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Next-Gen Vocabulary Tools: How Chatbots Elevate Technical English for Computer Science Students

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Abstract: This study examined how well chatbot-enhanced training can help computer science students understand technical vocabulary. Semi-structured interviews were combined with a pre-test and post-test design as part of a mixed-methods strategy. With a substantial effect size (Cohen's d = 1.59) and a mean increase of 12.7%, quantitative data showed a statistically significant improvement in vocabulary scores, suggesting major practical implications. A thematic analysis of qualitative responses identified three main themes: usability limits, motivation and involvement, and perceived benefits. Students commended the chatbot's ability to offer real-time, contextual feedback and promoted deeper learning by using examples that are interwoven with coding situations. The conversational tone, individualized contact, and emotional engagement of the chatbot were credited with increasing motivation. However, some students pointed up issues including repeating outputs, overuse of synonyms, and complex instances, highlighting the necessity of adaptive content calibration. These results demonstrated that, with careful integration, AI-powered chatbots can function as efficient, customized vocabulary instructors; nevertheless, wider adoption will require enhancements to content delivery systems.

Kata Kunci:
Pembelajaran yang Disempurnakan Chatbot, Kosakata Teknis, AI dalam Pendidikan, Keterlibatan Pembelajar, Perancah Kontekstual

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Abstrak: *Studi ini mengkaji seberapa baik pelatihan yang ditingkatkan dengan chatbot dapat membantu mahasiswa ilmu komputer memahami kosakata teknis. Wawancara semi-terstruktur dikombinasikan dengan desain pra-tes dan pos-tes sebagai bagian dari strategi metode campuran. Dengan ukuran efek yang substansial (Cohen's d = 1,59) dan peningkatan rata-rata 12,7%, data kuantitatif menunjukkan peningkatan skor kosakata yang signifikan secara statistik, yang menunjukkan implikasi praktis yang besar. Analisis tematik terhadap respons kualitatif mengidentifikasi tiga tema utama: batasan kegunaan, motivasi dan keterlibatan, serta manfaat yang dirasakan. Mahasiswa memuji kemampuan chatbot untuk memberikan umpan balik kontekstual secara real-time dan mendorong pembelajaran yang lebih mendalam dengan menggunakan contoh-contoh yang terjalin dengan situasi pengkodean. Nada percakapan, kontak individual, dan keterlibatan emosional chatbot dianggap dapat meningkatkan motivasi. Namun, beberapa mahasiswa menunjukkan masalah termasuk keluaran yang berulang, penggunaan sinonim yang berlebihan, dan contoh yang kompleks, yang menyoroti perlunya kalibrasi konten adaptif. Hasil ini menunjukkan bahwa, dengan*

integrasi yang cermat, chatbot berbasis AI dapat berfungsi sebagai instruktur kosakata yang efisien dan dapat disesuaikan; namun demikian, adopsi yang lebih luas akan memerlukan peningkatan pada sistem pengiriman konten.

INTRODUCTION

English has become the dominant language of computing and information technology in the rapidly expanding digital and technological sphere. Proficiency in English especially technical vocabulary acquisition is now an essential skill for Computer Science (CS) students. Understanding academic texts, code documentation, software development kits, and international collaboration requires domain-specific terms in technical English. However, many students, especially those studying in English as a Foreign Language (EFL) classes, struggle to master the specialized terms found in computer science discourse (Reynolds et al., 2023). This challenge persists even in institutions where English for Specific Purposes (ESP) is formally integrated, suggesting that current instructional approaches remain inadequate for supporting the rapid linguistic demands of emerging technologies.

Even though English for Specific Purposes (ESP) has been incorporated into the curriculum, traditional vocabulary education often falls short of keeping up with the rapid expansion of technological language. Textbooks and static materials frequently become obsolete as programming languages, libraries, and frameworks change along with their corresponding vocabularies. In order to support vocabulary acquisition in this ever-changing industry, digital and adaptable technologies are therefore desperately needed. Textbooks and static materials frequently become obsolete as programming languages, libraries, and frameworks change along with their corresponding vocabularies. In order to support vocabulary acquisition in this ever-changing industry, digital and adaptable technologies are therefore desperately needed (Pérez-Jorge et al., 2025). Chatbots driven by artificial intelligence (AI) have become a creative way to fill this pedagogical gap by providing contextualized, interactive, and real-time language support. Chatbots, as opposed to traditional learning materials, encourage learners to use language in context, which increases retention and engagement (Luckyardi et al., 2024). Prior studies have consistently shown that contextualized vocabulary learning leads to higher retention, particularly when learners repeatedly encounter terms within authentic disciplinary tasks (Van Den Broek et al., 2022). These findings reinforce the need for dynamic instructional tools capable of simulating real-world computational environments.

