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Improving English speaking fluency in engineering students through problem-based learning (PBL)

Ni Wayan Sadiyani[1], Selvie Ratna Ivone Mandang[2], Ni Putu Somawati[3]

Politeknik Negeri Bali[1,3]
Politeknik Negeri Manado[2]
[1]Email: niwayansadiyani@gmail.com
[2]Email: ivonemandang@gmail.com
[3]Email: somawati@pnb.ac.id

Abstract - This study examines the effectiveness of Problem-Based Learning (PBL) for improving English speaking fluency among engineering students at an Indonesian university. It aims to address persistent challenges in oral communication, including lack of confidence, limited exposure to authentic contexts, and reliance on passive instructional methods, by promoting active, collaborative, and contextually meaningful language practice. A quasi-experimental design was implemented over one semester, involving two student groups: an experimental group participating in PBL-driven English speaking sessions, and a control group receiving conventional instruction. Data collected included pre- and post-intervention assessments of speaking fluency, qualitative classroom observations, and student reflections. The intervention emphasized collaborative problem-solving tasks simulating real-world engineering scenarios rooted in constructivist learning principles. Quantitative analysis compared gains in speaking fluency, coherence, and language complexity between groups. The PBL group showed significantly greater improvement compared to the control group. Qualitative data indicated that students in the PBL group reported increased motivation, reduced anxiety, and higher engagement in communication tasks. The rich and cognitively demanding environment of PBL appeared to facilitate practical language use and deeper learning. Integrating PBL into English for Specific Purposes (ESP) instruction provides engineering students with authentic and engaging opportunities for language development. The study extends literature on innovative pedagogies and offers practical implications for curriculum designers and educators aiming to enhance communicative competence in STEM fields. Future research should address long-term impacts and scalability across varied educational contexts.

Keywords: : English speaking fluency, engineering students, problem-based learning (PBL), language education, communicative competence, ESP instruction

1. Introduction

In today's global engineering workforce, English speaking skills have become fundamental—almost as important as technical know-how—for graduates who aim to thrive in the international job arena (Alshareef, 2020; Liu et al., 2019). Engineering has transcended national boundaries, demanding constant collaboration across cultures, with English effectively serving as the universal language for technical teams (Kaur, 2020). In this context, speaking fluency is not just an extra; it is a vital soft skill that sits alongside technical expertise.

Despite its clear importance, achieving English speaking fluency remains an ongoing struggle among engineering undergraduates in non-English speaking countries. Common issues found among students include: Low confidence in using English verbally, Minimal authentic exposure to real-life communicative situations and Limited classroom interaction, which rarely prioritizes speaking practice (Alqahtani, 2019; Khan, 2016).

In Indonesia, these challenges are even more pronounced. English is positioned as a foreign language (EFL) and is taught through inflexible curricula that emphasize grammar and reading at the expense of spoken communication (Dewi et al., 2017). University engineering programs frequently focus almost exclusively on technical material, paying little attention to the development of students' communicative competence. As a result, we often see technically skilled graduates struggling to present or articulate their ideas in English—a stark mismatch between what industry demands and what education provides (Sulistiyo, 2016).

Given this persistent gap, a pedagogical shift is urgently needed. Approaches like Problem-Based Learning (PBL) have recently attracted attention within engineering education. As a student-centred, constructivist method, PBL encourages learners to engage actively with real-world problems, emphasizing collaboration and substantial language use (Hmelo-Silver, 2004; Savery, 2006). PBL's inherent focus on communication, teamwork, and critical thinking makes it especially appropriate for boosting engineering students' English fluency.

There is a strong industry demand for English speaking skills alongside technical competency. Non-English speaking environments, such as Indonesia, often lack appropriate pedagogical strategies for building spoken English fluency in engineers. Problem-Based Learning offers the potential to bridge this gap by embedding language development into content-rich, student-focused learning. This study explores the potential of PBL as a strategy to enhance English speaking fluency, aiming to close the gap between linguistic proficiency and the mastery of technical content.

English speaking proficiency has been consistently recognized as a core employability skill by global employers (Yusof et al., 2012; Jackson, 2014). Essential for success in settings such as Technical meetings, Project presentations, International conferences, and Multicultural project teams. Yet, many engineering students continue to face significant barriers when attempting to communicate complex technical ideas in English. Typical challenges include inadequate vocabulary specific to technical contexts, high levels of anxiety when speaking extemporaneously, scarce opportunities to engage in genuine speaking scenarios (Boonkit, 2010; Javid et al., 2012).

