

Engineering Students' Attitudes and Perceptions towards Project-Based Learning: A Study from Kerala, Southern India

Akshay R S

*Department of Electronics and Communication Engineering
Government Engineering College Barton Hill
Trivandrum, India
akshays135@gmail.com*

Alviya Sunny

*Department of Computer Science and Engineering
Model Engineering College
Thrikkakkara, India
alviya945@gmail.com*

Saranya V S

*Accenture Solutions Pvt Ltd
Coimbatore, India
saranyavs139@gmail.com*

Dr Aby John

*Faculty of Philology
RUDN University
Moscow, Russian Federation
drabyjohnpk@gmail.com*

Dr N P Subheesh

*Teaching Learning Centre
SRM University-AP
Amaravati, India
subheesh.n@srmmap.edu.in*

Dr S M Anzar

*Department of Electronics and Communication Engineering
TKM College of Engineering
Kollam, India
anzarsm@tkmce.ac.in*

Abstract—The shift from teacher-centric to student-centric education has been a subject of debate, with traditional instruction often criticized for fostering rote learning and passive engagement. Due to its emphasis on student autonomy and real-world application of knowledge, the growing popularity of Project-Based Learning as a novel alternative to traditional classroom-based teaching pedagogy is attracting educational institutions all around the world. In engineering education, multifaceted skill development is paramount. PjBL offers a dynamic approach to cultivate essential competencies and it significantly improves engineering education. The National Education Policy 2020 (NEP 2020) of India lays a strong emphasis on Project-Based Learning as the cornerstone of educational reform. But, only smaller number of research studies are conducted in the country to explore the attitudes and perceptions of students towards Project-Based Learning in the engineering sector. It lays bare the imminent need for educationalists to focus on this research gap. This paper explores the attitudes and perceptions of engineering students towards Project-Based Learning from Kerala, a state in Southern India. A novel questionnaire entitled Project-Based Learning in Engineering Education in Kerala (PLEEK) is developed by the IEEE Education Society Kerala Chapter to conduct the survey. A total of 136 students from all over Kerala attended the survey. It is observed that the students have a positive perception of Project-Based Learning and its impact on enhancing their education. On the other hand, an abysmally low count of 11% of students believed that their current campus ecosystem supported this teaching pedagogy. They highlighted the need for a drastic transformation in the present academic infrastructure to support Project-Based Learning. The findings of the study underscore the potential of Project-Based Learning in enhancing learning outcomes, fostering critical skills, and preparing students for real-world challenges. However, challenges in implementation

such as curriculum alignment and institutional support were also identified in the study. Recommendations for a phased integration of Project-Based Learning into the curriculum and enhancing teacher training are proposed to bridge the gap between student interest and its effective implementation. The findings of this study can be used as a significant tool while formulating action plans for implementing NEP 2020 in the academic landscape of Kerala. The study not only sheds light on the attitudes and perceptions towards Project-Based Learning but also sets the stage for further research and strategic interventions to optimize its impact on engineering education.

Index Terms—Project-Based Learning, Engineering Education, Student-Centered Learning, PLEEK, Curriculum Integration, Engineering Pedagogy

I. INTRODUCTION

Student-centric education versus teacher-centric education has been a topic of debate for the past few years. Traditional classroom instruction-based pedagogy is often argued to make the students rote learners without necessarily understanding the underlying concepts. A very few opportunities are provided for them to apply the concepts which they have learnt in the academic life. This makes students passive learners with them having little autonomy over the learning process. On the other hand, student-centred learning, where the student takes the centre stage of the learning process, offers them independence [1]. Project-based learning (PjBL) in particular is much more effective than traditional teacher-centered methods as it aids in the development of educational resources, methodology of teaching, curriculum improvement and evaluation procedures

[2]. Such approaches help students to have a better understanding of the concept and gain practical knowledge [3]. In this student-centered approach, the students learn concepts through solving related real-world challenges. This proactive approach promotes the development of analytical, critical and communicative skills of the students which in turn promotes deep learning.

Engineering students are tasked with developing a range of essential abilities throughout their education. These include designing and conducting experiments, analyzing and interpreting data, utilizing tools, techniques, and skills relevant to engineering practice, collaborating effectively within multi-disciplinary teams, cultivating professionalism, and assuming ethical responsibility for their tasks and communicating information proficiently. PjBL provides a dynamic and immersive approach that helps students to acquire and enhance these skills by engaging them in real-world projects and problem-solving scenarios. Since PjBL has been found to have a more positive impact on the academic achievement of students than direct instruction [4], it is imperative for educational institutions to consider its implementation, at least in combination with traditional pedagogies in the initial phase.