Natural Language Processing (NLP) advancements have made it possible for AI-based chatbots to mimic human-like speech, produce context-relevant responses, and modify their output according to the user's degree of expertise. These tools have a lot of potential for strengthening comprehension through real-world interaction and repetition when applied to vocabulary learning, especially in ESP environments. Studies showed that using chatbot chats that replicate actual professional situations helps students practice technical words (Behforouz et al., 2025). Additionally, learners benefit from chatbots' instant feedback, customization, and low-anxiety learning environments aspects that are often challenging to give in large classes (Yin et al., 2025). However, despite the growing literature on chatbot-assisted language learning, very few studies specifically examine how chatbots support technical vocabulary development for Computer Science students, a group whose learning needs differ substantially from those in general EFL contexts. This underexplored area presents a significant research gap.

AI chatbots provide an even bigger educational advantage in the field of computer science education since they may be equipped with domain-specific corpora to aid students in internalizing abstract terminology. According to a research by Kuhail et al., (2023), learners engaged with the content more thoroughly and retained domain-specific terminology better when chatbots take on multi-role pedagogical roles, such as tutors, peers, or emotional supports. Similar to this, AI-driven tutoring programs such as CourseAssist and Iris have demonstrated efficacy in assisting students in understanding difficult computer science ideas while also strengthening technical vocabulary in the field of computational linguistics (Lydia Velázquez-

García, 2025). Nevertheless, existing studies predominantly emphasize conceptual understanding rather than vocabulary mastery, leaving a gap in empirical evidence regarding how AI conversational agents specifically scaffold lexical development within highly specialized STEM contexts.

Additionally, learner autonomy, a fundamental tenet of adult education and 21st-century learning, aligns well with chatbots. Students value being able to learn at their own pace, especially when examining new and complicated terminology (Widodo & Musyarofah, 2025). Students can ask questions, get individualized examples, and review challenging language by interacting with AI chatbots until they understand it completely. In technical subjects, where a single misinterpreted phrase, like "abstraction" or "polymorphism," could make it difficult to understand a whole course or program, this is very helpful.

Furthermore, chatbots offer a chance to increase linguistic equity in STEM fields. Because they must learn both a second language and disciplinary subject at the same time, non-native English speakers frequently face an even greater disadvantage in technical education. They can get better without worrying about shame or criticism because of chatbot-supported learning, which offers them low-stakes practice settings (Luckyardi et al., 2024). Additionally, new developments in adaptive and sympathetic chatbot design enable systems to recognize learner dissatisfaction or disengagement and modify their replies appropriately (Liu et al., 2024). However, despite these promising developments, previous studies rarely investigate how such affective and adaptive features contribute to measurable vocabulary gains in CS-focused ESP settings. This gap indicates a need for empirical studies that connect affective support with technical vocabulary development outcomes.

But there are still issues in spite of the advancements. The precision and contextual suitability of AI-generated responses are still up for debate, especially when it comes to complex or specialist terms. Concerns have also been raised about learners' excessive dependence on AI support, data privacy ethics, and the necessity for teachers to carefully incorporate these technologies into more comprehensive learning objectives (Al-Zahrani, 2024). Existing research has also not sufficiently examined how CS students perceive the usability limitations of chatbots, such as redundancy, overly complex examples, or excessive synonym usage, issues that may impede vocabulary learning. Adressing these gaps is essential for designing more effective AI-mediated ESP instruction.

Given these gaps, the present study offers two key contributions. First, it provides empirical evidence on how chatbot-enhanced training improves technical vocabulary acquisition among CS students, a population underrepresented in previous AI-in-education research. Second, it integrates quantitative performance data with qualitative student perceptions to offer a comprehensive understanding of how next-generation chatbots function as vocabulary learning scaffolds within ESP-CS contexts. By addressing both linguistic and usability dimensions, this study advances existing literature and fills an important methodological and pedagogical gap.

The purpose of this article is to investigate how chatbots driven by next-generation AI can serve as educational scaffolding to assist computer science students in learning and mastering technical English terminology. The talk will emphasize best practices, potential challenges, and suggestions for incorporating chatbot-based vocabulary aids into computer science education by examining current empirical studies, theoretical frameworks, and classroom implementations.