Speaking fluency itself goes beyond basic linguistic knowledge. As described by Nation and Newton (2009), it involves Speed and spontaneity in speech, accuracy and clarity of message, ability to structure discussion coherently, and the use of discourse markers and appropriate communicative registers. Goh and Burns (2012) argue that fluency encompasses not only linguistic but also pragmatic competencies—such as understanding social norms, strategic communication, and effective participation in discourse. For engineering students, mastering the structural rules of English is not sufficient. Communicative competence—adaptability, clarity, and appropriateness of speech—is required for professional contexts. Training should focus on both language systems and real-world pragmatic skills to prepare students for the global workplace.

There are long-standing obstacles to embedding English speaking skills in engineering curricula, particularly in non-English-speaking countries namely Content-driven curricula: Technical content takes priority over language development (Rahman et al., 2018). General English courses: Often fail to address the specific linguistic requirements of engineering (Hyland, 2006). Underrepresentation of speaking activities: Due to constraints such as Large class sizes, Limited teacher expertise in oral language pedagogy, and Persistent use of traditional, lecture-dominated approaches (Richards, 2008; Nurpahmi, 2017).

Research also reveals additional barriers: Low student motivation, where many engineering students perceive English speaking as unrelated or secondary to their core discipline (Halim & Halim, 2016). Foreign Language Speaking Anxiety (FLSA): A widespread phenomenon hampering student engagement and progress (Horwitz et al., 1986; Liu & Jackson, 2008).

There is a clear need for learning environments that are both supportive and interactive, encouraging students to practise English in meaningful, discipline-relevant contexts. Overcoming disconnects between educational offerings and industry expectations requires innovative teaching approaches, with active learning and communication at the centre. Technical competence is not matched by English speaking proficiency in many engineering programs. Language development is marginalized in favour of technical depth. Problem-Based Learning—via its attention to real-world communication and teamwork—emerges as a promising tool for addressing these gaps.

This paper investigates PBL as a pedagogical intervention within engineering education, aiming to foster both technical mastery and the English speaking competence required for graduates to participate fully in the international workforce. Problem-Based Learning (PBL) initially emerged in medical education during the 1960s (Barrows & Tamblyn, 1980). Since then, its scope has expanded, gaining traction in disciplines like engineering and language study (Duch et al., 2001). In its essence, PBL places students in small, collaborative groups and presents them with authentic, real-world problems to tackle. Under this model, teachers function more as facilitators or guides than as traditional information deliverers. This paradigm shift fosters: active engagement in which students participate directly in the learning process rather than passively receiving information. Autonomy where individuals have greater responsibility for their own learning choices. Intrinsic motivation, how engagement with real-world challenges sparks genuine interest.

In the context of language learning, PBL offers particularly robust advantages. Learners engage in the target language not for rote practice, but for meaningful, purpose-driven communication. Multiple studies highlight the following outcomes: Enhanced linguistic output: Students practice the language in a variety of authentic situations. Development of critical thinking: Open-ended, messy problems demand creative reasoning (Tan, 2003; Nunan, 2004; Simons et al., 2000). Intercultural communication skills: Real-world tasks reflect the diversity and complexity of actual communication.

Moreover, the multidisciplinary and open-ended nature of PBL means these activities simulate the ambiguity and negotiation found outside of textbooks, promoting a more genuine learning experience. From a theoretical standpoint, PBL finds support in sociocultural theory, particularly as framed by Vygotsky (1978). According to this view, language development occurs through social interaction, especially within a learner's Zone of Proximal Development (ZPD)—where support from peers and instructors scaffolds growth. Participation in group problem-solving enables learners to co-construct knowledge: Building understanding collaboratively with peers and to develop communicative competence: Engaging in dialogue sharpens speaking and reasoning abilities (Lantolf & Thorne, 2006).

In addition, Swain's (2005) output hypothesis suggests that actively producing language during complex tasks compels deeper processing, contributing to improved fluency and linguistic accuracy. Integrating PBL into English language instruction for engineering students offers numerous pedagogical benefits. Key contributions include sustained interaction and student-centred learning. The **Sustained Interaction** through repeated, meaningful exchanges while solving problems, students practice speaking at length. This repeated practice underpins: *Language automaticity*: Greater ease in producing speech over time. *Fluency development*: Increased comfort and speed in formulating ideas (Gatbonton & Segalowitz, 2005).

The Student-Centred Learning in PBL enables learners to direct their own efforts, cultivating: *Autonomy*: Taking ownership of learning leads to deeper engagement. *Reduced speaking anxiety*: The supportive, collaborative environment lowers affective barriers (Hmelo-Silver, 2004; Hung, 2011). Research supports the effectiveness of PBL approaches in language classrooms where university students participating in PBL-based English courses reported notable gains in fluency and speaking confidence compared to those in more traditional setups (Aghbaria & Araj, 2019). For engineering students, Rahimi and Sajjadi (2020) observed improvements in vocabulary range, organization of speaking topics, and reductions in hesitation.

