

Improving Engineering Students' English Proficiency Through ChatGPT-Assisted Instruction: A Quasi-Experimental Study

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Abstract—English proficiency is crucial for the employability of engineering graduates in non-native contexts. The rise of AI technologies offers new opportunities to enhance EFL instruction in higher education, particularly within engineering disciplines. This quasi-experimental study examined the effectiveness of ChatGPT-assisted instruction in enhancing English proficiency among 60 engineering students at a Saudi university, comparing results from an experimental group using ChatGPT with those of a control group receiving conventional instruction. ANCOVA assessed the effectiveness of ChatGPT assistance compared to traditional instruction through pre-test scores. Improvements in speaking and writing scores were evaluated using paired-samples t-tests. MANCOVA examined the overall impact of the intervention, followed by univariate ANCOVAs for significant outcomes. The findings revealed that students who used ChatGPT-assisted learning experienced significant improvements in their speaking and writing skills compared to those who used conventional instructional methods. The findings suggest that ChatGPT effectively enhances engineering students' English proficiency by offering interactive language practice and immediate feedback. The study demonstrates the immense potential of AI-powered tools to enhance English proficiency, a crucial factor for achieving academic and professional success in global engineering environments.

Index Terms—academic and professional success, conventional instructional methods, interactive language practice, non-native contexts, specific disciplines

I. INTRODUCTION

In the globalized economy, English proficiency is vital for engineering graduates to collaborate internationally and share technical knowledge. English dominates science and engineering, necessitating strong communicative competence (Hyland, 2022; Murali et al., 2024). The employability of engineering graduates depends on both technical and soft skills, such as communication, teamwork, planning, ICT, and lifelong learning, with communication being vital for career advancement (Menand, 2014; Winberg et al., 2020). In countries such as Saudi Arabia, where English is taught as a foreign language, engineering students encounter challenges in developing necessary English proficiency for academic and professional success, particularly in technical vocabulary, oral presentation, and professional interaction, which are vital for participation in the global engineering workforce (Alanazi, 2025; Alharbi, 2015; Mahdi, 2024; Beagon et al., 2025). These challenges highlight the importance of technical vocabulary, oral presentation, and professional interaction skills in the global engineering workforce.

Recent advancements in artificial intelligence, particularly generative AI systems like ChatGPT, have transformed the landscape of language learning. These tools comprise approximately 30% of AI use in this sector, offering human-like text generation and enabling personalized learning experiences through immediate feedback and low-stakes practice environments (Garzón et al., 2025; Fortuna et al., 2025; Matos et al., 2025). ChatGPT improves language proficiency in education by enabling real communication practice, supporting vocabulary development, and providing corrective feedback, especially in English as a Foreign Language (EFL) contexts. It serves as a generative AI learning aid, facilitating interactive dialogue and content creation to enhance skills (Nguyen et al., 2024). Recent studies indicate that AI tools can improve language learning by providing personalized feedback on vocabulary, grammar, and discourse

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organization (Zhang, 2025; He et al., 2025; Marzuki et al., 2023). Conversational AI platforms also enhance fluency through interactive practice. However, research on ChatGPT's effectiveness for improving engineering students' English proficiency remains limited, focusing primarily on general language learning rather than discipline-specific contexts.

A. Research Problem

Engineering graduates require English proficiency; however, many EFL engineering students struggle with speaking and technical vocabulary due to traditional grammar-oriented teaching. While AI tools like ChatGPT offer potential for interactive practice and personalized learning, research on their effectiveness in engineering education remains limited, underscoring the need for further empirical studies to assess their pedagogical impact and enhance students' English proficiency.

B. Research Purpose Statement

The study seeks to examine the efficiency of ChatGPT-assisted learning in enhancing English proficiency among engineering students in an EFL context, comparing an experimental group engaged in ChatGPT-based activities with a control group using traditional methods, presenting empirical evidence of AI-assisted tools' pedagogical benefits, and improving instructional strategies to enhance students' communication abilities.