METHOD

This study used a mixed-method approach that combines quantitative and qualitative data to assess how chatbot-assisted vocabulary learning aids affect students studying computer science's ability to master technical English. The approach was set up to offer quantifiable results as well as in-depth analyzes to evaluate the ways in which next-generation chatbots aid in vocabulary learning.

Quantitative Data Collection

Pre-test and post-test results were obtained using a quasi-experimental one-group approach to gauge the vocabulary increases made possible by chatbots. In order to gauge their understanding of 30 technical English terms that are frequently used in the field of computer science, like compile, algorithm, framework, and encryption, all 30 students took a vocabulary pre-test at the beginning of the semester. These items were chosen after a corpus-based review of academic books and course curricula in the field of computer science.

To learn and apply technical language, students used AI-based chatbot tools, namely ChatGPT, over the course of the 16-week semester. Activities included contextual word usage exercises, vocabulary expansion activities, error correction feedback, and simulated conversations with the chatbot, all of which were in line with the course materials.

The students finished an equivalent vocabulary post-test at the end of the semester, which had the same format and degree of difficulty as the pre-test. The significance of vocabulary acquisition over time was then assessed using descriptive statistics (mean, median, and standard deviation) and inferential statistics (paired-sample t-test) on the gain scores (post-test − pre-test scores).

Shapiro-Wilk tests were used to determine normality, paired-sample t-tests were used to determine the statistical significance of vocabulary gains after the intervention, and descriptive statistics were used to summarize pre-test and post-test scores in the quantitative analysis carried out using SPSS version 26.

Qualitative Data Collection

Semi-structured interviews with ten students chosen from the participant group were used to gather qualitative data to supplement the quantitative findings. Three criteria, gender representation, performance variety (poor, average, and high vocabulary scores), and desire to participate, were deliberately used to select the students.

Three main topics were covered in the interviews: (1) how students felt about using chatbots to expand their vocabulary, (2) difficulties they faced when learning from chatbots, and (3) digital technologies they preferred for vocabulary development. In order to guarantee comfort and clarity, interviews were held in a combination of Indonesian and English and lasted roughly 25 to 30 minutes.

Thematic analysis was used to find recurring themes and sub-themes in the verbatim transcriptions of the data. Inductive coding allowed patterns to be found in the data without being constrained by predefined categories. Data was managed and visualized throughout analysis using NVivo software.

Qualitative analysis used Braun and Clarke's (2016) six-phase thematic analysis method, comprising (1) familiarization with data, (2) generating initial codes, (3) looking for themes, (4) reviewing themes, (5) defining and labelling themes, and (6) producing the final report.

RESULTS AND DISCUSSION

Quantitative Results

The impact of chatbot-enhanced instruction in enhancing students' comprehension of technical language was assessed using a pre-test and post-test design. As seen in Table 1, descriptive statistics showed that vocabulary scores significantly improved between the two assessment sessions. A 12.7% improvement, or a 7.4-point increase, in the mean vocabulary score from the pre-test (58.13) to the post-test (65.53), highlights the effectiveness of the intervention. In a similar vein, the median score increased from 57.7 to 66.5, supporting the notion that performance improved for the entire group.

These measures of central tendency indicate that the chatbot-based training was successful in filling in the knowledge gaps in technical vocabulary, especially when it came to domain-specific terminology like "recursion," "blockchain," or "API." The standard deviation showed a slight widening of the score distribution, but rather than undermining the overall

positive trend, this variability probably reflects individual differences in how the chatbot was used, such as how often follow-up questions were asked or how difficult it was to understand advanced explanations.

Table 1. Descriptive Statistics Summary of Pre-Test and Post-Test

Test Type	Mean	Median
Pre-Test	58.13	57.70
Post-Test	65.53	66.50

As seen in Figure 1, there is a noticeable shift to the right in the post-test scores when compared to the pre-test data, suggesting that performance is generally improving. The score distribution notably narrows at higher values, suggesting that the intervention benefitted students who originally struggled with technical vocabulary, in particular, by reducing inequalities. This supports Zhang & Huang (2024) claim that chatbots close the gap between high and lowperforming learners by democratizing access to high-quality language support. A preliminary estimate using the formula $d = t / \sqrt{n}$ (assuming a sample size of 30 students) produces an effect size of around 1.59, implying a strong practical impact of the intervention beyond mere statistical significance, even though the file does not report effect size (e.g., Cohen's d).

