# Project Based Learning: An Integrated Aproach for Outcome Based Learning

Prof. Dr. A. C. Attar[1], Prof. S. R. Kumbhar[2]
[1]Dean – Quality Assurance, [2]Automobile Engineering Department
Rajarambapu Institute of Technology, Sakharale
Tal. Walwa, Dist. Sangli – 415 414 (Maharashtra) India
abdulrashid.attar@ritindia.edu, sanjay.kumbhar@ritindia.edu

***Abstract*— Project-Based Learning (PBL) is a student-driven, teacher-facilitated approach to learning. It is a key strategy for creating independent thinkers and learners. Learning responsibility, independence, and discipline are three outcomes of PBL. In traditional engineering education, projects are given to UG and PG students as a separate course. For inculcating the skills required in 21st century, this seems to be in-sufficient. The PBL approach is suggested for subjects like Value Engineering, an open elective (student of any discipline can opt for), for better learning. The value engineering course is useful for various engineering programs, hence it is treated as multi-displinary subject. In this paper, authors have implemented the course at post graduate level and summarized the outcomes. The outcomes gained from this exercise is encouraging one. This paper provides foundation for changing education approaches from a traditional lecture-based format to advanced project-based format. An outline for a project-based learning course is presented with experiences and lessons learned from four implementations of the course. Student responses are presented to indicate the potential benefits of such an approach.**

***Keywords—traditional classroom learning; project based learning; ; formatting; style; styling; insert (key words)***

## I. INTRODUCTION

Project Based Learning (PBL) is an innovative approach to learning that teaches a multitude of strategies critical for success in the twenty-first century. Students drive their own learning through inquiry, as well as work collaboratively to research and create projects that reflect their knowledge. From gleaning new, viable technology skills, to becoming proficient communicators and advanced problem solvers, students benefit from this approach to instruction [1].

Prince and Felder has defined PBL as - 'Project-based learning begins with an assignment to carry out one or more tasks that lead to the production of a final product—a design, a model, a device or a computer simulation. The culmination of the project is normally a written and/or oral report summarizing the procedure used to produce the product and presenting the outcome' [2]

In practice, many engineering education activities developed on the basis of inductive instructional methods – active learning, inquiry-led learning, problem-based learning etc. – focus on a fixed deliverable and therefore fall within this definition of PBL.

Overall, the research on Project-based Learning (PBL) reports positive outcomes related to student learning in the areas of content knowledge, collaborative skills, engagement and motivation, and critical thinking and problem-solving skills. This summary utilizes Thomas's (2000) five criteria to define PBL: (a) "Projects are central, not peripheral to the curriculum"; (b) "projects are focused on questions or problems that 'drive' students to encounter (and struggle with) the central concepts and principals of the discipline"; (c) "projects involve students in a constructive investigation"; (d) "projects are student-driven to some significant degree"; and (e) "projects are realistic, not school-like". Collaboration is also included as a sixth criterion of PBL [3,4].

## II. METHODOLOGY

Project based learning is a teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to a complex question, problem, or challenge. Essential elements of PBL include [5,6,7]:

1. Significant Content – At its core, the project is focused on teaching students important knowledge and skills, derived from standards and key concepts at the heart of academic subjects.
2. 21st century competencies – Students build competencies valuable for today's world, such as problem solving, critical thinking, collaboration, communication, and creativity/innovation, which are explicitly taught and assessed.
3. In-depth Inquiry – Students are engaged in an extended, rigorous process of asking questions, using resources, and developing answers.

## III. PROS AND CONS OF PBL APPROACH

Project - based learning — powered by contemporary technologies — is a strategy certain to turn traditional classrooms upside down. When students learn by engaging in real-world projects, nearly every aspect of their experience changes. The teacher's role shifts. He or she is no longer the content expert, doling out information in bite-sized pieces [8,9,10]. Student behavior also changes. Instead of following the teacher's lead, learners pursue their own questions to

create their own meaning. Even the boundaries of the classroom change [3].

Teachers still design the project as the framework for learning, but students may wind up using technology to access and analyze information from all corners of the globe. Connections among learners and experts can happen in real time. That means new kinds of learning communities can come together to discuss, debate, and exchange ideas. The phrase "21st-century learning" slipped into use long before the calendar rolled over to 2000. A robust debate about the needs of digital-age learners and the workforce needs of the new century continues to engage a global audience. The business world demands employees who know how to work as a team, access and analyze information, and think creatively to solve problems [11]. In the academic world and the blogosphere, educators routinely call for new strategies to better connect with the plugged-in generation known as the Millennials. But with the new century now well underway, the shift in teaching necessary to realize this vision is far from complete [3].

The Pros (advantages) and Cons (disadvantages) [7] of PBL approach can be summarized as follows.

**Pros:**

- Students more easily develop team-building skills, which are essential in future work environments.
- The learning process puts greater emphasis on creativity, and students can see how their ideas can be successfully adopted and carried out to complete projects [8].
- Students are autonomous, yet they are also able to interact with one another freely.
- Real-world connections are easily derived from learning materials.
- Students get to know their peers better.