II. LITERATURE REVIEW

A. Theoretical Framework

This quasi-experimental study explores the educational implications of AI technologies, particularly ChatGPT, through a framework combining sociocultural theory, social constructivism, and self-determination theory. Drawing on Vygotsky's (1978) sociocultural theory, it asserts that learning is a social activity thriving within the zone of proximal development (ZPD), where collective language development occurs. The study posits that ChatGPT enriches the ZPD by providing prompts and feedback, helping engineering students improve both their technical and general English proficiency. Social constructivism further reinforces this by promoting knowledge creation through interactive, task-based learning activities such as role-plays and problem-solving discussions that improve communicative competence. Self-determination theory is also highlighted, emphasizing autonomy, competence, and relatedness as key motivational factors. Research suggests that AI chatbots like ChatGPT boost learner motivation, reduce anxiety, and promote autonomy, thereby improving English proficiency and confidence. This indicates the transformative potential of ChatGPT in language learning and the need for empirical studies rooted in theory to assess its effectiveness in enhancing English proficiency in engineering education.

B. Importance of English Proficiency for Engineering Students

English proficiency is crucial for engineering graduates, as it enables clear expression of ideas in international and multidisciplinary contexts alongside technical expertise (Passow & Passow, 2017). Research indicates that while engineering curricula focus on technical skills, they often neglect language training, even though the industry demands strong communication abilities for professional growth (Bravo & Cruz-Bohorquez, 2024; Mirón-Mérida & García-García, 2024). Multiple studies emphasize that English proficiency is vital for engineering students, greatly impacting their academic performance, job prospects, and career growth. For example, Biswas et al. (2021) noted that engineering students improved critical English proficiency, such as active listening, information sourcing, and organized delivery, through an online global health course, essential for interdisciplinary collaboration and problem-solving in global health. Public speaking and presentation skills are critical for effective English communication, as shown by Ningsih et al. (2023), indicating that individual presentations enhance essential speaking abilities for professional interactions. El-Sakran (2024) found that active learning in technical education enhanced English proficiency, especially in English for Specific Purposes, improving graduates' employability and better preparing them for real-world communication. It is also shown that interventions such as outcome-based education (OBE) effectively enhance English proficiency. Khan and Sarkar (2025) demonstrated that outcome-based education (OBE) notably enhanced students' English proficiency, particularly in academic writing and speaking fluency, which are vital for engineering careers. These studies show that English proficiency is essential for engineering students' academic success and professional readiness, underscoring the need for diverse teaching methods and industry-relevant curricula.

C. AI-Assisted Language Learning in Higher Education

The integration of generative AI in higher education, particularly tools like ChatGPT, enhances EFL learning by creating interactive, low-anxiety environments that improve their English proficiency, which is vital for global employability. Laato et al. (2023) examined the impact of ChatGPT and large language models on university learning, emphasizing the transformative role of AI in education and proposing that AI tools might become essential in higher education. Similarly, Lalira et al. (2024) demonstrated that AI tools were effective in improving grammar mastery and served as a beneficial resource for students lacking formal language instruction. Their research revealed that proper use of AI fostered significant gains in grammar learning and enhanced language proficiency. Allehyani et al. (2026a) evaluated ChatGPT's effectiveness in enhancing English writing skills in Saudi Arabia, demonstrating that AI tools

provide immediate, personalized feedback, thereby improving instructional effectiveness. Zafar et al. (2025) investigated AI-driven reading support for multilingual learners, identifying tools such as machine translation, speech-to-text, and annotation systems. Their review suggested that these AI applications could improve reading proficiency by addressing pedagogical needs and fostering inclusive learning environments. Allehyani et al. (2026b) analyzed AI-generated lesson plans against those created by instructors in EFL classrooms, finding that AI plans improved student performance and engagement. These studies highlighted AI's potential to enhance language instruction, alongside benefits such as increased proficiency and motivation in higher education, despite implementation challenges and emotional impacts. The future indicates a significant role for AI in innovative and inclusive language education.