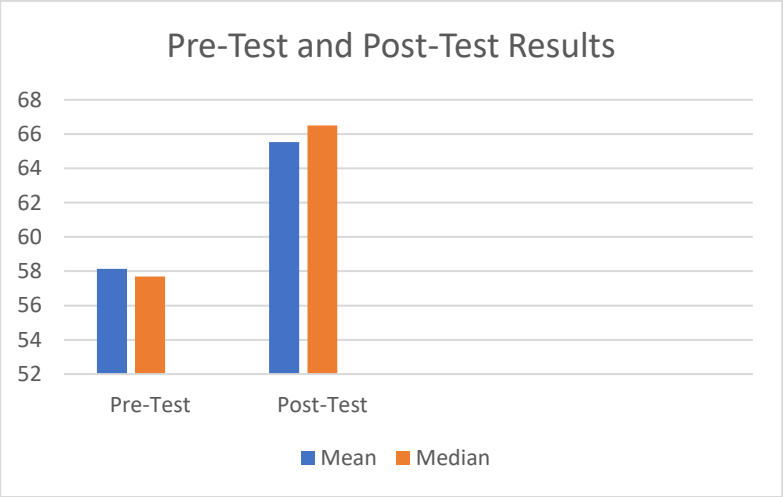

Figure 1. Pre-Test and Post-Test Results

A paired-sample t-test was used to confirm the statistical significance of these improvements, and the results showed an exceptionally low p-value (< 0.000000001) and a t-statistic of 8.70. This finding clearly implies that the reported increases were directly related to the incorporation of chatbot technology, notably ChatGPT, and were not the result of chance. The extremely significant p-value offers solid proof that AI-powered tools can improve technical English learning through individualized, interactive training, which is in line with previous findings by Chen (2025). Through repeated practice and real-world settings like code discussions or API documentation analysis, these studies demonstrate how AI chatbots provide contextual scaffolding and adaptive feedback, allowing learners to internalize difficult vocabulary.

Qualitative Results

Semi-structured interviews with ten students provide qualitative insights into their experiences, preferences, and difficulties when learning language through chatbot interaction. Three main themes emerged from the thematic analysis: (1) the advantages of chatbots as seen by users, (2) motivation and engagement, and (3) usability problems.

Theme 1: Perceived Benefits of Chatbot Tools

With its emphasis on contextual, interactive, and flexible support, a sharp contrast to conventional static resources, the qualitative data in Table 2 clearly demonstrates how students viewed the advantages of chatbot-assisted learning. Specific benefits that are consistent with previous research are highlighted in each participant's comment, highlighting the revolutionary potential of AI-driven tools for technical vocabulary acquisition.

The statement of P1," *ChatGPT helped me to learn words not just by definition, but in real code examples*" is directly highlighted the concept of contextual scaffolding (Hartley et al., 2024). The chatbot converts abstract definitions into useful information by incorporating technical terminology like "API" and "recursion" into real-world coding settings. This strategy is consistent with the findings of Hartley et al., (2024) who contend that providing learners in STEM areas with real-world applications to contextualize terminology improves relevance and retention. This idea is further demonstrated by P8's experience with recursion: *"When I asked about 'recursion,' the bot gave me a simple Python snippet. That made it stick!"*. A customized, condensed code sample is used to show how chatbots may deconstruct difficult ideas into easily understood, domain-specific settings. This is an essential ability for computer science students navigating voluminous technical content.

The chatbot's function as an adaptable dialogue partner is highlighted by P5's comments, *"It corrected my wrong usage politely and suggested a better one like a smart tutor."* (El Ebyary, 2022). The chatbot avoided the stigma of peer judgment by offering dynamic, individualized feedback that resembled the direction of a human instructor, in contrast to static learning aids. This supports the focus made by Lin et al., (2025) on AI's capacity to adapt responses to learners' changing demands while creating a safe environment for experimentation. In addition to reiterating accuracy, these exchanges foster confidence in using terminology appropriately, which is shown in P9's observation: *"I can ask follow-up questions endlessly. It never gets tired, unlike my classmates!"* Here, the chatbot's unending tolerance and round-the-clock availability stand out as major benefits, allowing for self-paced, curiosity-driven research and lowering dependency on limited human resources (like peers or teachers).

These remarks collectively highlight a common theme: chatbots democratize access to personalized, high-quality support that changes to meet the requirements of students. P8's Python snippet and P9's repeated questioning, for example, demonstrate how AI technologies may both simplify complexity and promote deeper participation. A recurring issue in technical education is striking a balance between the demands of accessibility and accuracy, which this dual functionality helps to resolve. Furthermore, the fact that P5's comments indicate that there is no social anxiety during chatbot conversations raises the possibility that AI-powered platforms could lessen the emotional obstacles that are frequently connected to language acquisition, especially in demanding academic settings.