PBL can be strategically aligned with English for Specific Purposes (ESP) in engineering by developing tasks rooted in real industry scenarios, such as: Project planning simulations, System troubleshooting exercises, and Ethics-based decision-making in engineering practice (Flowerdew, 2013). These contextualized tasks not only boost learner engagement but also equip students with language tools directly relevant to their future professions.

Despite its promise, effective PBL implementation is neither automatic nor effortless. It demands forethought at several levels namely teacher preparation, institutional support, and assessment adaption. In teacher preparation, instructors require ongoing training in PBL facilitation, including the art of posing discipline-specific, authentic problems and managing group dynamics (Hung, 2011). The institutional support where successful PBL environments depend on adequate time designation within curricula and access to technological and classroom resources for small-group work.

Traditional tests often fail to capture the dynamic, interactive nature of PBL learning. Alternatives include Performance-based rubrics focused on communicative outcomes, Peer evaluations to encourage active participation and accountability, and Reflective journals documenting students' learning trends (Brown & Abeywickrama, 2010; Boud & Falchikov, 2006). Classrooms may include students with a spectrum of language abilities and prior experiences. To ensure equitable learning, instructors should provide Scaffolded support (e.g., modeling complex tasks, guided questioning) and Visual supports for clarification and vocabulary expansion (Merrill, 2002). Through these strategies, PBL can offer a structured yet flexible environment. While it poses challenges for both educators and institutions, its capacity to foster authentic communication, critical thinking, and professional language use makes it a powerful pedagogical tool in the context of engineering language education.

2. Method

2.1 Research Design

This research adopted a quasi-experimental model using a mixed-methods approach to evaluate whether Problem-Based Learning (PBL) actually boosts English speaking fluency among engineering students. The integration of quantitative (measurable data) and qualitative (descriptive insights) methods enabled a comprehensive analysis of PBL's impact—not just in terms of language performance, but also considering motivation and classroom engagement.
Mixed Methods where Leveraged both statistical and narrative forms of data. Emphasized ecological validity; reflected real classroom dynamics and constraints. Methodology was informed by second language acquisition (SLA) and constructivist learning frameworks, which recognize language and knowledge construction as active, social processes in authentic contexts.

2.2 Participant

A total of 60 second-year undergraduate engineering students from a public university in Indonesia participated. Participants were drawn from two intact classes (30 students each), ensuring minimal disruption to standard educational practice. Students were randomly assigned at the classroom level to either: *Experimental group:* Received PBL-based instruction. *Control group:* Received traditional, lecture-based instruction. All students demonstrated intermediate (B1) English proficiency as established by standardized Oxford Placement Test scores. Informed consent was obtained from all participants. Confidentiality and anonymity were strictly assured. Withdrawal was permitted at any point, adhering to institutional and international ethical guidelines (Bryman, 2016).

2.3 Instructional Procedures

2.3.1 Control Group: Traditional Speaking Instruction

Students in the control group experienced standard English instruction as typically practiced in Engineering ESP classes in Indonesia. Teaching Format: Predominantly teacher-centred; heavy use of textbooks and formal exercises. Learning Activities: Included teacher explanations, grammatical drills, scripted dialogues, and vocabulary expansion. Interaction Patterns: Mostly limited to pair work or recitation; genuine communicative tasks were minimal. **Curriculum:** Instruction followed the university's approved ESP curriculum, emphasizing correctness and controlled language production at the expense of communicative authenticity (as referenced in Dewi et al., 2017).

2.3.2 Experimental Group: Problem-Based Learning (PBL) Instruction

The experimental group engaged in a 12-week PBL program, intended to create meaningful learning experiences by incorporating real-life engineering scenarios requiring collaborative English communication. Students worked in small groups (5–6 members). Weekly tasks included, for example Designing a sustainable energy system for a remote location, Planning a robotics competition as a team, Troubleshooting failed projects due to communication breakdowns, and Proposing solutions to ethical dilemmas in engineering contexts.

Structured PBL Cycle are as follows: *(1) Problem Presentation* — Introduction to the scenario and context. *(2) Problem Analysis* — Students mapped prior knowledge, identified learning needs, and planned steps. *(3) Self-Directed Learning* — Independent or sub-group research to gather information. *(4) Solution Development* — Teams discussed research findings, developed, and refined solutions. *(5) Presentation and Reflection* — Oral presentation of solutions, followed by peer feedback and reflective dialogue.

The instructor role functioned as a facilitator rather than a lecturer, providing scaffolding and monitoring student progress. The feedback emphasized fluency, vocabulary, discourse management, and pronunciation, aiming to cultivate confidence and competence in spontaneous communication.

