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Integrating Language Learning and Problem-Based Learning in Engineering Education: A Promising Approach

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***Abstract*—In the evolving landscape of global education systems, the need for transformation is evident to have an impactful teaching and learning process. English language teaching is no exception to this. As the contemporary engineering graduates increasingly engage with professionals across the globe, proficient English language skills have become paramount. This research paper examines the effectiveness of integrating problem-based language learning (PrBLL) into English language classes for undergraduate engineering students, aiming to enhance language proficiency, foster collaborative teamwork, and optimize the language learning experience. This approach aims to enhance the practical application of language skills, mirroring the demands of future engineering interactions on a global scale. This study employs a mixed-methods research approach to comprehensively investigate the integration of problem-based language learning into English language teaching. By contextualizing language acquisition within real-world scenarios through the innovative lens of PrBLL, this study seeks to contribute to the enrichment of language classrooms and the advancement of modern educational paradigms. Beyond language education, PrBLL's success echoes the broader potential for educational innovation.**

***Keywords*—Problem Based Language Learning; 21st Century Skills; Innovative Pedagogy; Language Practice for Engineering Graduates.**

***JEET Category*—Practice**

I. INTRODUCTION

IN the dynamic landscape of both Indian and global education systems, the imperative for transformative change is evident, necessitating more impactful teaching and learning processes. This urgency is particularly pronounced in the realm of English language learning, a need further underscored in the sphere of engineering education. As the contemporary engineering graduates increasingly engage with professionals across the globe, proficient English language skills have become paramount. This research examines the effectiveness of integrating problem-based language learning (PrBLL) into English language classes for undergraduate engineering students, aiming to enhance language proficiency, foster collaborative teamwork, and optimize the language learning experience. By contextualizing language acquisition within real-world scenarios through the innovative lens of PrBLL, this study seeks to contribute to the enrichment of language classrooms and the advancement of modern educational paradigms.

II. LITERATURE REVIEW

Current language learning methods face challenges in adequately equipping students, especially in technical fields like engineering, with the comprehensive language skills required for effective global communication (Smith et al., 2019). Meanwhile, Problem-Based Learning (PBL) has demonstrated its efficacy in enhancing critical thinking, problem-solving skills, and engagement across various educational contexts (Savery & Duffy, 2001). PBL's learner-centered approach, emphasizing active involvement and real-world applicability, makes it a potential vehicle for enhancing language acquisition in tandem with disciplinary knowledge. Literature also underscores the successful integration of language learning within PBL frameworks, with studies indicating improved language proficiency and contextualized language use (Beck & Kosnik, 2000; Willemyns, 2018). This synthesis of PBL and language learning aligns with the present study's exploration of similar integration within engineering education, offering a novel pathway for holistic skills development.

III. PURPOSE AND OBJECTIVES

The overarching purpose of this research is to investigate the potential benefits of integrating problem-based language learning (PrBLL) into language learning classes for undergraduate engineering students. Specifically, this study aims to assess the effectiveness of this innovative pedagogical

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approach in enhancing language skills, nurturing collaborative teamwork, and optimizing the overall language learning experience. The specific objectives encompass evaluating the impact of PrBLL on student engagement, determining its effectiveness in language acquisition through real-world scenarios, cultivating students' capacity to work synergistically within teams, and ultimately contributing to the advancement of educational approaches within the context of engineering language learning.

IV. METHODOLOGY

A. Research Approach and Rationale

This study employs a mixed-methods research approach to comprehensively investigate the integration of problem-based language learning (PrBLL) into English language teaching within the context of undergraduate engineering education. The rationale behind this approach lies in the need to capture both quantitative data on student performance and qualitative insights into their learning experiences. This comprehensive methodology aligns with the research objectives and positions, the study contributes to both pedagogical innovation and enhancement in engineering education.

B. Selection of Undergraduate Engineering Students

A purposive sampling strategy is employed to select a cohort of 284 undergraduate engineering students for participation in this study. This approach ensures representation from diverse engineering disciplines, acknowledging the varying linguistic needs within the field. The sample includes students from first year engineering programs pursuing their undergraduate studies in Coimbatore, Tamil Nadu, India, to capture a spectrum of language proficiency levels and familiarity with traditional teaching methods.

