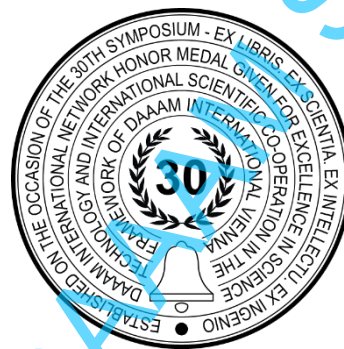


# IMPLEMENTATION OF AN AI-POWERED LANGUAGE ASSISTANT FOR ENHANCING ENGINEERING STUDENTS' COMMUNICATIVE PROFICIENCY THROUGH MOBILE TECHNOLOGIES

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## Abstract

This study investigates the impact of an AI-powered language assistant on improving the communicative proficiency of engineering students through mobile technologies. Recognising the critical role of communicative skills in engineering education, this research addresses the gap between technical expertise and effective communication. By integrating an AI-driven chatbot designed for language learning into the curriculum, the study explores its efficacy in enhancing students' abilities in technical writing, oral communication, and interdisciplinary collaboration. A quasi-experimental design involving 100 undergraduate engineering students from the Institute of Energy at Peter the Great St. Petersburg Polytechnic University was employed, with data collected through pre- and post-intervention assessments, surveys, and interviews. The findings demonstrate significant improvements in the experimental group's language proficiency, particularly in speaking and listening skills. High levels of student engagement and positive feedback underscore the potential of AI-powered tools to transform traditional language education, making it more interactive and accessible. The study highlights the importance of integrating advanced technological solutions in educational practices to prepare engineering students for the global professional environment.

**Keywords:** AI-powered language assistant; engineering students; mobile technologies; chatbot; glossary function; innovative educational tool.

## 1. Introduction

Communicative proficiency is a critical competency for engineering students, encompassing the ability to effectively convey technical information, collaborate in multidisciplinary teams, and engage with diverse stakeholders. In the context of engineering education, the significance of communicative proficiency extends beyond mere linguistic capabilities. It is instrumental in bridging the gap between complex technical concepts and practical applications, thereby enhancing both individual and collective problem-solving skills [1].

Effective communication is paramount for the dissemination and exchange of technical knowledge. Engineering students often engage in activities that require the articulation of intricate ideas through reports, presentations, and documentation. Mastery in technical writing and oral communication ensures that students can convey their findings and ideas clearly and concisely, which is crucial for academic success and professional practice (Sampath & Sethuraman, 2017). Poor communicative skills can lead to misunderstandings, errors, and inefficiencies, thereby impeding the progress of projects and research endeavors.

The collaborative nature of engineering projects necessitates proficient interpersonal communication. Engineers frequently work in teams comprising individuals from various disciplines and cultural backgrounds. Communicative proficiency enables students to collaborate effectively, fostering a productive team environment. It facilitates the negotiation of ideas, conflict resolution, and the synthesis of diverse perspectives, ultimately leading to innovative solutions [2], [3]. Inadequate communication can hinder teamwork, resulting in disjointed efforts and suboptimal outcomes.

The globalised nature of the engineering profession requires students to interact with international colleagues, clients, and regulatory bodies. Proficiency in communication, particularly in English as the lingua franca of the engineering domain, is essential for engaging in cross-border collaborations and staying abreast of global advancements [4]. This competency also encompasses the ability to understand and be understood by non-technical stakeholders, which is vital for project management, client relations, and public communication.

In addition to enhancing professional practice, communicative proficiency contributes to personal development and lifelong learning. It empowers students to participate in academic and professional discourse communities, access a broader range of resources, and continually update their knowledge and skills. This aligns with the dynamic and evolving nature of the engineering field, where ongoing education and adaptability are key to career longevity and advancement [5].

Given the critical importance of communicative proficiency, engineering education programs must prioritise the development of these skills, integrating communicative training into the curriculum to prepare students for the multifaceted demands of the engineering profession. In recent years, significant advancements in artificial intelligence (AI), particularly the development of AI-powered language assistants, have introduced novel approaches to enhancing communicative proficiency in educational settings. These sophisticated tools utilise AI, including machine learning and natural language processing, to provide interactive, personalised, and context-aware language learning experiences. Their integration into educational settings can transform traditional language education methodologies, addressing several key areas of improvement [6], [7].