2.4 Data Collection Instruments

2.4.1 Speaking Fluency Assessment

To objectively track any improvement, both pre-test and post-test assessments were conducted: *Impromptu speaking task* (e.g., technical process description). *Paired problem-solving discussion.* All sessions were audio-recorded, ensuring reliability and accuracy in evaluation.

2.4.2 Qualitative Data Collection

To gain richer insights into student experience and perception, the following qualitative tools were utilized: (a) Classroom observations: Provided by the instructor/researcher. (b) Student reflection journals: Recorded students' evolving attitudes and strategies. (c) Semi-structured interviews: Explored students' subjective experiences in more depth.

The quasi-experimental approach is particularly appropriate for classroom-based research, where random assignment often isn't feasible or ethical. By preserving intact classrooms and natural teaching contexts, findings are more relevant to real-world educational settings. Integrating multiple forms of data enables a nuanced appreciation of not just the "what," but the "how" and "why" behind observed outcomes.

This study's methodology sought to balance experimental rigor with the realities of classroom learning, providing a robust framework for evaluating PBL's effectiveness in improving English speaking fluency among engineering students.

2.4.3 Student Reflection Journals

So, in the experimental group, students had to jot down weekly reflections. Not exactly your average "Dear Diary" stuff—they wrote about what went down that week, what tripped them up, how their groups worked (or didn't), and whether they felt any smarter or more capable. These journals, honestly, were goldmines for figuring out how students actually felt and thought their way through PBL. Way more interesting than boring old test scores, if you ask me.

2.4.4 Semi-Structured Interviews

After everything wrapped up, ten students got roped into interviews. And no, they weren't picked out of a hat—this was more of a "let's get a mix of everyone" situation, based on who was thriving and who was…well, not so much. The questions were semi-structured, so there was a plan, but also plenty of room for rambling and real talk about how PBL worked (or didn't), how it affected their speaking game, and what tripped them up along the way. Each chat ran about 20–30 minutes and ended up transcribed—so yes, every cringe and awkward pause lived on forever.

2.5 Data Analysis

2.5.1 Quantitative Analysis

When it came to crunching the numbers, the researchers didn't just wing it. They threw the pre- and post-test speaking scores into some serious paired t-tests to see if students actually improved. And just for fun, they ran some independent t-tests to see if the experimental group left the control group in the dust. If something popped up as important (aka $p < 0.05$), they actually paid attention. They laid out the basic stats too—averages, stdev, effect size—all that jazz to show if improvements were a big deal or just meh.

2.5.2 Qualitative Analysis

For the touchy-feely, wordy stuff—observations, journals, interviews—the team rolled up their sleeves and dug into thematic analysis, doing it Braun and Clarke's way (from 2006, if you like to keep score). Basically, they looked for stuff that came up over and over: who got involved, who gave a damn, how the group dynamics played out, whether anyone felt their speaking was better, and what headaches came up. Oh, and to keep things legit, they checked across all sources to make sure nothing was totally out of left field.

3. Results and Discussion

3.1 Results

3.1.1 Pre- and Post-Test Results

Table 1 below summarizes the mean scores and standard deviations for the pre- and post-tests of the experimental and control groups.

Table 1: Pre- and Post-Test Speaking Fluency Scores

Group	Test	Mean Score	SD	Mean Gain
Experimental	Pre-Test	62.3	5.4	
	Post-Test	78.1	4.8	15.8
Control	Pre-Test	63.1	5.6	
	Post-Test	68.9	5.2	5.8

Examining the speaking fluency scores in Table 1, the quantitative results reveal a distinct difference in improvement between the experimental and control groups following the intervention. Both groups began at relatively similar baselines, with the experimental group reporting a pre-test mean of 62.3 (SD = 5.4) and the control group at 63.1 (SD = 5.6) on the speaking fluency measure. However, on the post-test, the experimental group exhibited a notable increase, reaching a mean score of 78.1 (SD = 4.8), compared to the control group's more modest improvement to 68.9 (SD = 5.2). This translates to a mean gain of 15.8 for the experimental group, compared to only 5.8 in the control group.

Statistical analysis underscores the significance of these differences. A paired-sample t-test showed that the experimental group's improvement was highly significant ($t(29) = 14.21$, $p < 0.001$), accompanied by a large effect size (Cohen's $d = 1.91$), which suggests the intervention's robust impact on speaking fluency. The control group's results also passed the threshold for statistical significance ($t(29) = 6.05$, $p < 0.001$), yet the effect size was much smaller (Cohen's $d = 0.73$), indicating a less substantial gain. Furthermore, comparing the mean gains between groups using an independent-samples t-test revealed an unequivocal advantage for the experimental group ($t(58) = 9.28$, $p < 0.001$), supporting the conclusion that Project-Based Learning (PBL) led to superior outcomes in speaking fluency.