D. ChatGPT as an Interactive Language Learning Tool

ChatGPT is a generative AI that enhances interactive learning by enabling dialogue for English-language practice and providing contextual feedback, improving understanding of language structure and communication coherence. A review of fifteen studies (2018-2025) by Aljohani (2025) found that ChatGPT boosts language learning through authentic interaction and personalized feedback, resulting in higher learner engagement and motivation. However, the fragmented nature of research restricts insight into its full educational integration. Du and Alm (2024) found that postgraduate English language students appreciated ChatGPT for fostering autonomy and competence with personalized feedback, though its effect on relatedness varied among users. Ahmed et al. (2025) discovered that AI technologies, including ChatGPT, improved English skills in Virtual University students in Pakistan through surveys and interviews. Gai (2024) reported that ChatGPT significantly enhanced vocabulary, writing evaluation, and motivation in EFL students through text tasks, automated evaluation, and personalized feedback. Jamshed et al. (2025) assessed the educational benefits of ChatGPT through a questionnaire and thematic analysis. The findings indicated that educators viewed ChatGPT as a valuable pedagogical asset that improved language instruction, facilitated professional growth, and fostered innovative learning methodologies. It is recognized as an important tool for interactive language learning, offering simulated real-life interactions and personalized feedback, thereby enhancing conventional educational materials.

The existing research shows that AI chatbots, such as ChatGPT, enhance speaking and English proficiency in EFL learners, reduce anxiety, and boost motivation. However, most existing studies focus on general EFL populations and their perceptions rather than on performance, and often have limited scales and durations. There is a notable gap in experimental research on engineering students, and few systematic comparisons between ChatGPT-assisted instruction and traditional teaching methods using pre- and post-testing of English proficiency.

E. Research Questions

1. How does ChatGPT-assisted learning improve the English proficiency (speaking and writing) of engineering students?
2. Is there a significant difference between ChatGPT-assisted instruction and traditional teaching methods in improving engineering students' English communication performance based on pre-test and post-test outcomes?

III. METHODOLOGY

A. Participants and Sampling

The study employed a quasi-experimental design involving 60 undergraduate engineering students enrolled in an EFL communication course at a Saudi Arabian higher education institution, with participants selected via convenience sampling, a method typical in educational research (Creswell & Creswell, 2017; Usama et al., 2024a). All participants provided informed consent and agreed to the use of their data for research purposes, ensuring compliance with ethical standards (Dörnyei & Griffee, 2010; Alam & Usama, 2023). All participants were native Arabic speakers from Saudi Arabia, learning English as a foreign language. Demographic data were collected using a structured questionnaire, followed by an assessment of baseline English proficiency (speaking and writing) using a standardized B1-level proficiency test aligned with the Common European Framework of Reference for Languages (CEFR), ensuring reliability and appropriateness.

Prior to the intervention, an independent-samples t-test was conducted to examine the equivalence of the two groups; the results indicated no statistically significant difference ($p > .05$), confirming baseline homogeneity, which is essential for internal validity in quasi-experimental research (Mackey & Gass, 2016). The study involved two groups: an experimental group ($n = 30$) using ChatGPT-assisted learning and a control group ($n = 30$) receiving traditional instruction. Given institutional constraints, intact classes with similar proficiency levels were selected to maintain group equivalence, as is typical in quasi-experimental designs (Ary et al., 2018; Usama et al., 2024b). All participants had 8–10 years of formal English instruction. The same instructor taught both groups to ensure consistency and reduce variability, thereby improving the reliability of the outcomes (Mackey & Gass, 2016).

B. Procedure of the Study

The experimental procedure lasted 12 weeks, beginning with an orientation session for both the experimental and control groups, during which the study's purpose, course structure, and evaluation criteria for speaking and writing were

explained. The experimental group received training on creating and using a ChatGPT account. In the second week, a pre-test assessed all participants' baseline English proficiency through individual speaking tasks and a timed writing exercise, conducted under controlled conditions to ensure consistency and reliability (Mackey & Gass, 2016). The pre-test results confirmed that both groups had similar proficiency levels prior to the intervention.

During the intervention phase from Week 2 to Week 11, students participated in a structured series of assignments and feedback sessions. In Week 2, they completed Assignment 1, which included a pair-based speaking task and an individual writing task. Feedback was provided in Week 3: the experimental group received detailed feedback from ChatGPT alongside teacher guidance, while the control group received only teacher feedback. This pattern continued with subsequent assignments and feedback sessions, culminating in final feedback and revision in Week 11. Students engaged in reflective learning by reviewing feedback at each stage, with the experimental group evaluating ChatGPT-generated suggestions for acceptance or rejection, thereby enhancing metalinguistic awareness (Little, 2007; Alam et al., 2023). During the revision stage, students improved their speaking and writing tasks based on feedback, presenting enhanced speaking skills to the teacher while submitting written work. The teacher oversaw these activities, ensuring equal instructional conditions for both groups, and evaluated students on pronunciation, fluency, coherence, grammatical accuracy, and communication effectiveness.