C. Problem-Based Learning Approach for English Language Teaching

Central to this study is the adoption of a problem-based language learning (PrBLL) approach for English language teaching. PrBLL is structured around real-world scenarios that align with engineering contexts. Students engage in tasks that require not only language comprehension and production but also problem-solving skills. This approach aims to enhance the practical application of language skills, mirroring the demands of future engineering interactions on a global scale.

D. Incorporating Real-World Scenarios

Real-world scenarios drawn from engineering contexts are integrated into language learning activities. These scenarios simulate the challenges engineers might face in international collaborations, thereby contextualizing language learning within relevant professional scenarios. This immersive approach aims to bridge the gap between language acquisition and its practical utilization.

E. Activities and Functional English Training

A range of activities is designed to ensure functional English training. These activities encompass technical discussions, collaborative projects, and presentations, fostering language use in authentic engineering situations. The emphasis is not solely on grammar and vocabulary but also on effective communication, as is crucial in the engineering domain.

The activities included both individual and group tasks ranging from simple activities like writing resumes to complex activities like providing suitable solutions to the given real-world scenarios. The total 284 learners were divided into 9 batches and the training was administered. For group activities, the students were divided into a 6-member team. The training started with providing real-world scenarios to the learners and each team was asked to prepare a chart providing suitable solutions to the problems identified and present the same. This was followed by writing resume activity. This task was assigned as an individual activity, and the learners were oriented on the nuances of writing effective resumes. Then they were made to write their resumes, which was then converted into an online profile. Each candidate was made to create their online profile on the LinkedIn platform.

The learners were then made to set their professional and personal goals, which was followed by mock interview, group discussion and situational play. This enabled the learners to identify their strengths and weaknesses, and it helped them to develop teamwork, decision making, time management and critical thinking.

F. Assessment Strategies

Assessment strategies include continuous performance, assessment and peer review providing a comprehensive understanding of student progress and the effectiveness of the PrBLL approach. Ongoing performance assessment involves continuous monitoring of students' language use, problem-solving abilities, and teamwork skills during classroom activities.

For chart preparation and presentation, the candidates were assessed based on the innovative and unique solutions provided and the overall presentation of the chart. Their ability to orally present their findings was also assessed. This was followed by resume writing and creating online profiles, which were evaluated based on the format, content and creativity of the learners. The next set of activities in the form of group discussion, mock interview and situational play were evaluated based on the candidate's ability to think out of the box, involvement with peers, clarity of thoughts and content, leadership and presentation skills, body language, and time management.

G. Data Collection

Data collection is facilitated through systematic observation of students' in-class performance. This approach involves recording their participation, language use, collaborative engagement, and problem-solving strategies during PrBLL activities. These observational notes form the basis for the analysis of student performance and the efficacy of the pedagogical approach. By employing this methodology, the study seeks to provide evidence-based insights into the viability and potential of integrating PrBLL into English language

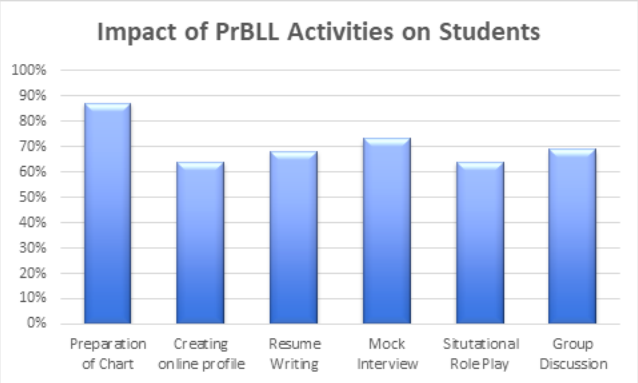

Fig. 1. Impact of PrBLL Activities on Students.

teaching for undergraduate engineering students.

