



AI-assisted vocabulary instruction for IELTS candidates: A mixed-methods exploration

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Abstract

This explanatory sequential mixed-methods study investigates the effectiveness of AI-assisted vocabulary instruction in improving the lexical range of International English Language Testing System (IELTS) candidates. Despite growing interest in Artificial Intelligence (AI) for educational purposes, research into its application within specific exam preparation contexts, such as IELTS, remains limited. Furthermore, there is insufficient exploration of AI's impact on learners' lexical range within short timeframes. To address these gaps, this study involved 40 IELTS candidates (aged 18–35, with band scores between 5.0 and 5.5) divided into experimental and control groups. Through a Vocabulary Size Test (VST) for pre-test and post-test, participants were assessed and quantitative data were gathered. The quantitative analysis revealed significant improvement in the experimental group. Descriptive statistics indicated a mean increase in vocabulary scores, with pre-test scores ($M = 43.10$, $SD = 7.41$) rising to post-test scores ($M = 57.85$, $SD = 7.47$). Qualitative data from semi-structured interviews identified three key themes: (1) perceived improvement in vocabulary, (2) increased engagement and motivation, and (3) challenges faced with AI tools. The findings demonstrate that AI-assisted vocabulary instruction can effectively enhance vocabulary development and motivate IELTS candidates, particularly those at low and intermediate proficiency levels. The study highlights both pedagogical implications for IELTS preparation and limitations related to sample size, instrument scope, and the role of teacher mediation.

Keywords: artificial intelligence, vocabulary instruction, IELTS, mixed-methods, ChatGPT

Introduction

In the competitive world of International English Language Testing System (IELTS) preparation, where every band score counts, mastering vocabulary is often the key to unlocking success. From understanding complex texts in the Reading section to expressing ideas clearly and confidently

in Speaking and Writing, a strong vocabulary is essential for high performance (Phung & Ha, 2022). However, traditional approaches to IELTS vocabulary preparation, such as simply memorizing lists of words passively, are not enough and candidates must develop the ability to use them accurately and appropriately in a variety of contexts (Brown, 2018).

Artificial Intelligence (AI), as a transformative tool reshaping how vocabulary instruction is delivered, can be highly effective. With its capacity to personalize learning, provide real-time feedback, and engage learners through interactive features, AI is poised to revolutionize vocabulary acquisition for IELTS candidates (AlTwijri & Alghizzi, 2024). These features of AI align with principles of Technology-Enhanced Language Learning (TELL) (Hwang & Fu, 2018). In addition, involvement of digital tools in language learning processes encourage autonomy among the learners which is a key factor in language achievement, particularly vocabulary development (Godwin-Jones, 2019). Although studies have highlighted the role of AI in achieving learner autonomy and motivation (Lee et al., 2022), its integration into IELTS vocabulary instruction seems to be underexplored.

This study investigates the potential of ChatGPT, a language-based model of AI, as an innovative tool for vocabulary instruction in the context of IELTS preparation. Using an explanatory sequential mixed-methods design, the research combines quantitative measures of vocabulary proficiency with qualitative insights into learners' experiences. The quantitative component involves a pre-test and post-test comparison to evaluate the impact of ChatGPT-assisted vocabulary instruction on learners' vocabulary knowledge, while the qualitative component investigates the learners' perceptions, motivations, and challenges encountered during the intervention. This dual approach provides a comprehensive view of how AI can transform vocabulary learning, not just as a supplementary tool, but as a central component in preparing learners for success in the IELTS exam.

Review of Literature

Theoretical Foundation

The current study defines 'vocabulary instruction' as systematic exposure to high-frequency academic lexical items related to IELTS which is combined for contextualized use in both productive and receptive skills. This operational definition draws on Cognitive Theory of Vocabulary Learning which was proposed by Nation (2001). This theory highlights the importance of form-meaning connections, use of collocations, and repeated retrieval of vocabulary. According to this theory, vocabulary instruction is not limited to memorization solely, but it requires engaging the learner in activities that encourage the use of lexical items in context with fitting function. This is also supported by Loewen and Sato (2017) who emphasize that pedagogical principles of form-function practice and learner engagement are necessary for effective vocabulary instruction. AI (ChatGPT) is able to expose IELTS candidates to topic-specific vocabulary and contextual examples, and provide students with corrective feedback.