This study focuses on engineering students and aims to investigate the potential role of AI-powered language assistants in enhancing their communicative proficiency. Given the advancements in AI and the specific educational context, this research explores the impact and effectiveness of using AI-powered language assistants for engineering students, with a particular emphasis on improving their communicative skills in English as a foreign language. By leveraging AI technology, this study seeks to provide insights into how these tools can address the communication challenges faced by engineering students and enhance their overall educational experience.

## 2. Literature Review

Communicative proficiency is increasingly recognised as a critical competency for engineering students. Traditionally, engineering education has focused on developing technical skills and knowledge; however, the ability to communicate effectively is essential for professional success [1]. Effective communication skills are necessary for various activities, including technical report writing, presentations, team collaborations, and interactions with non-technical stakeholders. According to Shuman, Besterfield-Sacre, and McGourty, engineering graduates must possess strong communication skills to effectively convey complex technical information and work collaboratively in multidisciplinary teams. The Accreditation Board for Engineering and Technology (ABET) has also emphasized the importance of communication skills, integrating them into their criteria for accrediting engineering [8], [9]. Despite this recognition, many engineering curricula still lack sufficient focus on developing these skills, resulting in a gap that needs to be addressed to better prepare students for the professional environment.

The application of artificial intelligence (AI) in language learning is grounded in several theoretical foundations, including constructivist and behaviourist learning theories. AI technologies, particularly machine learning and natural language processing, enable the creation of adaptive learning environments that can provide personalised instruction and feedback. The constructivist theory, which posits that learners construct knowledge through active engagement and interaction with their environment [10], is well-supported by AI-driven tools that offer interactive and immersive learning experiences. Behaviourist principles, emphasizing reinforcement and feedback [11], are also applied in AI systems that provide immediate corrective feedback to learners.

AI applications in language learning encompass various tools and platforms designed to enhance different aspects of language proficiency. These include automated speech recognition systems, intelligent tutoring systems, and conversational agents, such as chatbots, which can simulate human-like interactions and provide learners with opportunities to practice language skills in a controlled environment. Research has shown that these tools can significantly improve learners' language abilities by providing them with personalised, context-specific feedback [12].

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Mobile learning (m-learning) has emerged as a significant trend in education, driven by the widespread availability of smartphones and other mobile devices. M-learning facilitates learning anytime and anywhere, offering flexibility that traditional classroom settings cannot match. According to Smith, Traxler, and Scott, mobile technologies support informal, spontaneous, and contextual learning, making them particularly effective for language acquisition. Studies have demonstrated that mobile apps and platforms can enhance language learning by providing interactive and engaging content, fostering collaboration, and enabling access to authentic language resources [13], [14].

The integration of AI and mobile technologies in language learning presents unique opportunities for enhancing the educational experiences of engineering students. AI-powered language learning tools can address the specific needs of these students by providing tailored exercises that focus on technical vocabulary and communication skills relevant to their field. Mobile technologies, with their ability to deliver content in a flexible and accessible manner, complement these tools by facilitating continuous learning beyond the classroom [15].

The current research builds on these theoretical foundations and empirical studies to explore the effectiveness of integrating AI-powered language learning tools with mobile technologies in improving the oral foreign language communicative skills of engineering students. By leveraging the strengths of both AI and mobile learning, this study aims to provide insights into how these technologies can be used to address the communication challenges faced by engineering students and enhance their overall educational experience.

### 3. Methodology

The theoretical foundation of this study is anchored in the methodological principles of foreign language instruction in both mixed and online learning environments, principles of professionally oriented language teaching, and core principles of the communicative approach to foreign language teaching. General scientific methods of theoretical research were employed, including an analysis of domestic and foreign literature on the topic. The primary research methods included questionnaire surveys and analysis of scientific literature.

