selection of problem statement in terms of mindset of student and his carrier proves to be significant. Any student adopting for engineering education have following primary objectives

i) Good placement after graduation ii) Any innovative idea to resolve issue of society in terms of small start-up iii) Higher education after completing graduation and iv) Enter in research field to have his or her own patent. In initial phase of learning, student should be properly guided hence eco-system should contain this as major component. Financial condition of student to work on industry related problem also matters a lot. Any sponsoring mechanism really inspire student to accept the challenge. Intellectual level of student to work in team and successful completion of project is also critical.

Once the title of project got selected, working in team and to search for the solution of selected problem statement, the infrastructure facilities like library, e-library, research articles, literature required etc is very much necessary. While acquiring the knowledge of newer technology getting failure is obvious but taking continue review and helping them to complete the tasks within specified time frame decides the triumph of PBL. Activities like poster presentation, power point presentation, and participation in technical competitions really help every individual to extend their technical skills, communication skills and moral values.

While participating in all other activities beyond the class room walls facilities like PBL huts, Self Learning Classrooms really boost the confidence level of every individual.

To work on real time project, traditional laboratories will really face the limitation but industry sponsored laboratories help students to achieve their objective. Project Exhibition participation proves to be added feather to PBL approach since various industry expert with their valuable suggestions may offer them good opportunity based on selected technology.

The student's survey was conducted to check the effectiveness of the ecosystem which has been developed for the students. How the students take the advantage of this and how it supports the PBL activities was the purpose. The pilot survey has been conducted with the students. Questions are prepared by considering VAPBL and all aspects of ecosystem. For pilot purpose, 30 students from Mechanical Engineering branch, 36 students from Electrical branch, 40 students from Civil Engineering branch and 17 students from Electronics and

Telecommunication branch, who have done

VAPBL are selected. The questions are framed and divided into two parts 1) resources related questions 2) Infrastructures facilities related questions.

The questions were designed to access commonly known as attributes for resources person and learning facilities available and the rating are given by students on the scale of 'a' to 'd' where 'a' is strongly agree and d is disagree.

4. Results And Discussion

As stated above, review of students from different streams of engineering in Vishwaniketan is taken. Graphical representation of Electrical Engineering branch shown in figure 3, Civil Engineering branch shown in figure 4, Mechanical Engineering branch shown in figure 5 and Electronics and Telecommunication Engineering branch shown in figure 6 reflects that for to implement Project Based Learning model effectively in engineering education continuous monitoring of different components of PBL Eco-system is essential.

