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INTEGRATING STEM VOCABULARY INTO ENGLISH LANGUAGE TEACHING: CHALLENGES AND RENEWABLE ENERGY POTENTIAL IN THE DEPARTMENT OF ELECTRICAL ENGINEERING

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Abstract

The integration of STEM (Science, Technology, Engineering, and Mathematics) vocabulary into English Language Teaching (ELT) is becoming increasingly crucial in higher education, particularly for engineering students who must engage with global technical literature and communication. This study explores the challenges and opportunities in incorporating renewable energy-related vocabulary into the English curriculum of the Department of Electrical Engineering at the University of Mataram. Through a mixed-methods approach involving a needs analysis, classroom observations, and interviews with students and instructors, the research identifies key linguistic gaps, pedagogical constraints, and resource limitations. Simultaneously, the study highlights the potential of local renewable energy contexts such as solar, wind, and micro-hydro systems in West Nusa Tenggara as culturally relevant entry points for vocabulary acquisition. The findings suggest that embedding STEM vocabulary within project-based and content-based instruction not only enhances technical language proficiency but also fosters students' critical awareness of sustainable energy development in their region. This

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paper concludes with pedagogical recommendations for curriculum designers and English instructors aiming to align ELT more closely with the needs of engineering disciplines.
Keywords: STEM, English, Vocabulary, Engineering, ELT.

Introduction

In the 21st century, the role of English in scientific and technological communication has become indispensable. Particularly in the field of electrical engineering, the ability to comprehend and use technical English is no longer optional but essential. This is due to the dominance of English as the primary language in international journals, research collaboration, product manuals, and global engineering standards. However, engineering students in non-English speaking countries, such as Indonesia, often face significant difficulties in mastering the specific vocabulary associated with science, technology, engineering, and mathematics (STEM). Despite undergoing general English courses, many students find it challenging to decode technical terms and academic expressions that are frequently used in engineering contexts.

In the case of the Department of Electrical Engineering at the University of Mataram, this challenge becomes even more pronounced as the curriculum emphasizes hands-on applications of renewable energy technologies, such as solar panels, wind turbines, and micro-hydro systems. These fields require students to engage with specialized texts and technical documentation written predominantly in English. The integration of STEM vocabulary into English Language Teaching (ELT) thus emerges as a strategic response to bridge the gap between language education and students' academic and professional needs. Rather than teaching English in isolation, embedding content-specific vocabulary within the learning process may significantly enhance both linguistic competence and subject-matter understanding.

Moreover, the Indonesian government has prioritized the development of renewable energy in its national energy policy. This momentum creates an opportunity to align English language learning with real-world applications, particularly in regions like

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West Nusa Tenggara, where renewable energy potential is high but underutilized. The teaching of English through relevant STEM topics, especially renewable energy, offers a dual benefit: it supports students' communication skills and raises their environmental awareness. For instance, discussing how solar energy works or designing a presentation on energy-saving circuits allows students to practice English while reinforcing their engineering knowledge.

Despite these advantages, several challenges hinder the effective integration of STEM vocabulary in ELT. Among them are the lack of appropriate teaching materials, limited collaboration between English instructors and engineering lecturers, and students' low motivation due to the abstractness of vocabulary learning when disconnected from practical use. There is also a pedagogical concern: most English lecturers are trained in linguistics or literature, not in science or engineering. This background mismatch creates barriers to curriculum alignment and content-based instruction, which is necessary for meaningful vocabulary acquisition in STEM disciplines.

This study seeks to investigate how the teaching of STEM vocabulary particularly in renewable energy contexts can be improved within the English courses at the Department of Electrical Engineering, University of Mataram. By identifying the existing obstacles and examining the potential for local content integration, this research contributes to the development of a more functional and discipline-specific English language curriculum. Ultimately, the study aims to promote a model of English language instruction that is responsive to students' academic fields, aligns with national sustainability goals, and empowers future engineers with the linguistic tools to operate in a globalized, eco-conscious world

The integration of content knowledge with language instruction, often referred to as Content and Language Integrated Learning (CLIL), has been widely researched in multilingual education contexts. CLIL aims to develop students' language competence through subject-matter content, making it a suitable model for teaching STEM vocabulary in English language classrooms (Coyle, Hood & Marsh, 2010). In the context of

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engineering education, English for Specific Purposes (ESP) is another well established approach. ESP focuses on equipping learners with language skills that are directly applicable to their professional or academic fields (Hutchinson & Waters, 1987). For engineering students, this means a strong emphasis on technical vocabulary, passive voice, modal verbs for instructions, and schematic diagram interpretation.

Several studies emphasize the importance of vocabulary depth and domain-specific word knowledge in mastering STEM texts. Nation (2001) points out that technical vocabulary is often semi-technical, meaning it exists in both general and specialized forms (e.g., "current," "load," "power"). Therefore, teaching strategies must account for multiple layers of meaning and contextual usage. Research by Coxhead (2000) introduced the Academic Word List (AWL), which has been extended in engineering contexts by creating specialized lists like the Engineering Academic Word List (EAWL). These resources provide practical tools for English instructors who want to target vocabulary that students will encounter in textbooks, lab instructions, and technical articles.