This study utilised a quasi-experimental research design to evaluate the effectiveness of an AI-powered language assistant in enhancing the communicative proficiency of engineering students. The design incorporated both quantitative and qualitative methods to provide a comprehensive assessment of the intervention. The study was structured into three phases: pre-intervention, intervention, and post-intervention, allowing for the measurement of changes in language proficiency and the collection of detailed feedback from participants.

The study adopted a mixed-methods approach, combining quantitative data from standardised tests and usage analytics with qualitative data from surveys and interviews to triangulate findings and provide a comprehensive understanding of the AI-powered language assistant's impact. Quantitative data were collected through standardised language proficiency tests and usage analytics, while qualitative data were obtained from surveys and interviews with participants. This approach ensured that both measurable outcomes and subjective experiences of the students were captured.

Participants in this study were undergraduate engineering students at the Institute of Energy at Peter the Great Saint-Petersburg Polytechnic University. A total of 100 students were recruited, with 50 students assigned to the experimental group (using the AI-powered language assistant) and 50 students to the control group (utilising traditional language learning methods). Stratified random sampling was employed to ensure a representative sample in terms of gender, academic performance, and language proficiency levels.

The AI-powered language assistant was implemented as a supplementary tool in the language learning curriculum for the experimental group. This tool was accessible via mobile devices, allowing students to engage with the assistant outside regular classroom hours. The control group continued to use traditional language learning resources, such as textbooks and in-class activities.

The AI-powered language assistant used in this study was a ChatGPT-based chatbot designed to support language learning through personalised and interactive experiences. It incorporated natural language processing and machine learning algorithms to provide real-time feedback, adaptive learning pathways, and conversational practice.

The "Eng-Rus IEEE Energetics Glossary" (@Energy\_Glossary\_bot via Telegram messenger) chatbot (see Fig.1) within the domain of language education and professional training in higher education institutions represents a promising practice. This approach has the potential to substantially enhance the educational experience for both students and educators. The chatbot provides immediate access to definitions and explanations of terms, thereby facilitating a deeper comprehension of course material among students. Moreover, it enables students to swiftly find answers to their questions, enriching their knowledge base. Educators can also leverage the glossary chatbot to develop interactive assignments, allowing students to assess their knowledge and skills. This contributes to more effective assimilation and retention of information.

The chatbot, integrated with the "Eng-Rus IEEE Energetics Glossary", serves as a valuable tool that grants users access to the interpretation of energy-related terms from English to Russian and vice versa. This chatbot can be utilised in the context of professional language training for future energy engineers in the following ways:

1. Rapid translation of English terms into Russian: Users can input any term into the chatbot, which will not only provide the Russian version of the term but also suggest various interpretations.
2. Retrieval of relevant usage examples: The chatbot displays examples of term usage in specific contexts, aiding in a deeper understanding of the term and its applications in discourse.

3. Search for synonyms and derivatives: The chatbot offers all related derivatives and synonymous terms and phrases in both Russian and English.

4. Responses to professional thematic inquiries: For instance, in response to the question, "Can you explain the role of turbines in converting geothermal heat into electrical energy?" the chatbot replies, "Certainly. A turbine represents a crucial component in the process of electricity generation, not merely in geothermal systems but also in various other energy generation systems. In the context of generating geothermal energy or 'geotermal'naya energiya' in Russian, a turbine (or 'turbina' in Russian) plays the role of a converter that changes thermal energy into mechanical energy."