Table 2. Participants' Quotes Referred to Perceived Benefits of Chatbot Tools

Participants	Quotes
P1	*"ChatGPT helped me to learn words not just by definition, but in real code examples"*
P5	*"It corrected my wrong usage politely and suggested a better one like a smart tutor."*
P8	*"When I asked about 'recursion,' the bot gave me a simple Python snippet. That made it stick!"*
P9	*"I can ask follow-up questions endlessly. It never gets tired, unlike my classmates!"*

Theme 2: Engagement and Motivation

Table 3's qualitative data highlights how the conversational style of the chatbot made vocabulary practice an interesting, self-directed activity that greatly increased students' intrinsic motivation. The tool promoted curiosity-driven inquiry and sustained engagement, two essential elements of gamified learning, by mimicking a dynamic discussion instead of a strict drill (Khaleel et al., 2016). These findings are consistent with a larger body of research on AI-driven

education that highlights the need of interaction in maintaining learners' autonomy and engagement.

"Sometimes I stayed longer than class time, just to ask the chatbot more about tech terms," as stated by P2, demonstrates how the conversational format of the chatbot promoted the voluntary extension of learning time. Vázquez-Cano et al., (2021) refer to these phenomena as "gamified curiosity." In contrast to traditional exercises, which frequently felt mandatory, the chatbot's interactive style encouraged students to delve beyond the requirements of the curriculum. Similar to this, P3's observation, *"I used to be bored with vocab lists, but talking to the bot made me want to learn more,"* emphasizes how the tool may break up monotony and reframe learning new words as an inquisitive experience. This supports the claim made by Yaseen et al., (2025) that AI tools may tailor learning paths, giving monotonous jobs a sense of purpose through contextual examples and adaptive feedback.

Anecdotally, P7 said, *"It felt like chatting with a friend who knows everything about programming. I laughed at the jokes too!"* I also chuckled at the humor. adds emotional engagement, an unexpected yet crucial dimension. Through its ability to be humorous and use a conversational tone, the chatbot's anthropomorphic traits humanized technical content and helped to reduce the anxiety that comes with using complicated vocabulary. The ability of AI to mimic social interaction can reduce cognitive load in STEM learners, according to Wang et al., (2021), who concur with this conclusion. The chatbot established a psychologically safe environment for trial and error, which is a requirement for deep learning, by encouraging a sense of community.

Lastly, the experience of P10: *"The bot asked me to explain concepts in my own words that made me think harder"* has a clear connection to the active recall concept (Yin et al., 2024). The self-generated explanations provided by the chatbot forced students to actively retrieve and reorganize their knowledge, which has been shown to improve retention. This supports research in cognitive psychology that shows retrieval practice is better than passive review. In addition to strengthening vocabulary, the chatbot developed metacognitive abilities like self-monitoring and critical thinking, skills essential for technical fields, by integrating active recall into conversation.

Table 3. Participants' Quotes Referred to Engagement and Motivation

Participants	Quotes
P2	*"Sometimes I stayed longer than class time, just to ask the chatbot more about tech terms."*
P3	*"I used to be bored with vocab lists, but talking to the bot made me want to learn more."*
P7	*"It felt like chatting with a friend who knows everything about programming. I laughed at the jokes too!"*
P10	*" The bot asked me to explain concepts in my own words that made me think harder."*

Theme 3: Usability and Limitations

Critical usability issues that students faced when using chatbot-assisted learning are highlighted by the qualitative data in Table 4, highlighting the significance of user-centered design in educational AI systems. Participants underlined that the chatbot's efficacy depended on how well outputs matched their learning requirements and proficiency levels, even with its benefits in contextual scaffolding and engagement. These criticisms, which focus on clarity, adaptability, and cognitive overload, are in line with more general worries about AI-driven education.

The comment made by P4 that *"It sometimes gives too difficult examples like from journals I don't understand,"* highlights a persistent problem: the chatbot's propensity to produce content that is beyond the comprehension boundaries of its users. This supports the claim made by Kanchon et al., (2024) that AI technologies need to dynamically modify output complexity to accommodate different learner profiles. For example, a beginner who sees journal-level examples can become overwhelmed, which would defeat the purpose of the chatbot as a teaching tool. P6's concern, *"When I ask for word meaning, sometimes the explanation is too long and confusing,"*

also emphasizes the danger of consuming too much information. Although thorough explanations can add depth, being overly wordy without using tiered simplification runs the risk of offending students who need succinct, easily understood summaries.