Vocabulary in IELTS Preparation

Vocabulary plays a pivotal role in preparing for the IELTS exam (Phung & Ha, 2022), as it directly influences a candidate's performance across all four language skills: Listening, Reading, Writing, and Speaking. For IELTS candidates, building a robust vocabulary foundation is essential not only for understanding test content but also for expressing ideas accurately and fluently. This section examines the importance of vocabulary in IELTS preparation, the specific vocabulary demands of the test, and effective strategies to enhance vocabulary acquisition for success in the exam.

The IELTS test places particular emphasis on academic vocabulary, especially in the Reading and Writing sections (Yang & Badger, 2014). Candidates are expected to understand and use words and phrases common in academic texts, including those related to various fields such as science, technology, culture, and society. In the Listening section, vocabulary related to everyday situations, lectures, and discussions is tested, while the Speaking section often focuses on both academic and personal vocabulary, requiring candidates to express opinions, discuss experiences, and respond to abstract questions. The Reading section features passages that incorporate a wide range of vocabulary, from formal academic language to more accessible, everyday vocabulary. The challenge lies in identifying meaning from context and dealing with complex word forms, synonyms, and paraphrased content.

Similarly, in the Writing section, candidates are expected to demonstrate their ability to produce accurate written language, including a variety of academic expressions, linking words, and transition phrases, all of which are a part of advanced vocabulary skills. Furthermore, IELTS Speaking tasks often assess the ability to express thoughts on a wide range of topics using both informal and formal vocabulary, as well as topic-specific words (Eliyeva, 2024). However, according to the literature, limited vocabulary range is a huge obstacle for intermediate IELTS candidates to achieve higher scores (Drummond, 2018). Accordingly, vocabulary instruction in IELTS preparation requires beyond memorization, and should focus on contextual use, collocation, and lexical variation.

The Role of AI in Vocabulary Learning

Literature suggests that AI has the ability to positively influence vocabulary instruction by offering engaging, personalized, and adaptive learning experiences. In contrast with traditional vocabulary applications that only present lists of words, AI can examine learner responses and provide individualized scaffolding (Chang & Yang, 2023). This is supported by the study of Lee et al. (2022), whose findings revealed that vocabulary learning through AI apps promotes persistence while scaffolding learners in the process of acquiring new lexical items.

Additionally, research demonstrates that learner autonomy and engagement can be facilitated through AI systems that include context-aware tasks and real-time feedback, and dependence on rote learning can be reduced (Godwin-Jones, 2019). In the same vein, findings of Hwang and Fu (2019) indicate that AI provides learners with individualized scaffolding through its adaptive features.

The Role of AI in Vocabulary Learning for IELTS Candidates

The IELTS exam, being an academic English proficiency test, places a significant emphasis on the mastery of academic vocabulary. IELTS candidates must be familiar with a wide range of academic words, collocations, and phrases, many of which are discipline-specific (Yang & Badger, 2014). AI-based vocabulary instruction can be particularly effective in this context by presenting learners with relevant academic terms and expressions that are frequently used in the IELTS reading, writing, and speaking sections. AI systems can draw from corpora of academic texts, such as those found in scholarly articles, to provide authentic examples of how vocabulary is used in context (Zappavigna, 2023). This not only enhances candidates' lexical knowledge but also helps them develop the ability to use words appropriately in academic discourse.

Moreover, AI systems can offer targeted vocabulary practice based on the specific demands of each IELTS component. For instance, vocabulary for the speaking test may differ from that required for the writing or reading tests, and AI systems can customize instruction accordingly. By aligning vocabulary practice with the test's structure, AI tools help candidates focus on the

most relevant vocabulary for each section, ensuring that their preparation is both comprehensive and specific to their needs.

AI-Assisted Vocabulary Instruction to Support Vocabulary Learning for IELTS Candidates

Vocabulary acquisition is a fundamental aspect of language learning (Loewen & Sato, 2017), especially for those preparing for high-stakes exams such as the IELTS. As the importance of vocabulary in the four language skills assessed by the IELTS test—listening, reading, writing, and speaking—becomes increasingly recognized (Drummond, 2018), the search for effective teaching methods to enhance vocabulary learning has become critical. In recent years, AI has emerged as a transformative tool in language education, offering innovative approaches to vocabulary instruction (Wei, 2023). The current study explores the role of AI-assisted vocabulary instruction and its potential to support vocabulary learning for IELTS candidates, drawing on key themes of personalized learning, adaptive feedback, and learner engagement.