Beyond aggregate fluency scores, a component-level analysis of the data presents a

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multidimensional enhancement in the experimental group's oral proficiency. Specifically, the investigation targeted improvements in four domains: speech rate, lexical range, grammatical accuracy, and discourse coherence. First, in terms of speech rate and fluidity, the experimental group increased their output by an average of 24 words per minute. This reflects not only a higher volume of language production, but also an ability to communicate more spontaneously and with fewer hesitations—features widely recognized as hallmarks of fluency. The increased pace suggests a transition toward more automatic language use, which is crucial for real-time communication.

Second, the lexical range of the experimental group broadened by 18%. Participants demonstrated greater versatility in vocabulary use, including the incorporation of contextually relevant and subject-specific terminology. This growth is particularly valuable, as an expanded lexical repertoire empowers learners to articulate more precise and nuanced ideas. Third, the data indicate a 15% improvement in grammatical accuracy, as evidenced by a reduction in the number of errors per utterance. Enhanced grammatical control not only leads to clearer, more accurate speech, but also fosters greater listener comprehension and engagement.

Finally, notable gains in discourse coherence were observed. The learners improved in both logical sequencing of ideas and their use of cohesive devices (such as conjunctions and referential expressions). Such developments facilitate listeners' understanding and signal the speaker's ability to construct well-organized, connected discourse.

Collectively, these findings suggest that the PBL approach cultivated not just superficial gains on standardized assessments but also fundamental improvements across several core competencies of spoken language. The multidimensional development is particularly significant, as it demonstrates that learners enhanced both the quantity and the quality of their oral communication. Importantly, these quantitative outcomes have clear pedagogical implications. They support a growing body of research that suggests project-based, communicative methodologies can have a pronounced effect on second language oral proficiency, especially when implemented with sufficient rigor and support. Compared with more traditional, didactic methods, PBL offers a meaningful context for authentic language use, which, as the data suggest, translates into measurable gains on key fluency indicators.

The results unequivocally point to the effectiveness of the PBL intervention in promoting holistic speaking fluency among learners. These improvements—encompassing fluidity, lexical sophistication, accuracy, and coherence—are integral to successful real-world communication. Such evidence advocates for the continued implementation and further exploration of PBL and similar learner-centred approaches in language education.

3.2 Discussion

If you peeked in on a PBL session, you'd probably spot students bouncing ideas off each other like it's some kind of group hackathon. Folks didn't just sit there yawning—they jumped in, asked stuff when confused, even swapped roles like nobody's business. Dropping into their journals, the same vibe pops up: people actually felt in charge of their own learning for once. Power move. They kept mentioning how freeing it was not having someone spoon-feed them everything. "I enjoyed solving the problems with my group. It felt like real teamwork. I was not just learning English, I was using it to think and make decisions." (Student Journal Entry, Week 6) See? Not just grinding through language drills. They were brainstorming, disagreeing, figuring stuff out together. Honestly, I wish more classes worked like this. Savery (2006) and Hung (2011) already called it: PBL fires up people's motivation and gives learners more control—especially adults, who generally hate being babysat.

So, students flat-out said they liked wrestling with real engineering problems, not some fake worksheet from 2002. They felt like the speaking stuff mattered, like, for once they were learning something genuinely useful, not just memorizing random phrases.

> "Talking about real engineering issues helped me use the vocabulary I need for my future. It was not just general English – it was English I could use in my career."

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(Interview, Student A).

Absolutely. When classroom activities genuinely reflect real-world situations, student engagement noticeably increases. Flowerdew (2013) and Hyland (2006) support this perspective, emphasizing that integrating authentic content and purposeful tasks—especially in ESP (English for Specific Purposes) contexts—has meaningful impact. Essentially, discarding overly generic materials in favour of authentic ones results in learners who are more invested; their focus improves, and their language development feels relevant rather than arbitrary.

Admittedly, speaking a new language in front of an audience can be intimidating for almost anyone. However, facilitating small group work often alleviates much of that anxiety. Learners in these settings tend to support one another, mitigating pressure and promoting a more collaborative, encouraging environment.