The National Education Policy (NEP 2020) of India, which marks a significant transformative milestone in the educational landscape of the country, promotes PjBL as a key pedagogical approach to foster holistic development, logical thinking, and creativity among students. But, when compared to the progressive development of PjBL in K-12 education, its investigation in higher education is still in its infancy [4]. Very few research works explore the attitudes of students towards PjBL in India, with no significant research concentrating on Kerala, a state of India.

This paper aims to bridge the research gap by exploring students' attitudes towards Project-Based Learning (PjBL) in Kerala. An extensive survey using Google Forms was conducted among engineering students across Kerala. The survey form, comprising 24 questions employing a 5-point Likert scale, aimed to evaluate students' interest and satisfaction with PjBL, its reception and perception, effectiveness and impact, and its effect on career and lifelong learning. The result of this study is poised to act as a significant tool while formulating action plans for implementing the National Education Policy 2020 (NEP 2020) in Kerala.

II. BACKGROUND AND RELATED WORKS

Project-Based Learning (PjBL) is one of the most successful student-centered educational systems widely used in computer science, information systems, engineering education, and more [5]- [11]. PjBL is a comprehensive approach to the current scenario of classroom learning, where theoretical knowledge is often emphasized. Project-Based Learning (PjBL) refers to an inquiry-based instructional method that engages learners in knowledge construction by having them accomplish meaningful projects and develop real-world products [12]. Unlike other learning methods, PjBL is a student-centric approach where students investigate realistic problems, uncover the underlying

open-ended issues, explore possible solutions, and find the best feasible outcomes. Bender [13] describes PjBL as an instructional model where students confront existing issues and problems, address them, and act in a coordinated way to reach solutions

Since it is a student-centric model of learning, mentors do not have a central role but act as guides, with students taking on most of the responsibility for their learning process. Many engineering courses use projects as assignments to familiarize students with solving real-life problems. However, these do not strictly adhere to the PjBL method since they often do not involve open-ended questions. The benefits of PjBL include improved attitudes towards learning and the subject matter [13].

Moreover, PjBL helps develop meta-cognitive skills in students, such as self-regulation and monitoring skills [14]. In PjBL, projects drive students' motivation and learning processes, encourage them to acquire knowledge about the problem, investigate it, gather and apply necessary skills, and arrive at feasible and practical solutions. This approach helps students to acquire valuable 21st century skills such as soft skills like leadership, teamwork, critical thinking and creative thinking, which are essential for their future work environments [15].

Since PjBL focuses on solving existing problems, it is a demanding practice in engineering fields. The importance of applying PjBL in Software Engineering Education and analyzing its effectiveness has been described in [16]. The application and effectiveness of PjBL in higher education, Mechatronics, Vocational Education, and Civil Engineering have been recorded in various research articles. These studies highlight the need and positive impacts of PjBL in the vocational education sector and engineering studies [17] - [19].

From analyzing previous research papers, it is evident that no survey or research has been conducted to assess PjBL in Kerala, a state in India. Despite the presence of numerous engineering colleges in Kerala, there is no study analyzing the situation, impact, and implementation of PjBL in these institutions. The current research aims to analyze the impact and assess the current PjBL scenario among engineering students in Kerala, thereby bridging the research gap and exploring the attitude towards PjBL among these students.

III. METHODOLOGY

A mixed analysis approach was employed for the study. A questionnaire comprising 24 survey questions in total under 5 subheadings was meticulously prepared to analyse the attitudes and perceptions of engineering students in Kerala towards Project Based Learning. Google Forms, owing to its simplistic User Interface and popularity among students was used as the data collection tool. The form was circulated among engineering students across Kerala, through e-notices, publicity campaigns, and word-of-mouth communication.

A. Participants and Tools

PLEEK, an acronym for Project-Based Learning in Engineering Education in Kerala, is a novel questionnaire created

by the IEEE Education Society Kerala Chapter to evaluate the attitudes and perceptions of engineering educators and students towards PjBL. The questionnaire was carefully designed and structured to analyse the attitudes and perceptions of engineering students in Kerala towards Project Based Learning under different aspects. Data were collected from 136 engineering students (N=136). It was structured under five sections, each catering to a particular aspect. The questionnaire was designed using a five-point Likert scale. After a pilot study to determine the feasibility of the research design, the questionnaire was shared among engineering students across Kerala. The questionnaire focused on five significant factors.