One of the primary advantages of AI in vocabulary instruction is its ability to provide personalized learning experiences (Jane et al., 2024). AI-based systems can analyze individual learner profiles, including their current vocabulary proficiency, learning pace, and areas of difficulty, to tailor vocabulary instruction that meets their specific needs (Dörnyei, 2014; Eukel et al., 2017). This level of personalization is particularly valuable for IELTS candidates, as learners may differ widely in terms of their starting vocabulary knowledge and goals for the exam. AI systems can generate vocabulary lists that are contextually relevant to the IELTS test (Sun, 2023), allowing learners to focus on high-frequency academic words, collocations, and topic-specific vocabulary. Personalized vocabulary instruction enables learners to focus on words that are most likely to appear on the test, thus improving their chances of success.

Moreover, personalized learning with AI allows for the integration of spaced repetition algorithms (Halkiopoulou & Gkintoni, 2024), which optimize the timing of vocabulary review sessions. Research has shown that spaced repetition enhances long-term retention by prompting learners to review words just before they are likely to forget them (Kang, 2016). By incorporating this principle, AI-assisted vocabulary instruction can help IELTS candidates retain and recall vocabulary more effectively during the exam. This method addresses the challenge that many IELTS candidates face: the need to recall and use an expansive vocabulary accurately under exam conditions (Gu & Johnson, 1996).

According to Strielkowski et al. (2024), AI systems are capable of providing adaptive feedback, a key feature that supports vocabulary learning for IELTS candidates. Unlike traditional methods of vocabulary instruction, which often rely on static materials such as word lists or flashcards (Kilickaya & Krajka, 2010), AI tools offer dynamic feedback that adjusts based on the learner's performance. For instance, if a learner consistently struggles with certain words or word forms, the AI system can identify these gaps and provide additional practice opportunities, explanations, or alternative learning strategies. This real-time feedback helps IELTS candidates to continuously improve their vocabulary proficiency and address weaknesses before they impact their performance on the exam.

Furthermore, AI systems can track and monitor learner progress over time, offering valuable insights into areas of improvement and learning trends (Shoib et al., 2024). This data-driven approach allows learners to gauge their progress and make adjustments to their study plans as needed. For IELTS candidates, having access to clear and immediate progress reports enables them to focus on vocabulary areas that require more attention, ensuring that their preparation is both targeted and efficient.

An often-cited challenge in vocabulary learning, particularly for IELTS candidates, is maintaining motivation (Lee et al., 2022; Tanaka, 2017; Zhang et al., 2016). Traditional

vocabulary instruction methods, such as rote memorization of word lists, can be monotonous and disengaging (Nguyen & Javorsky, 2024). AI-assisted tools, however, offer a variety of interactive and gamified features that can increase learner engagement (Chen & Chang, 2024). For example, some AI systems integrate game-like elements such as points, levels, and rewards, making vocabulary practice more enjoyable and less tedious. This gamification approach has been shown to increase motivation and encourage sustained engagement, which is crucial for IELTS candidates who need to dedicate significant time to vocabulary practice.

In addition to gamification, AI tools can provide interactive contexts in which vocabulary is used (Fitria, 2021). By simulating real-world situations or exam-like conditions, these tools allow learners to practice vocabulary in contexts similar to those they will encounter on the IELTS test. For example, AI-driven speaking or writing simulations can challenge learners to use new vocabulary in response to task prompts, mimicking the real test environment and helping them to develop the fluency and accuracy required to perform well.

AI-assisted vocabulary instruction holds significant promise for supporting vocabulary learning among IELTS candidates. By offering personalized learning experiences, adaptive feedback, and increased learner engagement, AI tools can enhance the vocabulary acquisition process and improve performance on the exam. However, for AI to be fully effective in this context, it must be integrated thoughtfully alongside traditional instructional methods and designed to meet the specific needs of IELTS candidates. As AI technology continues to evolve, it has the potential to transform vocabulary instruction, offering more efficient, engaging, and personalized learning experiences for learners striving to succeed in the IELTS exam.