In Week 12, participants underwent a post-test to evaluate improvements in English proficiency, mirroring the pre-test's structure with different topics to prevent familiarity effects. The individual speaking test and the timed writing test were administered under controlled conditions in the same environment as the pre-test to maintain comparability of results.

C. Instruments

This study utilized a pre-test and a post-test to evaluate engineering students' English proficiency, focusing on speaking and writing. The pre-test served as a diagnostic tool to determine baseline proficiency, involving structured peer dialogue tasks to assess grammar, vocabulary, and communicative effectiveness. Additionally, students produced a short academic paragraph and corrected errors in a provided text. Responses were scored with a standardized 20-point rubric to ensure reliability, aiming to establish baseline equivalence and measure improvement over time in a quasi-experimental research context (Mackey & Gass, 2016).

The post-test assessed improvements in students' speaking and writing skills, comparing ChatGPT-assisted learning with traditional methods. It used the same structure and scoring criteria as the pre-test for comparability, with different topics to reduce practice effects and enhance validity (Ary et al., 2018; Alam et al., 2024). In the assessment of English proficiency, students engaged in peer-based speaking tasks evaluating grammar, vocabulary, pronunciation, and fluency, lasting about 20 minutes each. For writing, they produced structured responses showcasing coherence, organization, lexical range, and grammatical accuracy within a set timeframe. Three experienced teachers jointly evaluated both components to maintain objectivity and inter-rater reliability, ensuring a valid measurement of overall skills.

D. Data Analysis Procedure

The data analysis employed advanced statistical techniques to evaluate the impact of ChatGPT-assisted learning on engineering students' English proficiency. To analyze the extent of improvement within each group, paired-samples t-tests were conducted separately for speaking and writing scores, and effect sizes (Cohen's *d*) were calculated to determine the magnitude of change (Cohen, 2013). To compare the effectiveness of ChatGPT-assisted learning and traditional instruction, an Analysis of Covariance (ANCOVA) was performed, with post-test scores as the dependent variable, group as the independent variable, and pre-test scores as covariates, thereby controlling for initial differences and increasing statistical precision (Tabachnick et al., 2007). Multivariate Analysis of Covariance (MANCOVA) was used to evaluate the intervention's simultaneous effects on speaking and writing skills, enabling a detailed analysis of treatment impacts (Hair et al., 2019; Field, 2024). When significant multivariate effects were observed, follow-up univariate ANCOVAs were performed. Scoring reliability was verified through the Intra-class Correlation Coefficient (ICC), and the evaluation rubric's internal consistency was analyzed using Cronbach's alpha (Amir et al., 2025). All statistical analyses were conducted in SPSS, with significance set at $p < .05$.

IV. RESULTS

The analysis aimed to evaluate how ChatGPT-assisted learning affects engineering students' English proficiency, including speaking and writing. Preliminary assumption testing was done before conducting inferential analysis to confirm the appropriateness of parametric procedures. The Shapiro–Wilk test showed that all variables followed a normal distribution ($p > .05$), and Levene's test confirmed homogeneity of variance among groups ($p > .05$). Furthermore, the assumption of homogeneity of regression slopes required for ANCOVA was tested and found to be non-significant ($p > .05$), indicating that the relationship between the covariate (pre-test scores) and dependent variables (post-test scores) was consistent across groups. Descriptive statistics were computed to provide an overview of performance differences between groups, as presented in Table 1.

TABLE 1
DESCRIPTIVE STATISTICS FOR PRE-TEST AND POST-TEST SCORES

Group	Skill	Pre-test Mean (SD)	Post-test Mean (SD)
Experimental	Speaking	10.84 (2.11)	16.92 (1.78)
Experimental	Writing	11.12 (2.05)	17.35 (1.69)
Control	Speaking	10.76 (2.09)	13.48 (1.95)
Control	Writing	11.05 (2.01)	13.96 (1.88)

As indicated in Table 1, both the experimental and control groups improved in speaking and writing from pre-test to post-test, but the experimental group showed significantly greater gains: 6.08 points in speaking and 6.23 points in writing compared to 2.72 and 2.91 points in the control group. This indicates a stronger instructional impact from ChatGPT-assisted learning. To further examine within-group improvements, paired-samples t-tests were conducted separately for speaking and writing scores. The results, presented in Table 2, revealed statistically significant improvements in both skills for the experimental group, with very large effect sizes.

