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Importance and Scope of Implementing Project Based Learning in Tier-II Engineering Colleges

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Abstract: Project Based Learning (PBL) is a one of the important teaching methods in which student's gain knowledge and skills by working together for an extended period of time to investigate and respond to an authentic, engaging and complex question, problem, or challenge. In Tier-II engineering colleges, it is difficult to implement PBL because of rigid curriculum developed by affiliated university. Many papers focused on the importance of PBL and how they succeed, but could not address how to implement in Tier-II colleges. To address this problem, in K. G. Reddy College of Engineering & Technology, we have started implementing a few techniques. This paper gives some thoughts related to PBL in those colleges. The grading criteria of the students in Tier-II colleges will be evaluated based on their performance in the project. This method will likely impact the Engineering Education in the future.

Keywords: Engineering Education, Project based learning, Implementation, Tier-II colleges

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1. Introduction

Project Based Learning, is a transformative teaching method for engaging all students in meaningful learning and developing the 21st Century competencies. Twenty years back education means just focusing on technical skills, but now in 21st century workplace and in college, success requires more than basic knowledge and skills like teamwork, communications, life- long learning, creativity, and leadership. All these competencies are gained by implementing PBL in classrooms. Firstly, students identify a problem and then think about that in their own perspective. Next, discuss about it in their groups. They gather information from the variety of sources like teachers, peers, the internet and journals. It 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 a project that reflects their knowledge.

From gathering new, feasible technology skills, to becoming proficient commander and advanced problem solvers students benefit from this approach.

2. History of Project-Based Learning

There have been several studies and reports that identify today's graduate attributes can be achieved by implementing project-based learning. S. Chandrasekaran confessed in his conference that students participated in the PBL

enhance their learning process, communication skills, different learning styles and promotion of critical and proactive thinking skills [Chandrasekaran, S., et al 2012]. Authors Mary M. Staehle, Amy R. Reed, Harriet S. Benavidez & William T. Riddell identified four major categories of communication skills were identified to be critical for engineering graduates: rhetorical awareness, writing, oral presentations and interpersonal communication [Staehle, Mary M., et al 2015]. Jacek Uziak argued that in order to prepare graduates for their successful careers, curriculum needs to be changed to assist students to acquire practical skills and multidisciplinary knowledge, instead of simply feed them in the theoretical and core program knowledge [Uziak, Jacek., et al 2016]. The authors Helle, Laura, Päivi Tynjälä, and Erkki Olkinuora investigated on PBL and concluded that project-based learning can be used as a method of guided discovery learning with the intention of promoting self-regulated deep-level learning [Helle, Laura, Päivi Tynjälä, and Erkki Olkinuora 2016]. The review conducted by Julie E. Mills and David F. Treagust examine the difference between problems based and project based learning in engineering education. After observations they concluded that a mixed-mode approach as successfully adopted at several of the institutions, with some traditionally taught courses, particularly in the early years, mixed with some project-based components and with the project based components increasing in extent, complexity and student autonomy in the later years of the program, appears to be the best way to satisfy industry needs, without sacrificing knowledge of engineering fundamentals [Mills, Julie E., and David F. Treagust 2003]

3. Why Project Based Learning (PBL)?

According to the NBA accreditation criteria and surveys of Engineering Education it is clear that the parents, the alumni, the industry employers and the students all are trying for significant changes to the delivery of Engineering Education. Often, traditional classes have assigned projects, where students engage in only part of the inquiry process.

The teacher/trainer does the questioning, planning, and researching and presents all the material to the students and the students create something. The teacher and student work together to improve it, and then the student presents the project to the class. The model is shown in Fig.1

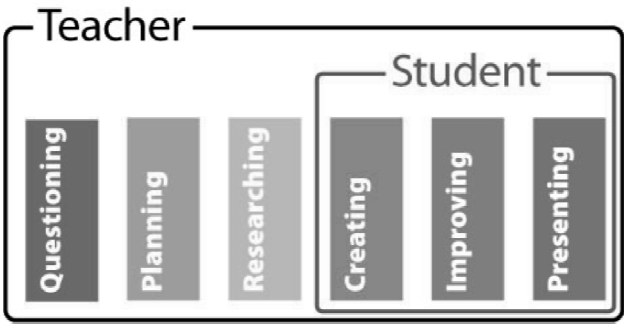

Fig. 1 Traditional project learning model

In project-based learning, the student is involved in the inquiry process from the very beginning. Students are immersed in an inquiry experience that gets them thinking about and questioning the topic. Then students work with their teacher to come up with a strong, driving questions about the topic and what they want to learn. Together they plan how they are going to go about answering their questions, and then dive together into their research.