P7's experience, *"I got stuck once because the bot kept using synonyms I didn't know. It made the answer harder."* serves as an example of the dangers of recursive synonym use, in which AI tries to define terms by replacing them with similarly new synonyms. This criticism is closely related to the simplified language adaption proposal made by Martínez et al., (2024), which calls for chatbots to give lexical accessibility precedence over linguistic diversity. In the absence of such protections, efficiency and confidence may be undermined by a vicious cycle of misunderstanding. P8's observation: "It would occasionally repeat the same example. The statement, "I wish it could sense I needed another angle," highlights a crucial drawback: chatbots frequently lack the tools necessary to identify learner weariness or redundancy. AI systems run the risk of becoming "stochastic parrots" tools that repeat information without regard for context, if they don't include feedback loops to dynamically improve explanations, as Förster et al., (2025) warned.

Table 4. Participants' Quotes Referred to Usability and Limitations

Participants	Quotes
P4	*"It sometimes gives too difficult examples like from journals I don't understand."*
P6	*"When I ask for word meaning, sometimes the explanation is too long and confusing."*
P7	*"I got stuck once because the bot kept using synonyms I didn't know. It made the answer harder."*
P8	*"Sometimes it repeated the same example. I wish it could sense I needed another angle."*

Discussion

The results of the study showed that, both statistically and practically, chatbot-enhanced teaching greatly enhances computer science students' acquisition of technical vocabulary. This study highlighted the revolutionary potential of AI-driven tools like ChatGPT while pinpointing crucial areas for improvement in educational design by fusing quantitative success measures with qualitative insights from student interviews.

Quantitative Evidence of Vocabulary Improvement

The findings of the pre-test and post-test showed a statistically significant paired-sample t-test ($t = 8.70$, $p < 0.001$) and a 12.7% improvement in vocabulary scores (mean increase: 7.4 points). This is consistent with earlier research on AI-powered language learning by Zhang & Huang, (2024) which highlights AI's ability to provide interactive, tailored training. The increase in the median score from 57.7 to 66.5 further demonstrates that improvements were uniform throughout the cohort, lessening the gaps between students who performed well and those who did not. Although there was a minor increase in the standard deviation, this variability probably reflects individual differences in involvement (e.g., frequency of follow-up questions) rather than compromising the overall effectiveness of the intervention.

A high practical effect is indicated by an estimated Cohen's d of 1.59 (measured for $n = 30$), indicating that chatbots not only improve scores but also promote deeper conceptual understanding. This supports the claims made by Hartley et al., (2024) that contextual scaffolding, or putting language into real-world contexts like coding examples, improves recall. For example, the chatbot's capacity to translate abstract definitions into useful information by using Python snippets to explain concepts like "recursion" (based on P8's comments) reflects the study's quantitative success.

Qualitative Themes: Benefits, Engagement and Limitations

a. Perceived Benefits of Chatbot Tools

Students highlighted the chatbot's function as an adaptable, contextual tutor. P5's compliment on error-correction ("like a smart tutor") and P1's experience with code-based examples demonstrate how AI tools mimic human-like scaffolding, which is consistent with Hartley et al., (2024) focus on dynamic, learner-centered feedback. P9's comment regarding "endless follow-up questions" highlights the chatbot's value as a round-the-clock tool that lessens dependency on limited human assistance, which is a crucial benefit in educational environments with limited resources.

b. Engagement and Motivation

By transforming vocabulary practice into an inquisitive activity, the chatbot's conversational design increased intrinsic motivation. The gamified learning concepts noted by Khaleel et al., (2016), where AI tools foster autonomy and curiosity, are reflected in P2's prolonged engagement ("stayed longer than class time") and P3's transition from boredom to curiosity. An unanticipated advantage is shown by P7's emotional attachment to the chatbot ("laughed at its jokes"): anthropomorphic interactions lessen anxiety related to technical information, a conclusion corroborated by Zhang & Huang, (2024). Further supporting the active recall theory (Larsen et al., 2013), which holds that verbalizing information improves retention, is P10's experience with self-explanation tasks.

c. Usability and Limitations

Students pointed out usability issues related to clarity and adaptability notwithstanding their excitement. The necessity of proficiency-level filtering is highlighted by P4's dissatisfaction with journal-level examples and P6's grievances regarding wordy explanations (Kanchon et al., 2024). The use of recursive synonyms by P7 ("made the answer harder") and the request for a variety of instances by P8 are reminiscent of Förster et al., (2025) caution about "stochastic parrots"—AI systems that repeat information without taking context into account. These criticisms draw attention to a discrepancy between theoretical promise and real-world application, which calls for incremental design enhancements.