> "At first I was nervous, but working with my group made me feel more comfortable. We supported each other." (Interview, Student C)

There's a reason Horwitz et al. (1986) and Liu & Jackson (2008) harp on this—get rid of that pressure, and folks actually take risks, mess up, and learn something. The group basically turns into a safety net, making it 100x easier to speak up (even if you butcher half the grammar). Observation data made it painfully obvious: PBL sessions just give students way more genuine opportunities for speaking than old-school, lecture-heavy classes. Instead of just tossing out a fast answer (or, let's be honest, repeating whatever the teacher said five seconds ago), students in the PBL group actually got into deep, extended discussions. You'd find them planning out projects, running group debates, presenting their findings—none of this was just "say your vocabulary word and sit down." In concrete terms, every PBL cycle usually guaranteed at least two sessions where students hashed things out in groups and another where teams stood up for formal presentations—meaning, per student, you're talking 100–120 minutes of actual, real-deal talk time each week. That's a massive leap from the 40 to 50 minutes kids usually get in your standard classroom. This directly backs up Nation & Newton's (2009) point that true growth in fluency needs a heap of real-world, sustained output. The way PBL discussions keep making students repeat, rephrase, and build their ideas? That's seriously pushing their automaticity and ability to manage longer stretches of discourse, which is what fluency is all about.

Looking at the implementation in English classes for engineering students, it was actually remarkable how quickly PBL shifted both fluency and engagement upwards. Students in these classes weren't passive listeners or micro-responders anymore; they were active contributors, tackling authentic scenarios much like ones they'd face in actual engineering workplaces. This lines up solidly with the social-interactionist theories put forward by Vygotsky (1978) and extended by Lantolf & Thorne (2006). Language acquisition, these theorists argue, flourishes when it's rooted in purposeful social activity. By shaping class sessions around real-life engineering challenges, PBL didn't just make students regurgitate textbook phrases — it pushed them to generate language on the fly, adapting and refining as they went.

This dynamic fits seamlessly with Swain's (2005) output hypothesis, which highlights the need for learners to actually *produce* language if they're going to process it deeply. Through cycles of problem analysis, heated negotiation, and extended group discussion, students not only moved past rote learning, but began to craft responses that demonstrated true communicative competence. The tasks weren't just filler—they were engines driving real linguistic and cognitive activity.

Notably, one of the standout achievements was a clear uptick in the use of technical vocabulary and more sophisticated discourse strategies during discussions. Students got to work with terminology relevant to their future professions, and developed the pragmatic skill to wield these words in job-related dialogue. This happens to dovetail with Hyland's (2006) vision of ESP (English for Specific Purposes), where teaching really centres on the linguistic needs of each discipline. PBL, in this case, functioned like a tailor-made delivery system for ESP: by embedding technical content, students organically picked up language forms that have direct relevance outside the classroom.

The affective side of things turned out to be just as important. PBL didn't just boost language skills; students felt better about the whole process. They reported feeling less anxious about speaking, more comfortable taking risks, and more pumped to show up and participate. Krashen's (1982) Affective Filter Hypothesis has always suggested that when anxiety drops, acquisition goes up — and the supportive group environment in these PBL classes definitely delivered here. Through shared responsibility and the safety of peer support, students faced far less fear of negative evaluation (a massive barrier, per Horwitz et al., 1986). This allowed them to participate more freely, experiment, and ultimately gain more.

Taking a broader perspective, the PBL approach doesn't merely enhance English proficiency in isolation—it also cultivates a range of essential "soft" skills for 21st-century engineers. These include teamwork, critical thinking, effective problem-solving, and, perhaps most importantly, the clear communication of complex ideas. This integrated approach—combining language development with wider professional competencies—positions PBL as a genuinely holistic educational model. Scholars and business leaders such as Jackson (2014) and Yusof et al. (2012) have emphasized the importance of preparing graduates for today's complex, collaborative, and creative work environments. Embedding PBL within ESP contexts ensures that students develop not only exam-oriented language abilities, but also the practical, workplace communication skills valued by modern employers.

The impact of PBL on students' fluency, confidence, and professional preparedness—particularly in engineering—underscores the theoretical and practical advantages of merging interactive learning with targeted language acquisition. In this way, classes transcend traditional, procedural exercises and become dynamic environments for the collaborative language use demanded in contemporary professional settings.

Drawing on the key findings from this study, there are several salient implications for stakeholders across the educational spectrum—educators, curriculum planners, and policy-makers alike. To begin with, in terms of curriculum design, it is essential that English language instruction for engineering students be contextualized through the integration of problem-based learning (PBL) tasks that closely mirror authentic challenges from the field of engineering. This alignment not only increases the relevance of instructional content but also supports the holistic development of communicative fluency, as students are prompted to grapple with professionally meaningful problems.

Furthermore, these demands inevitably reshape teacher preparation. It is crucial that instructors receive sustained professional development, specifically centred on the facilitation of PBL, the creation of nuanced tasks, and the implementation of assessment frameworks that are attuned to the linguistic and cognitive demands of content-rich settings. Such targeted support ensures that teachers are equipped not only to deliver the material but also to foster genuine language growth among their students.