TABLE 2
PAIRED-SAMPLES T-TEST RESULTS FOR WITHIN-GROUP COMPARISONS

Group	Skill	Mean Difference	t	p	Cohen's d
Experimental	Speaking	6.08	12.45	< .001	1.85
Experimental	Writing	6.23	13.12	< .001	1.92
Control	Speaking	2.72	6.28	< .001	0.78
Control	Writing	2.91	6.75	< .001	0.82

The experimental group showed significant enhancements in speaking and writing skills, with Cohen's d values over 1.80, indicating a large effect. In comparison, the control group had moderate improvements, with effect sizes below 1.00, suggesting that traditional instruction was less effective than ChatGPT-assisted learning. To assess the effectiveness of two instructional methods while controlling for initial differences, an ANCOVA analysis was utilized with pre-test scores as covariates. The results, presented in Table 3, indicate significant differences in post-test scores for both speaking and writing between the experimental and control groups.

TABLE 3
ANCOVA RESULTS FOR POST-TEST SCORES (CONTROLLING FOR PRE-TEST)

Skill	F(1,117)	p	Partial η^2
Speaking	28.64	< .001	0.32
Writing	31.27	< .001	0.35

The ANCOVA findings revealed that the instructional method significantly impacted students' communication performance, with large effect sizes (partial eta squared values of 0.32 for speaking and 0.35 for writing), indicating that the intervention accounts for a considerable amount of variance in post-test scores. These results confirm that ChatGPT-assisted learning significantly outperformed traditional teaching methods in enhancing both speaking and writing skills. MANCOVA was performed to assess the intervention's impact on several dependent variables simultaneously. The multivariate analysis using Wilks' Lambda indicated a statistically significant overall effect of instructional method on English proficiency, $\Lambda = 0.68$, $F(2,115) = 27.14$, $p < .001$, partial $\eta^2 = 0.32$. This result shows a strong and statistically significant impact of the intervention on both speaking and writing when analyzed together, with subsequent analyses confirming significant differences for each component. Reliability measures were calculated alongside inferential analysis to ensure scoring consistency and accuracy. The inter-rater reliability, assessed using the Intraclass Correlation Coefficient (ICC), was high (ICC = 0.91), indicating strong agreement among evaluators. Additionally, the scoring rubric's internal consistency was confirmed with a Cronbach's alpha of 0.88, indicating the assessment instrument's reliability.

Overall, the findings indicate that ChatGPT-assisted learning notably improves engineering students' English proficiency, with the experimental group showing greater gains in speaking and writing than the control group. This supports the effectiveness of ChatGPT-assisted instruction in engineering education for enhancing communication performance.

V. DISCUSSION AND ANALYSIS

The study assessed the impact of ChatGPT-assisted instruction on English proficiency among engineering EFL learners, demonstrating notable improvements in speaking and writing, particularly in grammar and vocabulary, consistent with earlier findings on AI language tools that support these areas. The improvement in Grammar accuracy can be attributed to ChatGPT's immediate feedback and clear explanations, which align with socio-cultural theory by providing scaffolding within the Zone of Proximal Development, thereby promoting learner independence (Vygotsky,

1978). Studies on Automated Writing Evaluation (AWE) systems indicate that AI-mediated feedback improves grammatical accuracy by enabling learners to revise their texts based on detailed feedback (Ningzi et al., 2026; Shen et al., 2023; Flores-González et al., 2025; Zhang et al., 2025). The research indicates that ChatGPT-assisted instruction positively impacts language learning, especially in grammar accuracy. For example, Song and Song (2023) found that AI tools like ChatGPT enhanced writing skills and motivation, suggesting advantages for improving grammatical accuracy. Similarly, Azennoud (2024) found that AI tools such as ChatGPT significantly improved writing accuracy among Moroccan EFL university students, demonstrating their value in achieving grammatical correctness. Providing more targeted evidence regarding grammar accuracy, Gao (2024) found that AI tools like ChatGPT significantly enhanced EFL students' understanding of non-finite verb structures, particularly improving grammatical accuracy in complex verb forms and demonstrating effectiveness. The findings of this study and existing studies show that ChatGPT-assisted instruction improves grammatical accuracy in EFL contexts by providing targeted practice and feedback, benefiting diverse learner populations.