Meanwhile, STEM-based ELT practices in Indonesia are still developing. A study by Ardi (2018) found that many Indonesian universities lack structured ESP courses tailored to engineering disciplines. English classes tend to focus on general skills, with insufficient integration of real-world tasks and technical terminology relevant to students' majors. Another relevant concept is Situated Learning Theory (Lave & Wenger, 1991), which posits that knowledge is best acquired when embedded within authentic activities. Applying this to ELT means that vocabulary is more effectively retained when learned through practical engineering projects or case studies such as building a solar power system rather than through isolated word lists.

There is growing interest in project-based learning (PBL) as a method to integrate STEM and language instruction. Studies show that PBL encourages active learning and better retention of both technical concepts and language (Beckett & Slater, 2005). For example, students tasked with writing an English report on their capstone project can

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naturally acquire relevant vocabulary. The literature also discusses the role of local context in vocabulary instruction. Using local case studies like renewable energy projects in West Nusa Tenggara can make lessons more relatable and motivate learners (Rahmawati & Daryanto, 2020). Culturally relevant materials increase engagement and bridge the gap between abstract terminology and students' lived experiences.

Challenges persist, particularly in teacher preparedness and curriculum design. Many ELT instructors lack familiarity with STEM fields and feel ill equipped to teach content-specific English. Conversely, engineering lecturers may not have the linguistic tools to support students' English development, leading to a disconnect in interdisciplinary collaboration. Despite these barriers, there is a clear consensus in the literature on the value of integrated language and content instruction in higher education. Effective integration requires institutional support, professional development for teachers, and the creation of context-sensitive teaching materials that link technical knowledge with language use. These insights inform the current study's exploration of STEM vocabulary instruction within the renewable energy curriculum of the University of Mataram.

Method

This study adopts a qualitative case study approach to explore the integration of STEM vocabulary into English Language Teaching (ELT) within the context of renewable energy education at the Department of Electrical Engineering, University of Mataram. The case study method is appropriate for in-depth exploration of real-life educational settings, allowing the researcher to gain nuanced insights into participants' experiences, perceptions, and instructional practices. The research site was purposefully selected due to the department's growing emphasis on renewable energy technologies and its ongoing efforts to internationalize the curriculum. As an institution situated in a region rich in renewable energy potential, the University of Mataram serves as a relevant context for examining the intersection of language, technical knowledge, and sustainability.

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Participants consisted of two groups: (1) English lecturers who teach General English and ESP courses for engineering students, and (2) electrical engineering students in their 4th and 6th semesters. A total of 1 lecturer and 10 students participated in the study. Participants were selected through purposive sampling to ensure they had relevant experience with both English learning and technical coursework in renewable energy. Data was collected using multiple sources to ensure triangulation and reliability. These included semi-structured interviews, classroom observations, and document analysis. Interviews were conducted in Bahasa Indonesia and later translated into English to preserve meaning and accuracy. Observations focused on classroom interactions, teaching materials, and the use of STEM related vocabulary.

Interview questions for lecturers focused on curriculum design, vocabulary teaching strategies, perceived challenges in teaching technical language, and opportunities for collaboration with engineering faculty. For students, interview questions explored their experiences with learning technical English, perceived difficulties, and suggestions for improvement. Classroom observations were conducted over a period of four weeks in both English and engineering-related classes that included instruction on renewable energy topics. These observations aimed to document how and when technical vocabulary appeared in instruction, and whether it was integrated or treated separately from language instruction.

Document analysis included syllabi, teaching modules, student assignments, and vocabulary lists used in class. These materials were analyzed to assess the extent to which STEM vocabulary, especially related to renewable energy, was explicitly included in instructional planning and assessment. Data were analyzed using thematic analysis, following Braun and Clarke's (2006) six phase framework. Transcribed data were coded manually, and themes were developed inductively, focusing on patterns related to vocabulary integration, teacher-student interaction, material relevance, and local contextualization.

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To enhance trustworthiness, member checking was conducted with selected participants to verify the accuracy of interpretations. Furthermore, peer debriefing sessions were held with fellow researchers from the Faculty of Teacher Training and Education to refine coding categories and validate emerging themes. Ethical considerations were addressed by obtaining informed consent from all participants, ensuring anonymity, and maintaining confidentiality. The research was approved by the university's ethics committee and conducted in accordance with ethical guidelines for research involving human subjects. The next section presents the findings of this study, grouped under key thematic categories.

Findings

The data collected through interviews, observations, and document analysis revealed a significant disconnect between English language instruction and the students' technical learning needs. While the English curriculum at the Department of Electrical Engineering includes general skills such as grammar, reading, and conversation, it lacks targeted instruction on technical vocabulary related to electrical engineering and renewable energy systems.