Not only are students learning content and concepts, but they are also gaining skills and zeroing-in on what they want to do with what they are learning. At that point, students work with their teacher to plan a project that they will create one that often extends beyond the classroom. Students and teachers might contact those they know in the community who can help as they create their projects. Final projects are presented to an audience that often includes parents and community members. Sometimes projects actually make a change in the world beyond the class. Here's what the project-based learning shown in Fig. 2

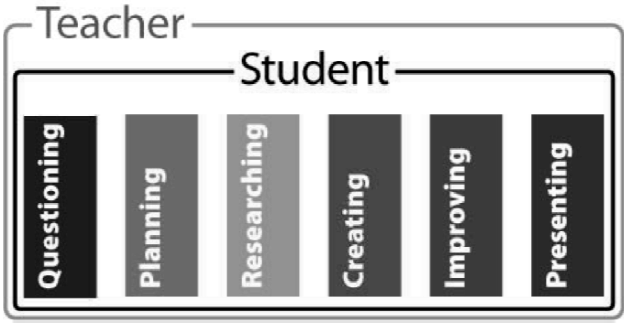

Fig. 2 Project Based Learning Model

In PBL, Students working both individually and cooperatively, feel empowered when they use effective work habits and apply critical thinking to solve problems by finding or creating solutions in

relevant projects. In this productive work, students learn and/or strengthen their work habits, their critical thinking skills, and their productivity. Throughout this process, students are gaining new knowledge, skills and positive attitudes.

Within this context the major issues we need to focus are as follows:

1. A curriculum developed by universities is too focused on engineering and technical courses without providing sufficient integration of these topics or relating them to industrial practice. Programs are content driven.

2. Current programs do not provide sufficient design experiences to students.

3. Programs are needed to be revised to provide more opportunities for the graduates to improve teamwork and communication skills.

4. Programs need to develop more awareness among students of the social, environmental, economic and legal issues that are part of the reality of modern engineering practice.

5. Existing faculty lack practical experience, hence are not able to adequately relate theory to practice or provide design experiences. Present promotion systems reward research activities and not practical experience or teaching expertise.

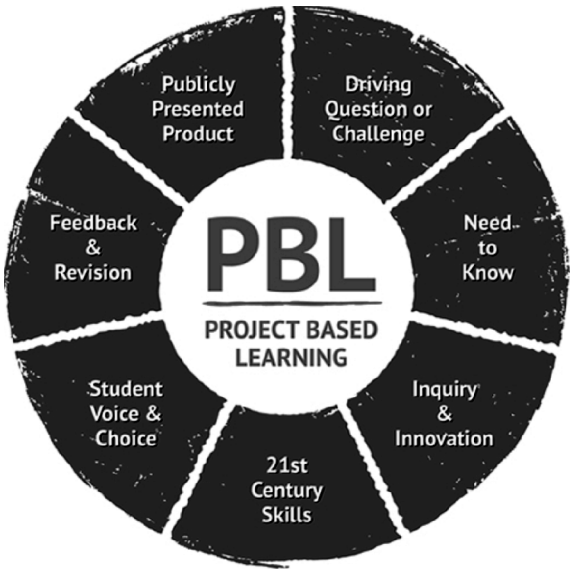

Fig. 3 Essential Elements of PBL

Project based learning is a transformative approach to classroom teaching and learning that is designed to engage students in investigation of authentic problems. The transformative approach implies a well planned, well organized process. The essential elements of that process are shown in Fig. 3

A. Need to Know

Many students in the class don't perceive a need to know. They are unmotivated by a teacher's suggestion that they should learn something because they'll need it later in life, for the next course, or simply because "it's going to be on the test." With a compelling student project, the reason for learning relevant material becomes clear that the student need to know this to meet the challenge he have accepted.

B. A Driving Question

A good driving question captures the heart of the project in clear, compelling language, which gives students a sense of purpose and challenge. The question should be provocative, open-ended, complex, and linked to the core of what you want students to learn. A project without a driving question is like an essay without a thesis. Without a driving question, students may not understand why they are undertaking a project.

C. Student Voice and Choice

This element of project-based learning is the key. In terms of making a project feel meaningful to students, the more voice and choice, the better. However, teachers should design projects with the extent of student choice that fits their own style and students. Some students make decisions about the project, including how they work and what they create.

D. Meeting 21st Century Skills

Students formed teams of three or four and began planning what tasks they would do and how they would work together. As they worked, each team regularly paused to review how well they are collaborating and communicating and using rubrics they had developed with the teacher's guidance. To boost collaboration skills, we need to use role-playing and team-building activities. They practiced oral presentation skills and learned to produce videos and podcasts. In writing journals, students reflected on

their thinking and problem-solving processes, which they knew they would need to explain in their oral presentation.