- 1) Demographic Information: The section aims to gather essential background details about the respondents, seeking to identify any patterns or correlations between these demographic factors and the students' experiences and opinions of Project-based Learning (PjBL).
- 2) PjBL Interest and Satisfaction: The section aims to evaluate students' enthusiasm for Project-Based Learning, the campus support for such activities, time constraints, the alignment of the curriculum with PjBL, and overall satisfaction with the opportunities provided to enhance their PjBL skills.
- 3) Effectiveness and Impact of PjBL: This session is intended to assess students' perceptions of how project-based learning influences their educational experience by enhancing learning outcomes, engagement, critical thinking, teamwork, and communication skills.
- 4) Career and Lifelong Learning: The section aims to evaluate students' views on the effectiveness of project-based learning in equipping them with industry-relevant skills, fostering lifelong learning, promoting autonomy and independence, enhancing knowledge retention, and improving career prospects in engineering.
- 5) PjBL Reception and Perception: The section aims to gauge students' openness to project-based learning compared to traditional teaching methods, its effectiveness in preparing them for real-world engineering challenges, its impact on their motivation to learn, its role in fostering interdisciplinary learning, and its encouragement of innovation and creativity in engineering education.

Additionally, an open-ended question is included at the end to receive any additional comments or suggestions the respondent might have.

B. Limitations of the Study

The questionnaire does not inquire about the reasons behind the respondent's choice of a particular option. Including this aspect would have provided a more comprehensive understanding of their attitudes and perceptions, as well as the underlying reasons behind them.

IV. FINDINGS AND DISCUSSIONS

The Project-Based Learning in Engineering Education in Kerala (PLEEK) Questionnaire, developed by the IEEE Education Society Kerala Chapter, was employed to assess the

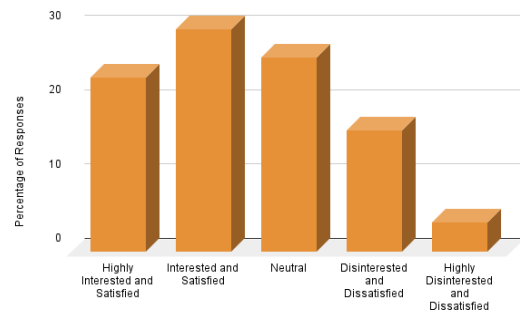


Fig. 1. Summary of Student Interest and Satisfaction with PjBL Activities

attitudes and perceptions of engineering students in Kerala towards PjBL. All 136 participants who participated in the survey were students of the Bachelor of Technology (B.Tech.) degree, with second-year/sophomore students (39%) and third-year/junior students (32.4%) being the majority category, followed by first-year/freshman (15.4%) and fourth-year/senior students (11.8%). A minority of 1.5% were graduates. The majority of the participants belonged to the Computer Science and allied branches (55.9%), followed by Electrical and Electronics Engineering and allied branches (39.7%), Mechanical and Automation Engineering and allied branches (2.9%) and Civil Engineering (1.4%). While 57.4% of the participants were females and 39.7% were males, 2.9% opted not to reveal their gender.

The 'PjBL Interest and Satisfaction' section of the questionnaire, as summarised in Fig. 1, assessed the participants' inclination towards the pedagogy and their contentment with the related educational measures already in place. Interest in participating in PjBL activities within their courses was high among students, with 54.4% expressing their interest in the same, 33.8% opting for the 'very interested' option, 8.1% being moderately interested and 3.7% only slightly interested. But in contrast, only 11% of the participants opined their current campus ecosystem highly supported PjBL; 29.4% found their institution to be supportive in general, 14% felt the ecosystem to be unsupportive and 1.5% highly unsupportive. 44.1% of respondents took a neutral stand on this question. Lack of time emerged as one of the constraints in effectively engaging in PjBL-related activities, with 33.8% and 39% feeling it to be a significant constraint and moderate constraint respectively, 5.9% seeing it as a slight constraint, one participant felt it was not to be a constraint and 20.6% remaining neutral.