**Cons:**

- Teachers who are not properly trained or equipped with the skills needed to facilitate a PBL classroom might not be able to help their students learn key concepts effectively.
- Conflicts between students might become common and possibly more difficult to detect.
- Group projects that are not heavily monitored by teachers can lead to uneven division of tasks between students.
- It's hard to determine how much each student contributes to a group project, which could mean that while some students are learning, others are letting their peers do all of the mental heavy-lifting [12].
- Parents might struggle to figure out how best to help their students, as homework and take-home assignments are hard to understand when taken outside of a group context.

## IV. CASE STUDY

IET 506 (Value Engineering) is part of an open elective at Post Graduated level in Engineering and Technology. The core curriculum was developed more than a decade ago as an effort to emphasize project-based learning in postgraduate education. Rather than introducing subjects in traditional discipline oriented courses, the curriculum courses focuses on a series of projects that aim to develop the skills and understanding required for 21st century. The pinnacle of the curriculum is the capstone sequence (IET 506) in which students complete an engineering project that integrates much of what they learned in their engineering classes. In particular, students are well-motivated to learn because the practical applications of the concepts are readily apparent [13].

### *A. Course Rationale:*

Value engineering is a structured and systematic problem solving technique or methodology. It is process that generates alternative solutions using a combination of creative and analytical techniques. It is a multidisciplinary technique and can be successfully applied to any economic activity in trade, industry, commerce, education, transport, civic, administration, healthcare, hospitals, police work, government etc.

### *B. Course Objective:*

This course is designed keeping in mind the following objectives -

- To describe the concept of value engineering and its importance in engineering and technology.
- To carry out job plan according to value engineering practices.
- To apply value engineering practices like life cycle cost theory, functional analysis system technique etc. in solving engineering problems.

### *C. Course Learning Outcomes :*

At the end of course the learner will be able to -

- Demonstrate the concept and fundamentals of value engineering
- Compose value engineering job plan
- Construct Functional Analysis System Technique (FAST) diagram.
- Decide cost model of a project.
- Analyze life cycle cost.
- Carryout value engineering study of engineering products/projects.

### *D. Background*

Value Engineering (VE) is a tool that will improve the ability to manage projects, solve problems, innovate, and communicate. It began at General Electric Co. during World War II. Because of the war, there were shortages of skilled labour, raw materials, and component parts. Lawrence Miles and Harry Erlicher at G.E. looked for acceptable substitutes. They noticed that these substitutions often reduced costs, improved the product, or both. What started out as an accident of necessity was turned into a systematic process. They called their technique "value analysis" [14].

Value analysis refers to the analysis of an existing product, service or administrative process while Value engineering

refers to the same analysis applied to the product, services or administrative processes that are under design and have not been finalized [15].

The principals of VE can be applied by anyone including systems analysts, shopkeepers, engineers, or homemakers. VE is often considered a management tool to control costs. In a broader context, it is a problem-solving tool that anyone can use.

*E. Traditional approah of teaching:*

Traditional VE methodology as it's taught and applied lacks a prescriptive cook book approach. The traditional approach merely re-engineers the product for material saving and invariably lands up in material complain. In traditional teaching methodology, the faculty explains the VE concepts in the classes and describes the various processes to be carried out [5].

For example; to explain the job plan (an organized plan of action for VE studies), the faculty explains the various steps to be followed for getting job plan, as follows –

- Function analysis
- Specific creative effort to develop design alternatives
- Not degrading the required performance
- Cost assignment for each function

From this learners will only get familiar with the steps to follow for job plan. Here learner is not getting the practical approach and skills of preparing job plan.

*F. PBL approah for VE teaching:*

In RIT, VE is taught by using new and scientific method, i.e. Project Based Learning (PBL). For this multi-disciplinary course the students from various streams like Automobile Engineering (1 student); Civil Engineering (16 students); Mechanical Engineering (7 students); Electronics and Telecommunication Engineering (1 student); and Computer Science and Engineering (1 student). The methodology used is summarized as follows –

- Firstly students were divided into groups and they assigned the small problems/projects for applying the VE theory.
- They all were given the sufficient time to think upon the VE methodology to be applied and the resources available.
- The student works in group, discusses the problem, and come up with methodology to be applied by brain storming session. Then they used various VE techniques for solving the problem.
- Each group has been assigned a job of preparing FAST diagram of their given problem/project.

Students have prepared FAST diagrams for various civil engineering products/projects like foundation; door; plinth; floor; window; wall; roof; staircase etc. One of the FAST diagram developed by students is shown in fig. 1.

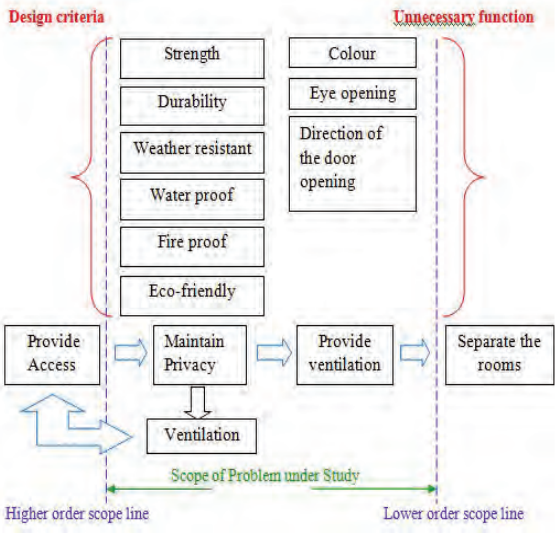


Fig. 1 Function Analysis System Technique (FAST) diagram of door

One such group is showing their prepared FAST diagram in Fig. 2.