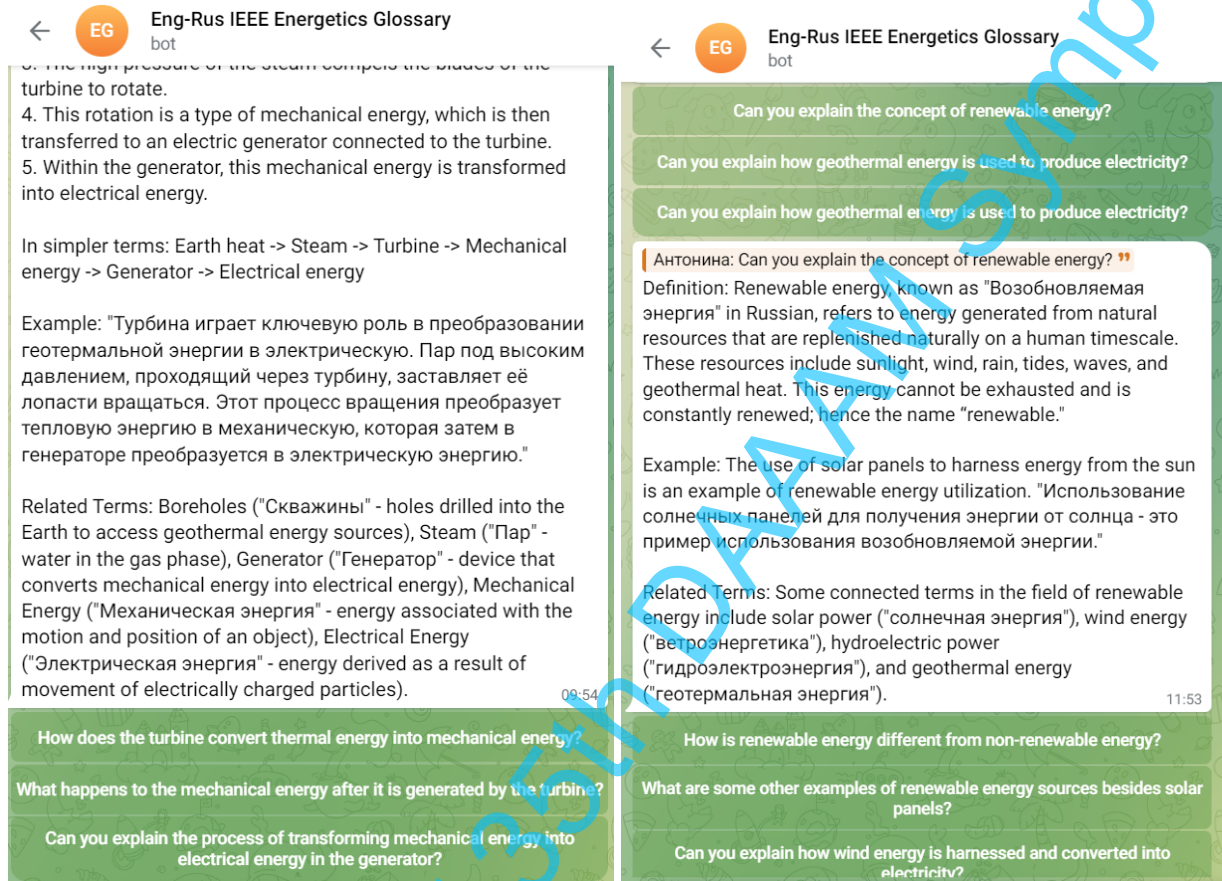


Fig. 1. The "Eng-Rus IEEE Energetics Glossary" chatbot

To maximise accessibility and engagement, the AI tool is integrated with mobile technologies, allowing students to use it on smartphones and tablets. The mobile integration ensures that learners can practice language skills anytime and anywhere, aligning with modern educational trends towards flexible and mobile learning environments.

Prior to the intervention, students in the experimental group received comprehensive training on how to use the AI-powered language assistant. This training covered the functionalities of the chatbot, best practices for effective usage, and troubleshooting common issues. Orientation materials were also provided in the form of user manuals and video tutorials to support independent learning.

Data collection involved multiple methods to gather comprehensive information on the impact of the AI-powered language assistant. These methods included pre- and post-intervention language proficiency tests, surveys, interviews, and usage analytics from the AI tool. The combination of these methods provided both quantitative measures of language proficiency and qualitative insights into student experiences.

Language proficiency assessments were conducted before and after the intervention to measure changes in students' language skills. The assessments included standardised tests covering speaking, listening, reading, and writing. The pre-intervention assessment established a baseline for each student, while the post-intervention assessment evaluated the impact of the AI tool on their language proficiency.