Opinions on the support of the curriculum and syllabus implemented at their institutions towards PjBL were mixed, with an equal 10.3% finding it to be highly promoting and highly hindering each, 22.1% feeling it to be promoting, 26.5% feeling it to be hindering and 30.9% remaining neutral. Consequently, a majority of students were not satisfied with the opportunities provided by their university and institution to enhance their skills through PjBL activities, with 7.4% being highly dissatisfied, 32.4% being dissatisfied, and 27.2%

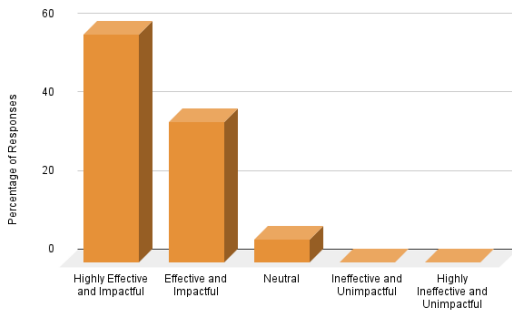


Fig. 2. Summary of the Effectiveness and Impact of PjBL on Engineering Students

remaining neutral. Only 25.7% were satisfied and 7.4% highly satisfied with the same. The findings suggest a stark picture of a majority of students being interested in pursuing PjBL-related activities, and the institutional ecosystem and support not being up to the mark at par with their interests

The 'Effectiveness and Impact of PjBL', as summarised in Fig. 2, gauged the perceived efficacy of PjBL in improving the learning outcomes and engagement of the course, and its influence on the soft skills essential for the workplace such as communicative and collaborative skills. A vast majority of 61.8% and 29.4% felt PjBl to be highly effective and effective respectively in enhancing the learning outcomes as an engineering student, with only 7.4% feeling neutral, and one participant each finding it to be highly ineffective and ineffective. With student engagement and achievement having a direct correlation with student motivation according to B. J. Baron et. al. [20], an even greater majority of 66.9% strongly agreeing with PjBL's effect on enhancing student engagement in the learning process, 30.1% agreeing to the same and 2.9% feeling neutral is a promising finding. This is further supported by 60.3% and 36% believing that PjBL highly enhances critical thinking skills and Higher-Order Thinking Skills (HOTS), with only a minority of 3.7% remaining neutral. Casner-Lotto, J. and Barrington, L. [21] believe that soft skills such as communication and teamwork are sought by employers in new entrants to the workforce. Most of the participants feel PjBL can help them improve these skills, with 49.3% and 43.4% perceiving the effect of PjBL towards teamwork and collaboration to be giggly fostering and fostering respectively. Only 7.4% felt its effect to be neutral. Similarly, 52.2% felt the impact of PjBL on communication skills is highly positive whereas 40.4% found it to be positive, and 7.4% took a neutral stand. The results are congruent with the impression of PjBL in positively impacting the learning process and development of critical skills according to existing research.

The section 'Career and Lifelong Learning', as summarised in Fig. 3, analysed the effect of PjBl in helping acquire industry-relevant skills needed for engineering careers, its role in fostering lifelong learning, contribution towards the autonomy and independence of students in the learning process, influence on the retention of knowledge and understanding of

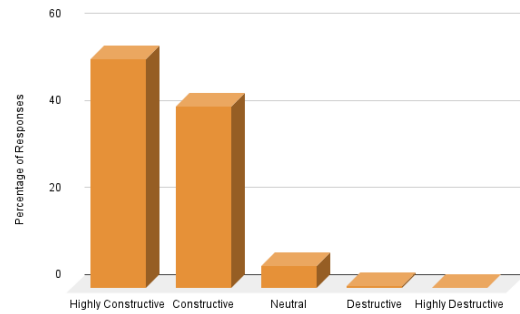


Fig. 3. Summary of the Effectiveness and Impact of PjBL on Career and Lifelong Learning

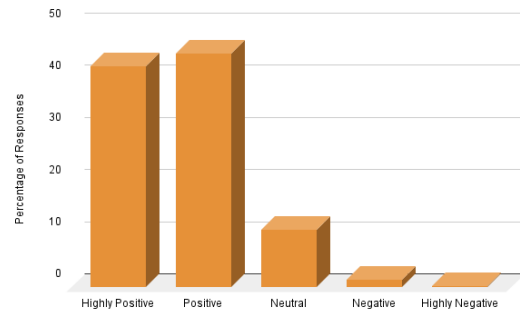


Fig. 4. Summary of Reception and Perception of PjBL Among Engineering Students

concepts, and its influence on improving career prospects in engineering. About 95.6% of the students perceived the impact of PjBL on engineering career prospects to be beneficial. The survey found that 93.4% of respondents have a positive belief about the influence of PjBL on knowledge retention and understanding of concepts. Over 92.7% of the students indicated that PjBL contributes to fostering their autonomy and independence in the learning process and nearly 94.1% of students found that PjBL encourages the development of lifelong learning skills. Additionally, a total of 95.6% of the students reported that PjBL helps them to develop industry-relevant skills needed for engineering careers. Overall, these findings strongly suggest that PjBL has a significant positive impact on engineering students' preparation for their careers and lifelong learning.