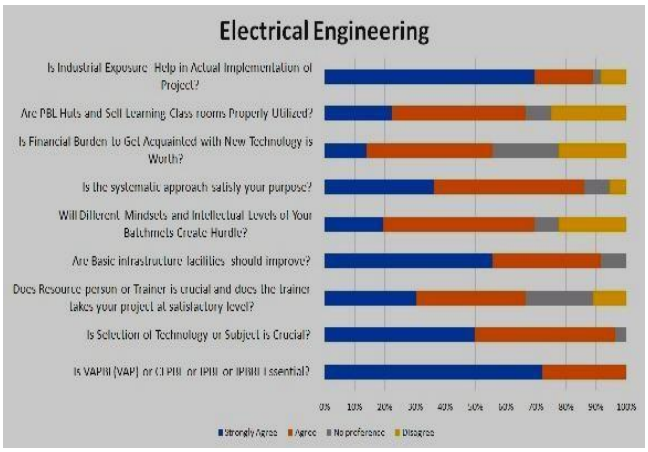

Fig. 3: Electrical Engineering Branch Students Review

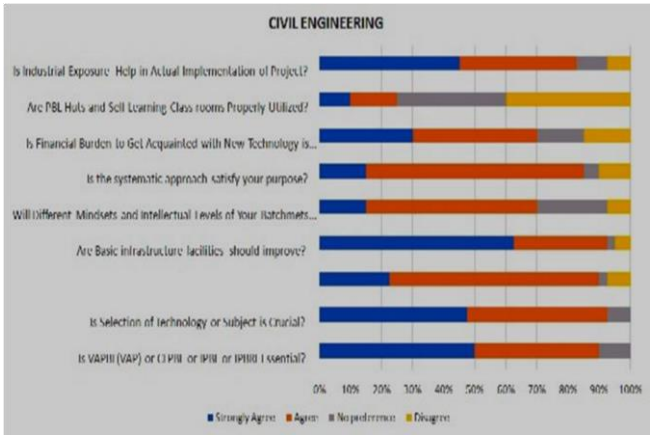

Fig. 4: Civil Engineering Branch Students Review

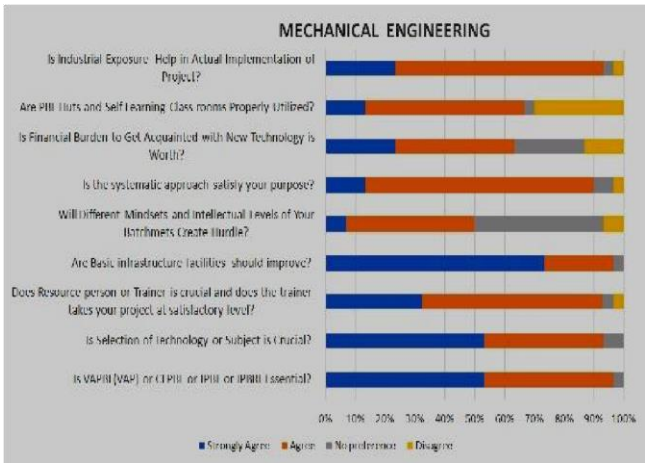

Fig. 5: Mechanical Engineering Branch Students Review

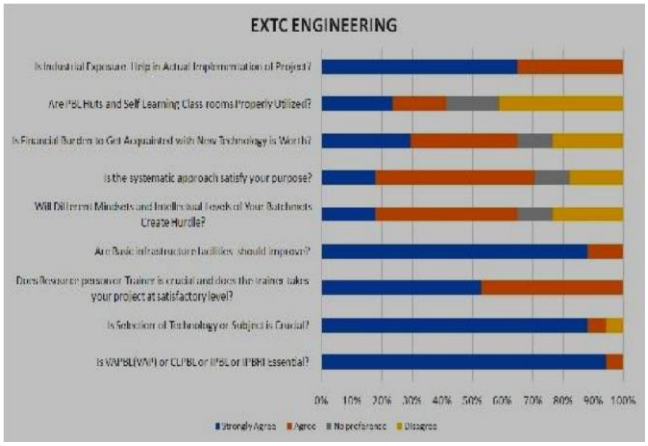

Fig. 6: EX & TC Engineering Branch Students Review After pilot survey was successfully exercised, the main survey is carried out. Total 45 students which are involved in VAPBL projects are given paper questionnaire, 33 students participated in the survey. Response rate is 73.33 percentages. As shown in fig. 7, the percentage of students who strongly agree or agree for the attributes related to the VAP quality, trainer and staff co-ordinator involvement in the project work. Due to PBL model implemented the overall approach of students in projects is improved as compared to last two years.

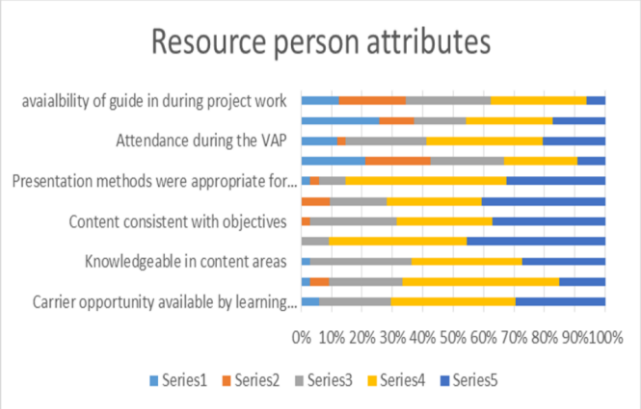

Fig. 7 Role of Resource Person Attributes.

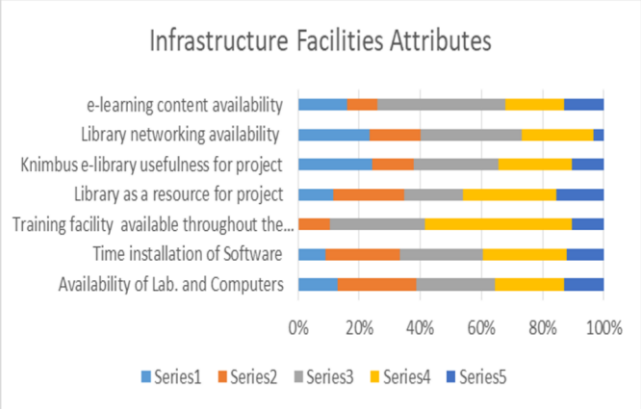

Fig. 8 Role of Infrastructure Facilities

From figure 3, 4, 5, 6, 7 and 8 it is following points are to be noted very precisely

1. Traditional teaching approach of teaching and learning should be transformed to any PBL based model.
2. Selection of current technology and the resource person always decide the success ratio of PBL implementation.
3. Continuous support of resource person while implementing the project is crucial.
4. Infrastructure facilities to implement PBL are must to create interest in teaching and learning.
5. Intellectual levels of team mates while working in team find it difficult.
6. Systematic approach in terms of time management found to be mixed opinions due to difficulty level of project.
7. Scope of improvement in other facilities of elbow rooms is always there.
8. Industrial exposure like technical conferences, workshops, technical fairs, project competitions and project exhibitions is a demand from students to execute project smoothly.
9. Selection of current technology and resources person impact on the project quality.
10. Students are strongly agree that after completion of VAPBL training they have good opportunities in career

5. Conclusion

This paper takes a holistic view on complete ecosystem of PBL and its effectiveness to insure framework and effectiveness of eco-system. Institute has developed its unique framework for supporting PBL practices which is names as PBL ecosystem. All the models developed which follows the PBL principles. Only one model which was developed for implementation of PBL that is VAPBL taken into consideration for analysis purpose. A pilot survey has been conducted for all departmental students who had been involved in VAPBL and then main survey was carried out under the two headings as resource person attributes and infrastructure facilities In future other models such as IPBL, CLPBL and IPBRI could be possible for detail study. If you want to imbibe PBL in campus then teachers training on PBL is very essential component with special focus on teachers who are going to implement it. Student involvement and counselling to change towards PBL approach is critical because students are prone to followed traditional practice. Cleary augment PBL infrastructure with financially assistant helps to create conducive environment for promotion of PBL in campus.

6. Acknowledgment

We are heartily thankful to Dr. S. Inamdar , Dr. Mrs. J. Inamdar and Dr. B. Patil for trusting and allowing us for project.

We are really thankful to Dr. Vikas Shide, Director PBL Excellence Centre, ViMEET for their continues guidance and encouragement for completion of this research work.

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