E. Inquiry and Innovation

The teams fine-tuned their questions and discussed how to find answers from the teacher, books, articles, websites and experts. As these learners found answers, they raised and investigated new questions. Students synthesized the information they gathered and used it both to inform their individually written papers on the driving question and to help create their team's product related to that question.

F. Feedback and Revision

Formalizing a process for feedback and revision during a project makes learning meaningful because it emphasizes that creating high-quality products and performances is an important purpose of the endeavor. Students need to learn that most people's first attempts don't result in high quality and that revision is a frequent feature of real-world work.

In addition to providing direct feedback, the teacher should coach students in using rubrics or other sets of criteria to critique one another's work. Teachers can arrange for experts or adult mentors to provide feedback, which is especially meaningful to students because of the source.

G. A Publicly Presented Product

Work is more meaningful when it's not done only for the teacher or the test. When students present their work to a real audience, they care more about its quality. Once again, it's "the more, the better" when it comes to authenticity. Students might replicate the kinds of tasks done by professionals, but even better; they might create real products that people outside institutional use. The invited audience included parents, peers, and representatives of community, business, and government organizations. Students answer the questions and reflected on how they completed the project, next steps they might take, and what they gained in terms of knowledge, skills and pride.

4. Learning Through Projects

The main characteristic of a project is to make the learning environment student-centered. Teamwork is regarded as a way to construct knowledge. In each and every project, students develop different skills [Chandrasekaran, S., et al 2012].

Principles of project based learning in common are as follows:

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

On the basis of the recommendations of the stakeholders as well as national and international research, it is very important and critical that a framework is needed to be defined and is unique to Engineering projects. Based on graduate engineers competencies it is proposed that fundamental knowledge base, engineering ability and professional attributes are the key elements of competency and part of the integrative learning principle for a project approach.

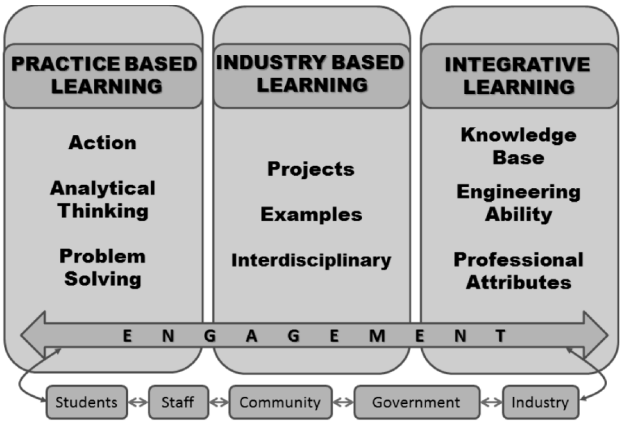

Fig. 4 Project Approach learning principles

The other key learning principles forming part of the PBL are practically based learning which includes

action based learning, analytical thinking and problem solving, and industry based learning which is based on project learning and interdisciplinary learning. These three learning principles are all constructively aligned by the constant engagement between students, staff, community, industry, and the government. This is illustrated in Fig. 4

We need some changes in current educational approach in order to provide students some professional practice. This change needs to cover all stakeholders.

Needs of Employer:

Twenty years back engineer attributes means just focusing on technical skills. But now in the 21st century the industry expectations of graduates are seeking more rather than just basic knowledge and skills. They are searching for graduates who are able to adapt to rapid changes in technology. Their expectations are

- Team work
- Communications
- Life- long learning
- Creativity
- Leadership.
- Analytical
- Management skills

Needs of Learners:

In the traditional classroom teaching, where teacher centered, we are assuming that all the students in the class will learn the same way and the knowledge can be transmitted from one to another. However, psychology studies reveal that students have different learning styles and different speeds of acquiring the knowledge and knowledge is constructed by the learner. The main objective of project Based learning is engaging students in the process of learning while doing.

For this, the learner needs to focus on the following

- Team learning capabilities – By discussing with group members and collaborate with peers tutoring..
- Learning Skills: Read the related Journals, Magazines, and Articles in newspapers.
- Technical Skills: Updating themselves with new technology introduced.
- Develop critical thinking:

Needs of Educators:

The industry experts, parent's, students and the society's expectations of the engineering graduates increase day by day. It is a big challenge for the educators to prepare 21st century graduate engineers. To achieve this educator needs to transform the teaching method from passive to active.

They need to update themselves to cope up with the students in the areas like practical exposure and new technologies. Project-based learning shifts away from teacher directed learning to a more student centered learning activities that focus on real world issues and practices. This, along with a global paradigm shift to outcome based tertiary education that demands generic or transferable skills, as well as technical excellence, is driving the need for a change in the teaching approach.