The second greatest improvement in second-language acquisition was observed in vocabulary development, attributed to ChatGPT's interactive features. This tool provides learners with diverse lexical choices and paraphrases, facilitating vocabulary acquisition in meaningful contexts. Influenced by sociocultural theory and interactionist perspectives, ChatGPT serves as a valuable learning resource in EFL education by promoting incidental learning through meaningful interactions and scaffolded input. Previous research indicates that AI-supported language learning enhances lexical diversity and word usage through rich linguistic input from chatbot interactions (Temiz & Kafadar, 2025; Yilmaz, 2025; Pitura, 2024; Wang et al., 2024). Multiple other studies show that AI-powered instruction positively impacts language learning, particularly in vocabulary development. For example, a study by Alilo (2025) showed that AI-assisted learning-oriented assessments significantly improved vocabulary acquisition among 40 male Iranian EFL learners in a quasi-experimental setting. Similarly, A review by Yang (2025) of 30 studies revealed a significant rise in research on AI-supported vocabulary acquisition (AISVA), highlighting a lack of a comprehensive theoretical framework in this domain. A study by Yu (2025) found that AI-enhanced vocabulary learning strategies, including incidental exposure, contextual priming, and multimodal scaffolding, significantly outperformed traditional methods in vocabulary acquisition and retention. Alangari (2025) found that AI-assisted learning significantly improved high school students' writing proficiency, particularly in content development, language use, and vocabulary enhancement. Empirical studies show that tools like ChatGPT enhance vocabulary for EMI university students. A study by Abdullajon (2026) highlighted the role of ICT tools in improving vocabulary and English skills, advocating the integration of ChatGPT into traditional language-learning methods. Existing studies on CALL and MALL show a great impact of digital and mobile technologies on vocabulary enhancement. For example, Hanafiah et al. (2022) noted that CALL enhanced vocabulary learning and speaking skills, reducing anxiety for Indonesian EFL learners. Lei et al. (2022) emphasized MALL's positive impact on learners' attitudes and self-regulation, which are crucial for independent vocabulary learning. These studies show that ChatGPT-assisted instruction can improve vocabulary learning by providing personalized feedback and supporting autonomous learning alongside traditional and digital methods.

The discussion shows that AI-assisted language learning tools like ChatGPT enhance the structural and lexical aspects of language acquisition, but phonological skills and real-time communication may still require additional educational support. These tools complement traditional teaching by offering personalized feedback and interactive experiences in EFL classes.

VI. CONCLUSION

This study examined the impact of ChatGPT-assisted instruction on engineering students' English proficiency. The findings showed that integrating ChatGPT into EFL instruction leads to significant improvements in language development compared to traditional methods. The experimental group demonstrated marked enhancements in grammar accuracy and vocabulary use, highlighting the effectiveness of AI-mediated feedback and interactive practice in promoting linguistic accuracy and vocabulary growth. In engineering education, effective communication skills are crucial for global collaboration. The integration of AI tools such as ChatGPT into EFL instruction can enhance engineering students' communicative competence, equipping them for international settings. The findings suggest that AI tools such as ChatGPT enhance language proficiency, but higher-order writing skills require continuous instructional support. ChatGPT serves as a supplementary resource that encourages autonomous learning, offers immediate feedback, and increases engagement in language practice. While the study indicates that ChatGPT-assisted learning can effectively improve engineering students' English skills, it has notable limitations. The small, single-context sample limits the generalizability of the findings, and the brief intervention period fails to provide insights into long-term language development. Additionally, the focus on speaking and writing neglects vital skills such as listening and reading, underscoring the need for more comprehensive research on AI-assisted language learning.

ACKNOWLEDGEMENTS

The authors extend their appreciation to Prince Sattam Bin Abdulaziz University for funding this research work through the project number (2025/01/37443).

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