Surveys were administered to both the experimental and control groups to gather data on student perceptions, engagement, and satisfaction with their respective learning methods. Additionally, semi-structured interviews were conducted with a subset of participants from the experimental group to gain deeper insights into their experiences with the AI-powered language assistant. These qualitative data helped to understand the subjective impact of the AI tool and identify areas for improvement.

Usage analytics from the AI-powered language assistant were collected to monitor how students interacted with the tool. Metrics such as frequency of use, types of activities completed, and time spent on different exercises were analysed to

identify patterns and correlations with learning outcomes. This data provided valuable insights into student engagement and the effectiveness of different features of the AI tool.

This study's methodology was designed to rigorously assess the effectiveness of an AI-powered language assistant in enhancing the communicative proficiency of engineering students. By combining quantitative and qualitative methods, the research aimed to provide a comprehensive evaluation of the intervention, offering insights that can inform future implementations of AI technologies in language education.

#### 4. Results

The quantitative findings from this study provide a detailed analysis of the impact of the AI-powered language assistant on the communicative proficiency of engineering students. Data were collected from pre- and post-intervention assessments as well as from usage analytics of the AI tool.

The pre- and post-intervention assessments revealed significant improvements in the communicative proficiency scores of the students in the experimental group (see Fig.2). The average overall language proficiency score increased by 15% from pre-intervention to post-intervention. Specifically, the experimental group showed notable gains in speaking (+20%), listening (+18%), reading (+12%), and writing (+10%) skills. In contrast, the control group exhibited only marginal improvements with an average overall increase of 5%. These results suggest that the AI-powered language assistant substantially enhanced the language skills of the students compared to traditional learning methods. The chart clearly shows that the experimental group, which used the AI-powered language assistant, had substantial gains in language proficiency across all skill categories compared to the control group.

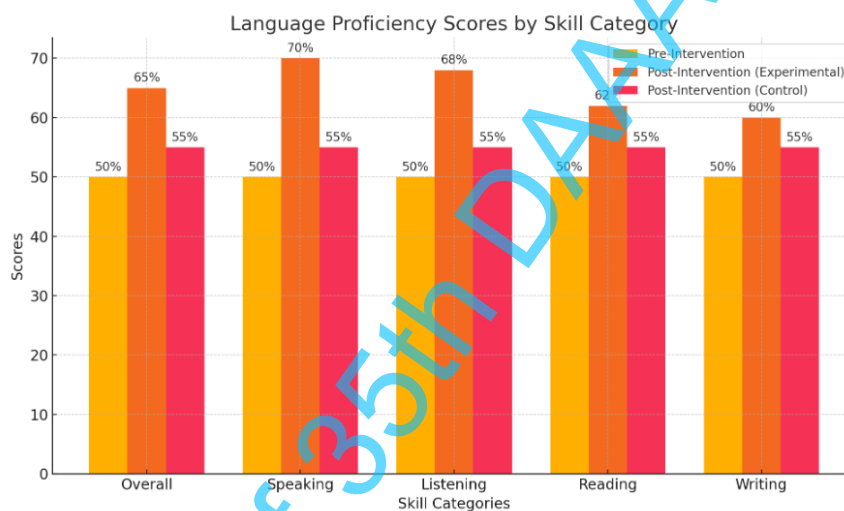


Fig. 2. The pre- and post-intervention assessments

Usage analytics from the AI tool provided insights into student engagement and usage patterns. On average, students in the experimental group used the AI assistant for 45 minutes per day. The most frequently used features were grammar and vocabulary (40% of total usage), spelling correction (30%), and conversational practice (30%). Engagement metrics indicated high levels of sustained interaction, with 85% of students using the tool consistently throughout the intervention period (see Fig.3). Higher usage frequency correlated positively with greater improvements in language proficiency, highlighting the importance of regular practice.