The 'PjBL Reception and Perception' section of the questionnaire as summarised in Fig. 4 evaluated the openness of students towards adopting PjBL, their belief of it in preparing them for real-world engineering challenges, its impact on their motivation to learn, its role in promoting interdisciplinary learning and perceived level of innovation, and creativity encouraged by PjBL in engineering education. The data analysis revealed that 86.8% of students perceived PjBL in engineering education as something that fosters innovation and creativity. The remaining 13.3% of the students were neutral and found it inhibiting. PjBL was viewed favourably by 87.5% of students for its role in promoting interdisciplinary

learning. The remaining 12.5% of students were neutral or saw it as hindering. Nearly 99.1% students reported a highly positive view of PjBL's impact on their motivation to learn. A total of 94.8% of the students believe that PjBL prepares them very well for the challenges of real-world engineering. Moreover, the survey found that nearly 75% of students were receptive to PjBL compared to traditional teaching methods, while the remaining 25% were unreceptive. In conclusion, the data overwhelmingly supports the positive impact of PjBL on engineering students. The students reported that PjBL helps them to have an increased level of motivation as it fosters innovation and interdisciplinary learning. They also stated that it helps them to prepare for the real-world challenges. Furthermore, a significant majority of the students found PjBL preferable to traditional teaching methods.

Numerous students gave additional feedback on their views of PjBL through the open-ended question intended to collect the same. According to them, a hectic load of assignments and written coursework, along with a tight academic schedule packed with frequent examinations may pose a significant challenge in integrating PjBL into the existing curriculum. They believe that PjBL will improve the quality of engineers and give them the confidence to excel in the industry. Some participants also opined the need for training the teachers in PjBL methodologies to ensure its successful implementation. These comments suggest the need for an overhaul in the curriculum in order to implement PjBL.

V. RECOMMENDATIONS BASED ON THE FINDINGS

As is evident from the study, a vast majority of students favour the inclusion of PjBL in their courses. The study reveals that academic infrastructure needs strategic transformation for the effective implementation of PjBL. This leads to the following recommendations:

- 1) In order to promote a holistic development of the hard and soft skills of students, PjBL should be integrated into the curriculum. This integration should be done in a phased manner so that the changes are not perceived drastic or refractory.
- 2) Adequate prior-training should be provided to educators on the importance of PjBL and the methods for handling course-related projects, so as to encourage a supportive campus ecosystem.
- 3) Restructuring of academic schedules should be considered to reduce the burden of excess written coursework for technical subjects, and shift the focus towards related projects.
- 4) Internships at reputed institutions should be promoted, as it helps in gaining exposure in overcoming real-world challenges.

VI. CONCLUSION AND FUTURE SCOPE

This study evaluates the attitudes and perceptions of engineering students from Kerala towards Project-Based Learning. The study found a positive predisposition of students towards PjBL, with a cumulative of 88.2% respondents expressing

interest in participating in related activities. It is viewed to improve soft skills and Higher Order Thinking Skills (HOTS), autonomy and engagement in the learning process, and promote lifelong learning. PjBL helps to have a better preparedness to face the real-world challenges and improves career prospects. However, lack of a conducive campus ecosystem and shortcomings in the curriculum structure may prove to be a barrier in implementing PjBL in engineering institutions across Kerala. This paves way for several possible reforms in the structure of the current academic programmes such as a phased integration of PjBL into the curriculum, training programs for teachers to adapt to these changes, changes to the existing academic schedule to overcome time constraints in undertaking projects, and promotion of internships at reputed institutions to face the industry in a better manner.

Evaluating the perceptions of educators towards PjBL is a promising area of research that can be worked on before preparing an action plan for the strategic implementation of PjBL. Additionally, a qualitative and quantitative analysis of the impact of PjBL on academic community can be conducted at each stage of its implementation to ensure successful execution of the action plan and formulate suitable interventions as and when required. These ideas point towards a promising scope for research in this area in the near future.

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