Assessment, too, emerges as a space ripe for innovation. Rather than relying exclusively on traditional speaking tests, educational institutions should consider a more dynamic, performance-based approach. This could encompass group presentations, opportunities for structured peer feedback, and reflective activities. Together, these assessment forms enable more nuanced evaluations of speaking fluency while providing learners with formative, process-oriented insights into their development. Institutional backing remains a decisive factor in sustaining PBL initiatives. To this end, investment is necessary—not merely in terms of physical infrastructure, such as adaptable classrooms, but also through policies that support reduced class sizes conducive to active, small-group work, as well as enhanced access to multimedia and technology resources that can facilitate interactive learning.

That said, it is important to acknowledge this study's limitations. The sample, comprising

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students from a single institution, potentially narrows the scope for broader generalization. Additionally, the focus on immediate or short-term gains in speaking fluency leaves open questions regarding the durability or workplace transferability of these language skills—dimensions that matter greatly for real-world impact. Moving forward, future scholarly inquiry would benefit from several avenues of extension. First, longitudinal research could illuminate whether the proficiency gains observed through PBL approaches are sustained over time and in diverse contexts. Second, exploring the integration of digital platforms—such as virtual simulations or collaborative online environments—may increase the accessibility and engagement of PBL, especially as educational technology proliferates. Third, comparative investigations into how PBL functions across different cultures could provide valuable insights, given the global and multicultural nature of STEM education. Lastly, examining group dynamics, including gender roles and participation patterns, would help ensure that PBL environments foster equity and inclusivity for all learners.

The study adds robust empirical support to the view that problem-based learning constitutes a powerful approach for enhancing English speaking fluency among engineering students, especially in English as a Foreign Language (EFL) contexts where communicative competence often remains elusive. By embedding linguistic practice in authentic, discipline-specific scenarios, PBL not only amplifies language skills but also bolsters student motivation, decreases communicative anxiety, and cultivates essential soft skills such as collaboration and critical thinking. These outcomes point to PBL as a transformative model deserving broader adoption in English for Specific Purposes (ESP) programs, particularly within STEM fields where language barriers may otherwise hinder professional development and workplace readiness.

4. Conclusion

This study set out to examine whether Problem-Based Learning (PBL) can genuinely boost English speaking fluency among engineering students—a topic that's become pretty pressing these days. In today's global engineering landscape, communication isn't just some soft skill tacked onto a résumé; it's central, particularly with so many projects crossing borders and drawing teams from all sorts of backgrounds. It's not just a bonus anymore—it's becoming non-negotiable for young engineers to be able to express ideas clearly, negotiate, and collaborate in English.

Traditionally, English instruction for technical students has leaned hard on rote memorization and grammar-translation methods. These methods rarely go beyond drilling students on rules or stock phrases, and honestly, their real-world value is questionable. They might churn out students who can ace a grammar test or fill out the blanks, but put them in an actual meeting or ask them to present? Frequently, those skills fall flat. This disconnect between classroom exercises and the kinds of interactions engineers actually have in the workplace has long been an issue, and it leaves graduates ill-equipped for the demands of international communication in their field.

Problem-Based Learning, on the other hand, offers a fresh, learner-centred approach, where students engage in tackling authentic, complicated problems, usually in teams. It requires them to produce language as part of solving realistic tasks, pushing them well beyond simply memorizing content. In this context, PBL doesn't just make sense pedagogically—it almost feels essential. Students need to be able to explain ideas, argue their points, pitch solutions, and clarify misunderstandings, all in real time and in English. The findings of this study really drive that point home: students exposed to PBL showed significant gains not just in fluency, but also in vocabulary depth, pronunciation, and their ability to string together more sophisticated sentences.

The most significant aspect here extends well beyond just acquiring vocabulary or mastering grammar; the broader impact lies in affective factors that are often overlooked in language learning. Participants expressed increased motivation—something notoriously difficult to foster in traditional language classrooms. Their engagement improved, and they experienced reduced anxiety about speaking English. Anyone who has ever struggled through communicating in a second language can relate to that challenge. These social and emotional elements aren't trivial; in fact, they often represent the primary obstacles preventing learners from actively using their language skills.

One of the most valuable features of PBL is its capacity to give students a low-stakes environment for real-life practice. By simulating professional scenarios—putting students in the position of engineers solving technical challenges and having to communicate their process and solutions in English—PBL makes the language meaningful. It isn't practice for the sake of abstract improvement; it's tied to the kinds of situations students will genuinely face in their future careers. The engineering context provides a substantive foundation and lures students into communicating because there's a pressing need to reach understanding, not just a grade to achieve.