CONCLUSION

This study has shown that chatbot-based tools, especially those that use cutting-edge natural language processing technologies like ChatGPT, greatly improve computer science students' learning of technical English vocabulary. The mixed-method approach, which included both quantitative data from pre- and post-tests and qualitative data from interviews, showed that students' vocabulary proficiency increased statistically as well as their motivation and participation in the learning process.

Quantitative results confirmed the effectiveness of the intervention by showing a statistically significant improvement in vocabulary performance. In the meantime, qualitative data showed that students valued the chatbot's interactive, context-sensitive, and adaptable features. According to their perception, the chatbot encouraged curiosity, participation, and independent learning as a non-judgmental learning companion. However, feedback also highlighted the need to contextualize examples for learners with different levels of ability and simplify excessively complex responses.

These findings support earlier research that supports the pedagogical incorporation of AI-powered chatbots in English language instruction, particularly in STEM-focused educational settings. Crucially, this work provides empirical support for current debates about the digital transformation of education by demonstrating the potential of intelligent conversational agents to close the gap between accessible language acquisition and technical information.

In order to maximize the educational potential of chatbots in ESP (English for Specific Purposes) domains, more research may examine longitudinal impacts, comparative efficacy with other digital interventions, and integration with broader curricula. As digital tools continue to

evolve, educators and instructional designers must concentrate on improving chatbot-based interfaces to ensure inclusivity, adaptability, and effectiveness.

REFERENCES

Al-Zahrani, A. M. (2024). Unveiling the shadows: Beyond the hype of AI in education. *Heliyon*, *10*(9), e30696. https://doi.org/10.1016/j.heliyon.2024.e30696

Behforouz, B., Ghaithi, A. A., & Balushi, Z. A. (2025). Revolutionizing Vocabulary Acquisition through AI Chatbots. *International Journal of Learning, Teaching and Educational Research*, *24*(7), 1–22. https://doi.org/10.26803/ijlter.24.7.1

Chen, X. (2025). Enhancing Interactive English Learning through Embedded Artificial Intelligence Technology. *International Journal of High Speed Electronics and Systems*, 2540727. https://doi.org/10.1142/S0129156425407272

El Ebyary, K. (2022). Native and non-native speakers' reaction to Grammarly-flagged errors: Implications for L2 teaching of writing. *Electronic Journal of Foreign Language Teaching*, *19*(2). https://doi.org/10.56040/ebya1921

Förster, M., Broder, H. R., Fahr, M. C., Klier, M., & Fink, L. (2025). Tell me more, tell me more: The impact of explanations on learning from feedback provided by Artificial Intelligence. *European Journal of Information Systems*, *34*(2), 323–345. https://doi.org/10.1080/0960085X.2024.2404028

Hartley, K., Hayak, M., & Ko, U. H. (2024). Artificial Intelligence Supporting Independent Student Learning: An Evaluative Case Study of ChatGPT and Learning to Code. *Education Sciences*, *14*(2), 120. https://doi.org/10.3390/educsci14020120

Kanchon, Md. K. H., Sadman, M., Nabila, K. F., Tarannum, R., & Khan, R. (2024). Enhancing personalized learning: AI-driven identification of learning styles and content modification strategies. *International Journal of Cognitive Computing in Engineering*, *5*, 269–278. https://doi.org/10.1016/j.ijcce.2024.06.002

Khaleel, F. L., Sahari@Ashaari, N., Tengku Wook, T. S. M., & Ismail, A. (2016). Gamification Elements for Learning Applications. *International Journal on Advanced Science, Engineering and Information Technology*, *6*(6), 868. https://doi.org/10.18517/ijaseit.6.6.1379

Kuhail, M. A., Alturki, N., Alramlawi, S., & Alhejori, K. (2023). Interacting with educational chatbots: A systematic review. *Education and Information Technologies*, *28*(1), 973–1018. https://doi.org/10.1007/s10639-022-11177-3

Larsen, D. P., Butler, A. C., & Roediger Iii, H. L. (2013). Comparative effects of test-enhanced learning and self-explanation on long-term retention. *Medical Education*, *47*(7), 674–682. https://doi.org/10.1111/medu.12141