Each activity was evaluated for a total of 20 marks based on the rubrics mentioned above. The students were categorized based on the cut-off marks. The learners securing 14 marks out of 20 were considered to be satisfactory and the remaining candidates were considered to be performing below average. Based on this criterion, the data was collected for this analytical study.

V. Results and Analysis

A total of 284 first-year engineering students were selected as participants for this study. Throughout the course of the study, a series of carefully curated activities were administered to engage the students and enhance their language skills in alignment with the problem-based learning approach. The activities encompassed a diverse range of tasks, including designing a solution for a given scenario, creating online profiles, writing resumes, participating in the Paper Car Activity, engaging in mock interviews, discussing goal setting and SMART goals, identifying strengths and weaknesses, and converting challenges into opportunities.

Further activities included group discussion practice, situational role play, describing a product launch event, engaging in customer interaction simulations, and sharing personal experiences on the completion of internships. These activities were meticulously designed to provide a holistic learning experience, integrating language acquisition with practical engineering scenarios.

A. Impact of Problem-Based Learning on Student Engagement

The diverse range of activities implemented under the problem-based learning framework, such as the Chart Preparation, Creating Online Profile, and Resume Writing Activity, showcased impressive levels of student engagement. The preparation of chart on the given problem scenario, where the total students were divided into a six-member team for presentation. This task was performed very well by 247 students which were evaluated based on the realistic and achievable solutions provided, clarity of presentation. Additionally, despite being individual tasks, it was observed that 182 students were more active during online profile creation activity and 193 students were active during effective resume preparation task. The observation was based on the completion of the activity within the stipulated time and appropriate content. The level of active involvement underscores the effectiveness of problem-based language learning in capturing students' attention and motivating them to excel.

B. Effectiveness of Language Acquisition through PrBLL

The outcomes of various activities provide insights into the effectiveness of problem-based learning in enhancing language acquisition. In activities like the Mock Interview, Goal Setting Introduction & Discussion, SMART Goals, Strength & Weakness, and Converting Challenges into Opportunities, where effective communication and articulation are essential, 207 students consistently demonstrated their ability to perform well. Furthermore, tasks like Customer Interaction Speaking - Situational Play, although initially met with hesitation, resulted in 182 students successfully engaging in language-rich interactions after a second opportunity. These outcomes collectively indicate that problem-based learning facilitates the acquisition and application of language skills in real-world scenarios.

C. Development of Teamwork Skills

The "Preparation (Chart work)" activity, in which students collaborated within teams for presentations, showcased exceptional teamwork skills, with 247 students achieving excellent results. Similarly, the "Paper Car Activity," despite consuming more time, was executed well by all teams, highlighting the successful application of teamwork and collaboration. These outcomes demonstrate the positive impact of problem-based learning in fostering teamwork and cooperative abilities among students.

D. Comparison with Conventional Teaching Methods

The outcomes of problem-based learning activities can be compared favorably with conventional teaching methods. Activities like Group Discussion Practice yielded a success rate of 195 students performing in a commendable way, indicating the effectiveness of an interactive problem-based approach over passive traditional methods. The higher engagement levels in problem-based learning activities, coupled with strong performance rates, underscore the advantage of this approach in achieving both active involvement and meaningful skill development.

E. Presentation of Statistical Data or Qualitative Insights

Out of 284 students, the statistical data derived from the outcomes of each activity paints a comprehensive picture of the effectiveness of the problem-based learning approach. In Chart Preparation activity, 247 students exhibited their problem-solving capability. Mock Interview and Goal Setting impacted 207 students with consistent success rate, and others with varying achievement rates provided quantitative insights into the impact of the methodology. Additionally, the qualitative insight from activities like Customer Interaction - Situational Play activity where 112 students initially hesitated but