A. Problems Encounter While Implementing Project Based Learning:

It is a challenging task for academic staff to implement a project-based approach and integrate technology into projects in meaningful ways. The following difficulties will arise while implementing PBL.

Time: Projects often take longer than anticipated. In addition, difficulties that teachers experience in incorporating Project-Based Science into district guidelines are exacerbated by the time necessary to implement in-depth approaches such as Project Based Learning.

Classroom management: In order for students to work productively, teachers must balance the need to allow students to work on their own with the need to maintain order.

Control: Teachers often feel the need to control the flow of information while at the same time believing that students' understanding requires that they build their own understanding.

Support of student learning: Teachers have difficulty scaffolding students' activities, sometimes giving them too much independence or too little modeling and feedback.

The technology uses: Teachers have difficulty incorporating technology into the classroom, especially as a cognitive tool.

Assessment: Teachers have difficulty designing assessments that require students to demonstrate their understanding.

5. Institutionalization of PBL in K.G.R.C.E.T

PBL in practice takes place in the context of a college, a district, and a community. It is important to describe factors that influence the conditions under which PBL thrives and spreads in a college setting and becomes a viable part of the district and community. Thus, the research focus should extend beyond the classroom to those colleges, district, and community factors that facilitate the institutionalization of PBL at a site, and to the ingredients by which PBL becomes a spearhead for whole college change. No matter what the educational topic, there is always need for more research. In the case of Project-Based Learning, the lack of an overarching theory or model of PBL, the paucity of research devoted to PBL methods, and the gaps in our knowledge about the relative effectiveness of teacher-initiated projects create an unusual and vulnerable situation for PBL practitioners.

As K. G. Reddy College of Engineering & Technology is affiliated with J. N. T. University, Hyderabad, Telangana, needs to follow the curriculum developed by university for both teaching and assessment methods. The present assessment methods in the university are two midterm examinations each 25 marks (average of both is taken) and final End Semester Examination. For theory subjects, during a semester there shall be 2 midterm examinations. Each midterm examination consists of one objective paper, one descriptive paper and one assignment. The objective paper and the descriptive paper shall be of 10 marks each. Five marks are allocated for Assignments as specified by the subject teacher concerned. The first assignment should be submitted before the conduct of the first mid-examination, and the second assignment should be submitted before the conduct of the second mid-examination.

Previously, assignment marks were specified by the teacher, usually asking the students to answer / solve the questions given by teacher mostly in written form. In this only few students write/solve by themselves. Remaining students copy from their friends. Most of the students are doing this only for the sake of marks and not for knowing the concept. Instead of these passive assignments, this semester onwards Project based learning is being implemented for the entire discipline students.

- For each semester we have six subjects, total assignment marks are 30.
- These 30 marks are assessed based on their involvement in the project at each phase.

As we are in the initial phase, we are asking them to do small/mini projects which should be completed before the first mid examination or the second mid examination of this semester. This may be a virtual prototype of a system or a process. Within this regard the first phase of assessment has been completed. All the students did small prototype projects and exhibit their work to the concerned department faculties. Based on their involvement in the work first mid assignment marks are awarded. Again the students have started the second phase of this work for awarding second mid marks.

6. Results

Observations have been made with PBL approach and has been shown below tabular form.

Table 1. Performance Report of students

Skills Observed	Before PBL Approach	After PBL Approach
Presentation skills in a group	30%	60%
Team Building	20%	80%
Communication	30%	75%
Duplication of work	80%	10%

From the performance of second year Electronics and Communication Engineering Discipline students it has been observed that, before implementing Project Based Learning students were not actively involved in any discussions in the classroom, Continuous

motivation was needed to involve them. In group presentations, only a few students presented with confidence and most of the students were not confident. They even didn't coordinate with their friends to gather information and gain knowledge. After implementing Project Based Learning student's active participation in the classroom increased. Continuous improvement in their presentation, team building and new thinking skills has been observed. The details of the results are shown in Table1.

7. Conclusions

The Project based learning movement is growing rapidly and has many strong supporters. Yet the movement has taken place first time in the college and hear so many difficulties are identified like motivating students for time management, supporting tools needed, proficient teachers to help them and infrastructure to do projects. Despite all these difficulties, it has been observed that a variety of skills like teamwork, communications, confidence and technical knowledge have been gained by the students. This will continue to progress successfully till the institution becomes autonomous with increased accountability on the part of teachers and management. All these strategies tend to lead the institution towards the student centered. Thus, there is a timely need for expansion of some of the PBL research reported above, coupled with a systematic effort to build knowledge bases, which is the reflection of what they can anticipate when entering employment as a graduate engineer.

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