Fig.2 FAST Diagram

- After their complete VE work, expert faculties from the institute were invited to judge their work. Such assessment work has been shown in fig. 3.
- From student's perspective, there's no substitute for the real world when it comes to generating interest in learning.
- The general expression on the PBL approach received is – students enjoyed the learning and taken keen interest, which developed their interpersonal skills, thinking ability, working in team, presenting the ideas, results to peers and others effectively etc.
- At the end of a project, students are encouraged to publish a paper/monograph and share their original findings or participate in a community symposium about science and ethics. They know that their work matters.

Fig.2. Expert Evaluation

- The experts also given comment that students enjoyed their work and happy to share their findings with enthusiasm. Students were tried better as compared to traditional teaching-learning process and really some learning has taken place.

*G. Course attainment:*

The course attainment was divided into various components like ISE (In Semester Evaluation), MSE (Mid Semester Examination) and ESE (End Semester Examination), Course end survey etc. For course end survey, a sheet was prepared for getting learning outcomes attainments. At the end of the semester, separate course end survey sheet was designed and students were asked to give their opinion regarding their learning. The format prepared is given in Table No. 1.

Table No. 1 Course End Survey

| Expected Outcomes | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| You feel that you can demonstrate the concept and fundamentals of value engineering | | | | | |
| In your opinion, you can compose value engineering job plan | | | | | |
| You can construct Functional Analysis System Technique (FAST) diagram | | | | | |
| In your opinion, you can decide cost model of a project | | | | | |
| You can also analyze life cycle cost. | | | | | |
| In your opinion, you can carry out value engineering study of engineering products/projects. | | | | | |

During analysis, weightage to levels on course end survey sheet are referred as; Strongly Disagree (0); Disagree (1); Neutral (2); Agree (4); Strongly agree (5).

After analyzing, the attainment achieved is shown in Table No. 2.

Table No. 2 Analysis of Course End Survey

| Expected Outcomes | Attainment of outcome (%) |
|---|---|
| You feel that you can demonstrate the concept and fundamentals of value engineering | 81.40 |
| In your opinion, you can compose value engineering job plan | 75.77 |
| You can construct Functional Analysis System Technique (FAST) diagram | 71.26 |
| In your opinion, you can decide cost model of a project | 65.21 |
| You can also analyze life cycle cost. | 73.80 |
| In your opinion, you can carry out value engineering study of engineering products/projects. | 76.90 |

Till date, only the attainment through course end survey has been prepared and complete attainment will be after declaration of results of ISE, MSE and ESE.

The final actions will be decided on the analysis report, so as to improve the level of attainment.

## V. Conclusion

Present study indicates the positive effects of Project Based Learning (PBL) approach : (a) has a positive effect on student's knowledge base and the development of their skills like problem solving, working in team, and thinking critically to solve the problem; and (b) benefits students by increasing their involvement in at actual work and enjoying the learning.

Following barriers for successful implementation of PBL were noted: (a) time-consuming activity, (b) difficult to control the flow of information, (c) disorderly classrooms, (d) difficult to give student independency and provide timely supports to them, and (e) hard to design assessment criteria.

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## *References*

[1] Stephanie Bell, 2010, Project-Based Learning for the 21st Century: Skills for the Future, Taylor & Francis Group, LLC, ISSN: 0009-8655 print, DOI: 10.1080/00098650903505415

[2] https://wiki.csc.calpoly.edu/pbl/wiki/definition

[3] http://cell.uindy.edu/docs/PBL%20research%20summary.pdf

[4] http://www.alvinisd.net/cms/lib03/TX01001897/Centricity/Domain/3792/SummaryOfPBLResearch.pdf

[5] www.bie.org/about/what_pbl

[6] http://www.gcucore.com/what-is-pbl.html

[7] SSA Techknowlogies (P) Ltd., 2012 SSAT_ VE-DMAIC©_R00

[8] www.education.com, Pros and Cons of project-based learning – Katherine Shields, January 12th, 2014.

[9] http://www.education.com/blog/author/kmshields/

[10] http://slideplayer.us/slide/150283/

[11] https://www.scribd.com/doc/111662737/Reinventing-Project-Based-Learning

[12] Suzie Boss and Jane Krauss, 2007, Reinventing Project-Based Learning, International Society for Technology in Education.

[13] http://tilt.colostate.edu/reinvention/proposal_civil202.pdf

[14] http://www.valuecreationgroup.com/analysis_value.htm

[15] http://www.answers.com/Q/What_is_the_Difference_between_value_analysis_and_value_engineering.