Lin, M. P.-C., Chang, D. H., & Winne, P. H. (2025). A proposed methodology for investigating student-chatbot interaction patterns in giving peer feedback. *Educational Technology Research and Development*, *73*(1), 353–386. https://doi.org/10.1007/s11423-024-10408-3

Liu, H.-L., Lai, C.-F., & Lin, H.-C. K. (2024). Effects of Facial Recognition and Text Semantic Recognition on Affective Tutoring System. *Journal of Internet Technology*, *25*(6), 807–814. https://doi.org/10.70003/160792642024112506001

Luckyardi, S., Karin, J., Rosmaladewi, R., Hufad, A., & Haristiani, N. (2024). Chatbots as Digital Language Tutors: Revolutionizing Education Through AI. *Indonesian Journal of Science and Technology*, *9*(3), 885–908. https://doi.org/10.17509/ijost.v9i3.79514

Lydia Velázquez-García. (2025). AI-Based Applications Enhancing Computer Science Teaching in Higher Education. *Journal of Information Systems Engineering and Management*, *10*(2), 14–32. https://doi.org/10.52783/jisem.v10i2.920

Martínez, G., Hernández, J. A., Conde, J., Reviriego, P., & Merino, E. (2024). Beware of Words: Evaluating the Lexical Diversity of Conversational LLMs using ChatGPT as Case Study.

ACM Transactions on Intelligent Systems and Technology, 3696459. https://doi.org/10.1145/3696459

Pérez-Jorge, D., Olmos-Raya, E., González-Contreras, A. I., & Pérez-Pérez, I. (2025). Technologies applied to education in the learning of English as a second language. *Frontiers in Education*, *10*, 1481708. https://doi.org/10.3389/feduc.2025.1481708

Reynolds, B. L., Xie, X. (Serina), & Pham, Q. H. P. (2023). The potentials for incidental vocabulary acquisition from listening to computer science academic lectures: A higher education corpus-based case study from Macau. *Frontiers in Psychology*, *14*, 1219159. https://doi.org/10.3389/fpsyg.2023.1219159

Van Den Broek, G. S. E., Wesseling, E., Huijssen, L., Lettink, M., & Van Gog, T. (2022). Vocabulary Learning During Reading: Benefits of Contextual Inferences Versus Retrieval Opportunities. *Cognitive Science*, *46*(4), e13135. https://doi.org/10.1111/cogs.13135

Vázquez-Cano, E., Mengual-Andrés, S., & López-Meneses, E. (2021). Chatbot to improve learning punctuation in Spanish and to enhance open and flexible learning environments. *International Journal of Educational Technology in Higher Education*, *18*(1), 33. https://doi.org/10.1186/s41239-021-00269-8

Wang, L., Wang, D., Tian, F., Peng, Z., Fan, X., Zhang, Z., Yu, M., Ma, X., & Wang, H. (2021). CASS: Towards Building a Social-Support Chatbot for Online Health Community. *Proceedings of the ACM on Human-Computer Interaction*, *5*(CSCW1), 1–31. https://doi.org/10.1145/3449083

Widodo, J. P., & Musyarofah, L. (n.d.). *The Impact of Digital-Interactive-Book Gamification-Based Instruction on Academic Learning Outcomes of Students who Learn at Their Own Pace: Insight from Indonesia*.

Yaseen, H., Mohammad, A. S., Ashal, N., Abusaimeh, H., Ali, A., & Sharabati, A.-A. A. (2025). The Impact of Adaptive Learning Technologies, Personalized Feedback, and Interactive AI Tools on Student Engagement: The Moderating Role of Digital Literacy. *Sustainability*, *17*(3), 1133. https://doi.org/10.3390/su17031133

Yin, J., Xu, H., Pan, Y., & Hu, Y. (2025). Effects of different AI-driven Chatbot feedback on learning outcomes and brain activity. *Npj Science of Learning*, *10*(1), 17. https://doi.org/10.1038/s41539-025-00311-8

Yin, J., Zhu, Y., Goh, T.-T., Wu, W., & Hu, Y. (2024). Using Educational Chatbots with Metacognitive Feedback to Improve Science Learning. *Applied Sciences*, *14*(20), 9345. https://doi.org/10.3390/app14209345

Zhang, Z., & Huang, X. (2024). The impact of chatbots based on large language models on second language vocabulary acquisition. *Heliyon*, *10*(3), e25370. https://doi.org/10.1016/j.heliyon.2024.e25370