All of this aligns well with established theories in language acquisition, particularly the input-interaction-output model. According to scholars like Swain (2005) and Long (1996), language fluency develops through meaningful use, back-and-forth interaction, and producing output in real situations—precisely what PBL encourages. The study's results also echo the conclusions of researchers who have long supported experiential and task-based learning (think Nunan, 2004; Richards & Rodgers, 2014). They all arrive at the same takeaway: for English for Specific Purposes, especially in technical and vocational spheres, instructional methods that centre on authentic tasks are far more effective than the old models.

Integrating PBL into technical English instruction does more than improve classroom test scores. It equips students with the practical skills and the confidence to participate in the kind of communicative, cross-disciplinary work that defines contemporary engineering. The evidence is robust: when language use is embedded within engaging, relevant problem-solving activities, students make real leaps not just linguistically, but cognitively and professionally as well.

Furthermore, the implementation of Problem-Based Learning (PBL) significantly enhanced students' affective responses toward English speaking. Language anxiety—so often a pervasive and paralyzing barrier for non-native speakers—showed a marked decrease among those in the PBL group. This reduction in anxiety can be attributed to the collaborative and interactive nature of PBL environments, where students engage in problem-solving as part of small, supportive teams. Through mutual encouragement, ongoing peer feedback, and opportunities to practice in context-rich situations, learners are able to build confidence incrementally. In effect, PBL classrooms foster a psychologically safe atmosphere, one where linguistic risk-taking is normalized and even encouraged (Horwitz, 2016). Students, as a result, do not simply make gains in technical fluency or grammatical correctness. They also develop a sense of agency as communicators—an attribute absolutely vital for future engineers, who must frequently engage in high-stakes, team-based projects and interdisciplinary collaboration, often across cultural and linguistic borders.

Nevertheless, the implementation of PBL brings with it a series of non-trivial challenges. The approach necessitates meticulous and contextually relevant preparation; instructors must design authentic problem scenarios that resonate with both the realities of engineering and the linguistic goals of the course. This, in turn, requires investment in instructor training—not only in PBL philosophies, but also in advanced facilitation strategies suited for language learners. Assessment practices, too, must be restructured to reflect process-oriented rather than purely outcome-based achievement, ensuring that the skills fostered through PBL are captured and valued. Instructors, therefore, are compelled to move away from the conventional role of knowledge transmitter, instead adopting the more dynamic position of learning facilitator—supporting students' self-directed learning, mediating group dynamics, and scaffolding skill development.

Such a substantial pedagogical shift evidently calls for thoughtful institutional support.

Professional development initiatives, increased curricular flexibility, and the allocation of planning resources all become essential if PBL is to be implemented with fidelity and sustained over time. Despite the obstacles, the accumulating body of research—supported by the present study—demonstrates that the long-term benefits of embedding PBL within language instruction more than justify these efforts. Beyond measurable increases in fluency, PBL nurtures a suite of transferable competencies: critical thinking, collaborative problem-solving, information synthesis, and oral communication skills. These are not simply desirable add-ons; they are fundamental capabilities demanded by modern engineering practice and explicitly echoed in frameworks for twenty-first century skills (Trilling & Fadel, 2009).

It is therefore clear that PBL serves a dual function. It addresses explicit linguistic outcomes, certainly, but also cultivates academic and professional competencies in a holistic and interrelated manner. In summary, the findings of this study reinforce the efficacy of Problem-Based Learning as not just an alternative, but as a compelling pedagogical approach for the cultivation of English speaking fluency in engineering education. Notably, PBL presents an effective platform for contextualized, purposeful language use that mirrors the communicative challenges engineers face in real-world professional practice. It facilitates the development of fluency not as an isolated, abstract skill, but as an integrated aspect of collaborative knowledge-building and problem-solving.

The evidence collected here suggests that engineering programs should strongly consider adopting PBL-informed language pedagogy to better equip their students for the demands of an increasingly interconnected, globalized workforce. Future research could fruitfully expand this line of inquiry: for instance, by examining the longitudinal impacts of PBL on language retention and professional communication, exploring its efficacy in hybrid or remote learning environments, or considering how best to tailor PBL strategies to accommodate differing language proficiency levels. Comparative studies across various academic disciplines and cultural contexts could also yield valuable insights regarding the adaptability and scalability of PBL as a pedagogical model.

Ultimately, the adoption of PBL in English language instruction stands as a progressive and necessary step toward realigning teaching practices with the complex communicative realities facing twenty-first century engineers. Realizing this vision will require collaboration and sustained commitment from institutional leaders, educators, and curriculum developers. With adequate support, future engineers can graduate not only with robust technical expertise, but also with the confidence, fluency, and communicative competence essential for meaningful engagement in the global professional landscape.

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