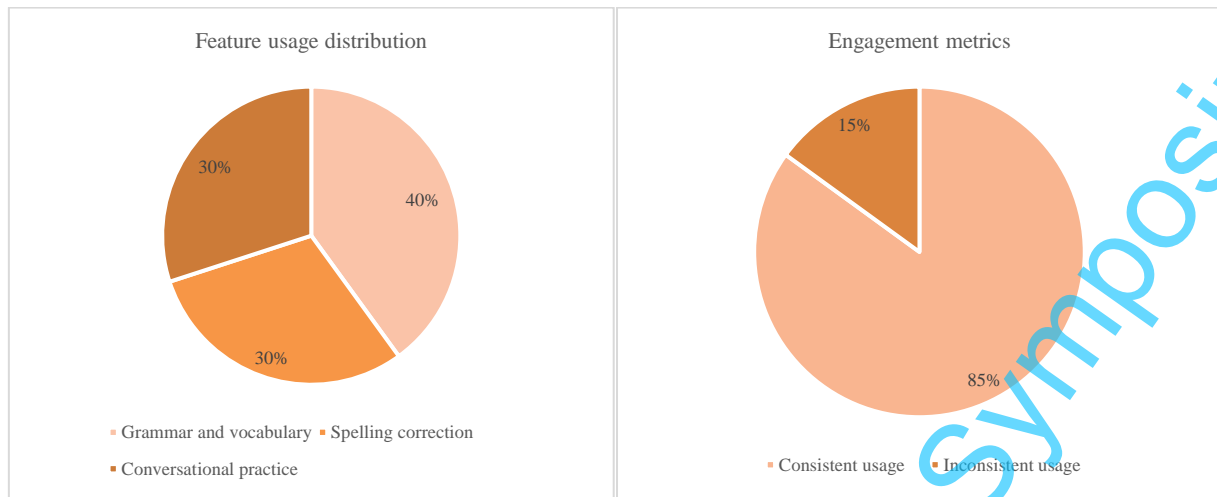


Fig. 3. The visualisations of the usage analytics and engagement metrics

Qualitative findings were derived from surveys and semi-structured interviews conducted with students in the experimental group. These findings provided valuable insights into student feedback and perceptions regarding the AI-powered language assistant.

Student feedback was overwhelmingly positive, with 90% of participants expressing satisfaction with the AI tool. Key themes that emerged from the surveys and interviews included appreciation for the personalised feedback, the interactive nature of the learning activities, and the flexibility offered by mobile access. Students reported that the AI assistant made language learning more engaging and less intimidating, as they could practice at their own pace and receive immediate corrections. Additionally, many students highlighted the convenience of using the tool on their mobile devices, allowing them to integrate language practice into their daily routines seamlessly.

The qualitative data indicated that the AI-powered language assistant had a positive impact on the overall learning experience and student motivation. Students reported feeling more motivated to engage with language learning due to the gamified elements and interactive exercises provided by the AI tool. The ability to track progress and set personal learning goals within the app was also cited as a motivating factor. Moreover, students felt that their confidence in using English had increased, particularly in speaking and listening skills, as the AI assistant provided a safe environment for practice without the fear of judgment.

The results of this study demonstrate that the AI-powered language assistant effectively enhanced the communicative proficiency of engineering students. The quantitative improvements in language proficiency scores combined with high levels of engagement and positive qualitative feedback suggest that AI-powered tools can play a significant role in improving language learning outcomes. These findings underscore the potential of integrating AI technologies into educational practices to create more personalised, engaging, and effective learning experiences.

## 5. Discussion

The findings of this study provide compelling evidence for the effectiveness of AI-powered language assistants in enhancing the communicative proficiency of engineering students. The significant improvements observed in the experimental group's language proficiency scores highlight the potential of AI tools to effectively supplement traditional language learning methods. This discussion explores the implications of these results, addresses potential limitations, and suggests directions for future research.

The substantial gains in speaking, listening, reading, and writing skills observed in the experimental group underscore the value of integrating AI-powered language assistants into engineering curricula. The 15% overall increase in language proficiency, particularly the 20% improvement in speaking skills, suggests that these tools can address specific challenges faced by engineering students in mastering technical and professional communication.

The positive impact on speaking and listening skills is particularly noteworthy, given that these areas are often the most challenging for non-native speakers. The AI assistant's ability to provide real-time, personalised feedback likely contributed to these gains by allowing students to practice conversational English in a low-pressure environment. This aligns with constructivist learning theories, which emphasize the importance of active engagement and interaction in the learning process [10], [16].