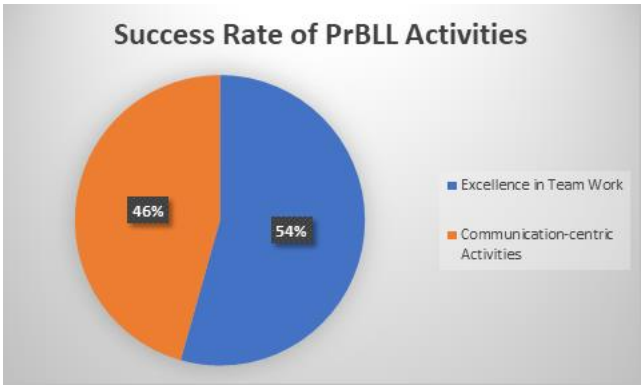

Fig. 2. Success Rate of PrBLL Activities

eventually engaged after a second chance, contributes a nuanced understanding of the approach's influence on student behavior and attitudes. Overall, this comprehensive data-driven examination underscores the multifaceted impact of the problem-based learning approach, not only in enhancing problem-solving skills but also in fostering teamwork, critical thinking, and effective communication among students. The nuanced insights gleaned from both quantitative and qualitative assessments provide a robust foundation for understanding the holistic influence of the methodology on student behavior and attitudes.

VI. Findings

A. Interpretation of Findings in Relation to Objectives

The exceptional performance observed in the Chart Preparation, with 87% of teams excelling, directly aligns with the objective of evaluating the impact of problem-based learning on student engagement. Similarly, the consistent success rates of 73% in communication-centric activities like the Mock Interview, Goal Setting, and others directly address the objective of assessing the effectiveness of problem-based learning in enhancing language acquisition and communication skills. The varying success rates in different tasks provide a comprehensive understanding of the students' engagement and performance, lending nuanced insights that contribute to the interpretation of the study's objectives.

B. Implications of Problem-Based Language Learning

The implications of the findings underscore the significance of problem-based learning in fostering language acquisition within an engineering context. The consistent success rates in communication-rich tasks indicate that problem-based learning can effectively enhance language skills by providing real-world scenarios for application. The success of activities like the Mock Interview and Goal Setting, where communication is central, suggests that problem-based learning not only facilitates language acquisition but also prepares students for effective communication in professional settings. This bears implications for language learning methodologies, highlighting the potential of problem-based learning to bridge the gap between language education and practical linguistic competence.

C. Potential Benefits for Engineering Education

The outcomes of the various activities showcase the potential benefits of problem-based learning within engineering education. The exceptional teamwork displayed in the Chart Preparation, the cooperative abilities highlighted in the Paper Car Activity, and the interactive skills demonstrated in activities like Customer Interaction - Situational Play underscore the potential of problem-based learning to cultivate teamwork, collaboration, and effective communication – all vital skills for future engineers. Additionally, the consistent achievement of high success rates signifies the potential for problem-based learning to optimize skill development, preparing students for the multifaceted challenges of engineering careers. These findings emphasize the alignment of problem-based learning with the needs and aspirations of engineering education.

VII. Conclusion and Recommendations

The study's findings underscore the efficacy of problem-based language learning (PrBLL) in enhancing language acquisition and engagement in engineering education. A range of activities, from team-based tasks like Chart Preparation to communication-oriented exercises like Mock Interviews, consistently yielded impressive success rates. These outcomes offer a comprehensive insight into student engagement and performance, substantiating the potential of PrBLL to bolster language skills, teamwork, and communication abilities. The study's significance lies in the practicality of language acquisition through PrBLL, evidenced by successful tasks like Goal Setting and Converting Challenges into Opportunities. This approach bridges the gap between language learning and real-world application, preparing students for authentic linguistic engagement in their future engineering careers.

Considering these findings, implementing PrBLL in language classrooms within engineering education holds promise. The balanced mix of team-based and individual tasks, coupled with the optimization of time-consuming activities, can enhance the approach's efficiency. Addressing hesitant students, as exemplified by the success of the Customer Interaction - Situational Play, ensures inclusivity and active participation. Aligning activities with specific language learning objectives further ensures purposeful implementation. Beyond language education, PrBLL's success echoes the broader potential for educational innovation. By integrating problem-based approaches, educators can cultivate active, practical, and context-driven learning experiences that better equip students for the multifaceted challenges of the modern educational landscape.

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