One of the clearest findings from student interviews is their difficulty in understanding technical materials in English, particularly texts related to solar energy, circuit analysis, and power systems. Many students mentioned that they often rely on Indonesian translations or peer explanations to understand essential concepts, which undermines their confidence when accessing English-language academic resources or manuals.

From classroom observations, it was apparent that technical vocabulary rarely appears in English teaching sessions. Instructors tend to avoid using engineering-related terms due to their unfamiliarity with the subject matter. Consequently, opportunities to contextualize language learning through STEM content are missed, leading to surface-level engagement with the language and limited vocabulary acquisition.

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Conversely, engineering lecturers reported that they frequently use English terminology in technical classes, but they do not explain them linguistically or semantically. Students are expected to acquire these terms passively, which contributes to confusion and poor retention. This reinforces the argument that explicit vocabulary instruction in context is necessary for meaningful language development in technical fields (Nation, 2001).

Another major theme that emerged was the potential of local renewable energy initiatives to serve as relevant content for English instruction. Many students had hands-on experience with solar home systems or community micro-hydro installations, particularly in rural areas of West Nusa Tenggara. However, these experiences were not being integrated into English learning activities despite their educational potential.

Discussion

The use of authentic, project-based tasks was identified as a promising solution. Students expressed greater interest and motivation when learning vocabulary that was directly tied to their final projects, such as “solar inverter,” “charge controller,” and “efficiency ratio.” This aligns with Beckett and Slater’s (2005) argument that project-based learning fosters deeper linguistic and conceptual understanding through active engagement.

Lecturers also highlighted the need for interdisciplinary collaboration. English instructors acknowledged that they lacked confidence in selecting or creating materials that reflect engineering content. On the other hand, engineering lecturers were open to contributing content but required support in simplifying language for instructional purposes. This mutual need suggests that collaborative teaching and co-planning could enhance both departments’ effectiveness.

Document analysis further confirmed the limited integration of STEM content. Most English modules were generic, with only minor references to technical fields. Assignments were centered on topics such as “introducing yourself” or “describing daily

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routines," with no scaffolding toward writing a project abstract, describing technical processes, or interpreting engineering diagrams—all of which are key academic and professional skills in the field.

Importantly, students reported that their confidence in using English improved when vocabulary was grounded in familiar, practical experiences. For example, one group of students had completed a renewable energy design competition and later presented their project in English. They recalled this experience as the most effective form of language learning during their university years, as it required them to internalize and apply technical vocabulary in a real-world context.

Overall, the findings indicate a strong need for curriculum redesign that intentionally embeds STEM vocabulary—especially in the context of renewable energy—into English language teaching. Such integration can enhance students' academic literacy, prepare them for global technical discourse, and connect language learning with national sustainability goals. Addressing this need will require coordinated efforts among language instructors, engineering faculty, and curriculum developers to bridge the current gap between language and content in engineering education.

Conclusion

This study has explored the integration of STEM vocabulary specifically in the field of renewable energy into English Language Teaching (ELT) within the Department of Electrical Engineering at the University of Mataram. The findings highlight a clear gap between the English curriculum and students' actual academic and professional language needs. It is evident that although electrical engineering students are exposed to renewable energy concepts in their technical courses, they often lack the English language tools necessary to articulate and understand these concepts in global contexts. This mismatch hinders their ability to engage with international academic resources and communicate effectively in professional settings.

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The study confirmed that general English instruction fails to address the discipline-specific vocabulary that students require. The lack of authentic, engineering-related content in English classes has led to low motivation and minimal retention of technical terms, especially those related to renewable energy technologies. Furthermore, English instructors reported significant limitations in designing content-relevant materials due to their limited background in engineering. This disciplinary disconnect underlines the need for collaborative curriculum development between language and technical faculty.

Despite these challenges, both students and lecturers demonstrated a willingness to adopt new approaches that integrate content and language instruction. Students showed particular enthusiasm for learning English through project-based tasks and real-life applications, such as presenting their renewable energy designs in English or reading technical datasheets. To address these issues, it is recommended that the English curriculum for engineering students be redesigned using CLIL (Content and Language Integrated Learning) and ESP (English for Specific Purposes) frameworks. These should prioritize technical vocabulary development embedded in relevant engineering contexts.

Practical strategies may include: creating bilingual glossaries of engineering terms, integrating renewable energy topics into reading and writing assignments, encouraging joint projects between language and engineering classes, and training English instructors in basic STEM concepts. The study also emphasizes the value of localizing content. Renewable energy applications in West Nusa Tenggara, such as community-based solar or hydro installations, offer culturally relevant and technically rich topics for vocabulary instruction, promoting both language skills and sustainability awareness.

Future research could expand on this study by examining the long-term effects of integrated instruction on students' language proficiency and technical communication skills. Additionally, quantitative studies could measure vocabulary acquisition more precisely across different teaching models. Ultimately, integrating STEM vocabulary into ELT not only enhances students' academic success but also equips them to contribute more effectively to Indonesia’s renewable energy future. A collaborative, localized, and

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interdisciplinary approach is key to building a new generation of globally competent, environmentally aware engineers.

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