Moreover, the integration of mobile technologies facilitated continuous learning, allowing students to practice language skills anytime and anywhere (Dawadi et al., 2024). This flexibility is crucial in the context of engineering education, where students often juggle demanding coursework and project deadlines. The ability to integrate language practice seamlessly into daily routines can enhance learning outcomes and foster a more positive attitude toward language acquisition.

The high levels of student engagement and satisfaction with the AI-powered language assistant, as indicated by the qualitative data, suggest that these tools can significantly enhance the overall learning experience. The interactive and gamified elements of the AI assistant, along with the convenience of mobile access, contributed to sustained student interaction and motivation. These findings are consistent with previous research on mobile learning, which highlights the benefits of flexibility and accessibility in promoting language acquisition [13].

The positive feedback regarding personalised feedback and progress tracking further supports the use of AI tools in language education. Students' ability to set personal learning goals and monitor their progress can foster a sense of ownership and responsibility for their learning, which is crucial for sustained motivation and success [17].

The study's results underscore the critical role of communicative proficiency in engineering education and professional practice. Effective communication is essential for collaborating in multidisciplinary teams, engaging with diverse stakeholders, and disseminating technical information [3]. The AI-powered language assistant's focus on technical vocabulary and professional communication skills directly addresses these needs, preparing students for real-world engineering challenges.

The ability to practice and receive feedback on technical terms and professional discourse is particularly valuable in the engineering context. The "Eng-Rus IEEE Energetics Glossary" chatbot, for example, provided students with immediate access to technical definitions and usage examples, enhancing their understanding and retention of course material. This practical application of AI technology aligns with behaviourist principles, which emphasize reinforcement and feedback as key components of the learning process [11], [18].

While the study's findings are promising, several limitations should be acknowledged. The quasi-experimental design, while robust, cannot completely rule out potential confounding variables. Additionally, the study was conducted with a specific sample of engineering students at a single institution, which may limit the generalisability of the results. Future research should aim to replicate these findings across diverse educational contexts and with larger sample sizes.

Another limitation is the reliance on self-reported data for qualitative insights. While the feedback from surveys and interviews provided valuable information, self-reported data can be subject to biases. Future studies could incorporate more objective measures of engagement and motivation, such as observational data or third-party assessments.

Further research is also needed to explore the long-term effects of using AI-powered language assistants. While the study demonstrated significant short-term gains in language proficiency, it is important to assess whether these improvements are sustained over time and translate into enhanced professional performance.

Concerns have been raised regarding the effectiveness of banning the use of ChatGPT, which could lead to stringent measures against students, such as expulsion, physical closed-book examinations, and written tests (Crawford et al., 2023). Restricting access to this tool may inadvertently increase its allure. Attempting to circumvent artificial intelligence by designing tasks beyond its current capabilities may prove futile, given the advancements in newer model versions like ChatGPT, which can analyse images and provide extensive descriptions. While such an approach demands additional effort from higher education faculty, they can assess students' knowledge through oral examinations based on unique assignments.

We concur with researchers who advocate for educating students on the responsible use of chatbots rather than imposing bans [12], [17], [18]. Students should be instructed on the importance of academic integrity, ethics, and personal accountability, as they are responsible for the quality of their work. Allowing students to choose topics that genuinely interest them, where their voices are heard and their opinions respected, is crucial [19]. Implementing authentic assessments that provide students with a creative, substantive, and motivating learning experience, and evaluating their skills and knowledge in real-world situations is recommended.

Incorporating artificial intelligence tools into discussions and assignments is vital, teaching students the prudent use and limitations of text processing and demonstrating poor-quality text examples to highlight the value of human writing. Emphasizing the importance of motivation and the writing process within the context of intellectual growth is necessary [12]. Updating assessment methods and transitioning to modern formats such as oral presentations, group projects, self-assessments, peer reviews, results-based evaluations, and the creation of web pages, videos, and animations by students is essential.

Educating students on the effective use of chatbots in higher education necessitates clear guidelines and expectations. It is crucial to instruct students on the responsible use of chatbots, including authorship and ethical considerations [19]. Generative artificial intelligence can assist students in developing critical thinking skills through iterative interaction and the application of their abilities in new contexts. Students should be encouraged to use ChatGPT within reasonable limits and to critically evaluate its outputs [16].

Encouraging broad, multi-faceted dialogue among various stakeholders, including students, learning and teaching experts, faculty from all disciplines, IT specialists, career center staff, industry and community representatives, legal and external experts, and government officials, and subsequently implementing the outcomes of these discussions in policies, guidelines, and instructional materials underscores the importance of digital literacy in education. This includes the use of AI tools such as chatbots and Grammarly, which employs AI to review texts and suggest improvements.

Fostering extensive and diverse exchanges of opinions among stakeholders, including students, faculty across disciplines, learning, teaching, and IT experts, career center staff, industry, community representatives, legal and external experts, and government officials [18], and implementing the results in policies, guidelines, materials, and instructional aids underscores the significance of integrating digital literacy. This encompasses the use of AI tools like chatbots. Updating academic honesty policies and developing clear guidelines for the use of language models, including proper usage and

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consequences of violations, is imperative. The University of Tasmania provides an example of AI utilisation, but adherence to academic integrity rules when using generative AI is necessary [17]. The use of chatbots and other AI tools represents only the initial steps in developing more powerful technologies in higher education, potentially impacting various aspects of academic life.

## 6. Conclusion

The findings of this study underscore the significant impact of AI-powered language assistants on enhancing the communicative proficiency of engineering students. Through the integration of advanced AI technologies and mobile learning, the experimental group demonstrated substantial improvements in language skills compared to traditional learning methods. This research highlights the transformative potential of AI in addressing the specific communication challenges faced by engineering students, preparing them for the demands of professional practice in a globalised and interdisciplinary environment.

The quantitative results reveal that the AI-powered language assistant facilitated significant gains in speaking, listening, reading, and writing skills. The observed 15% overall increase in language proficiency, particularly the 20% improvement in speaking skills, suggests that personalised, real-time feedback provided by the AI tool is highly effective in fostering language development. These findings align with the principles of constructivist and behaviourist learning theories, emphasizing the importance of interactive, immersive learning experiences and immediate corrective feedback.

Qualitative data from surveys and interviews further reinforce the positive impact of the AI-powered language assistant on student engagement and motivation. The interactive, gamified elements of the AI tool, combined with the convenience of mobile access, contributed to high levels of sustained interaction and a positive learning experience. Students appreciated the personalised feedback, the ability to track progress, and the flexibility to practice language skills at their own pace, indicating that these features enhance motivation and confidence in language learning.

The integration of AI tools into engineering education not only improves language proficiency but also prepares students for real-world challenges by focusing on technical vocabulary and professional communication skills. The "Eng-Rus IEEE Energetics Glossary" chatbot exemplifies the practical application of AI in providing immediate access to technical definitions and usage examples, thereby enhancing students' understanding and retention of course material.

Despite the promising results, this study acknowledges certain limitations, including the quasi-experimental design and the specific sample of engineering students, which may affect the generalisability of the findings. Future research should aim to replicate these results across diverse educational contexts and with larger sample sizes to validate the effectiveness of AI-powered language assistants. Additionally, exploring the long-term effects of these tools on language proficiency and professional performance will provide deeper insights into their sustained impact.

The study also addresses concerns about the ethical use of AI tools in education. It emphasizes the importance of educating students on responsible AI use, academic integrity, and personal accountability. The study advocates for authentic assessments and innovative teaching methods that incorporate AI technologies, enabling students to develop critical thinking skills and apply their knowledge in real-world situations.

In conclusion, the integration of AI-powered language assistants into engineering education represents a promising advancement in enhancing communicative proficiency. The substantial improvements in language skills, coupled with high levels of student engagement and satisfaction, demonstrate the potential of AI to revolutionise language learning. By leveraging AI technologies, educational institutions can provide more personalised, engaging, and effective learning experiences, ultimately better preparing students for the multifaceted demands of the engineering profession.

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