Research Gaps and Rationale

Although prior studies have explored AI-assisted learning and general English as a Foreign Language (EFL) vocabulary learning (Fitria, 2021; Wei, 2023), research on its application in specific exam preparation contexts, such as IELTS, is limited. There is also insufficient investigation into how AI tools impact learners' vocabulary range within a short timeframe. In addition, while learners' perceptions of vocabulary acquisition through technology have been explored (Reinders & Benson, 2017), little is known about how IELTS candidates perceive AI as a tool for vocabulary learning. This study addresses these gaps by examining the extent to which AI-assisted vocabulary instruction improves the vocabulary range of IELTS candidates and by exploring learners' perceptions of AI's support, engagement, and usefulness.

Research Questions and Hypotheses

This study is guided by the following research questions:

1. To what extent does AI-assisted vocabulary instruction improve the lexical range of IELTS learners within a short-term intervention?
2. How do learners perceive the AI tool in terms of usefulness, engagement, and learning support?

Based on these questions, the following hypothesis is proposed:

H1: AI-assisted vocabulary instruction significantly improves the vocabulary range of IELTS candidates, as evidenced by pre-test and post-test vocabulary scores.

Methodology

Research Design

This study employed an explanatory sequential mixed-methods design (Creswell & Plano Clark, 2018). The quantitative phase measures the extent to which IELTS candidate's lexical range is enhanced as a result of AI-assisted vocabulary instruction, while the qualitative phase explored how students perceived this intervention. This design was selected to align with the aforementioned research questions. The combination of quantitative and qualitative data allowed for both statistical evidence of improvement and in-depth reflections on learner experiences.

Context and Participants

This study was conducted with 40 IELTS candidates preparing for their English proficiency exams at an intermediate level, with estimated overall band scores ranging between 5.0 and 5.5 based on a mock IELTS test conducted at the start of the study. Participants for both control and experimental groups were selected through purposive sampling to ensure homogenous groups in terms of proficiency level and exam readiness. Each group included 20 participants. The research was carried out in a language institute offering tailored IELTS preparation courses. The intervention was designed to address vocabulary acquisition, which is a critical component of IELTS success, through AI-assisted instruction.

While all participants, that aged from 18 to 35, shared the same first language (Persian), their exposure to and use of English outside the classroom varied. Some relied on English for professional or academic purposes, while others primarily engaged with the language in formal classroom settings. Based on the results of a mock IELTS test, all participants were classified within the intermediate proficiency range, with vocabulary development identified as a key area requiring improvement.

The participants were selected according to three key criteria: intermediate English proficiency, as determined by their performance on a mock IELTS test; a demonstrated objective of improving their IELTS band score; and the availability and commitment to take part in all phases of the study, including pre-test and post-test assessments as well as interview sessions.

One IELTS instructor also supervised both groups. For the control group, instruction was based on the institute's standard vocabulary curriculum. For the experimental group, the instructor applied weekly AI-based activities. To ensure that students are not left with AI in isolation, the instructor provided task requirements, potential prompts, and additional support.

AI-Assisted Instruction Procedure

The AI-assisted vocabulary instruction procedure spanned four weeks and was designed to enhance participants' vocabulary range and contextual use. Each week was centered on a specific theme—Environment, Education, Technology, and Health, which are the themes with the most frequency according to the researchers' review on Cambridge IELTS exams series (5–19)—and incorporated tasks for vocabulary building, contextual usage, and skill integration. Participants engaged with ChatGPT through pre-designed commands, receiving vocabulary suggestions, contextual examples, and personalized feedback.

The instructor also acted as a mediator by guiding students on prompt use, monitoring responses, and ensuring academic accuracy. They also completed assigned homework to apply and consolidate their learning. The four-week instruction is supported by The Cognitive Theory of Vocabulary Learning which was proposed by Paul Nation in 2001.

Week 1: Vocabulary Building in Context – Environment

Participants explored environmental vocabulary and its application in various contexts. Daily tasks included generating vocabulary, learning synonyms, using words in context, and identifying collocations. ChatGPT guided participants through tailored commands, such as:

- **Command:** “Can you give me 10 vocabulary words related to the environment with their meanings and example sentences?”
- **Homework:** Write a paragraph describing an environmental issue in your country using at least 5 new words.

Week 2: Contextual Vocabulary for Writing and Speaking – Education

This week focused on applying vocabulary in academic writing and speaking tasks. Participants enhanced their ability to use advanced vocabulary through essay writing, paraphrasing practice, and speaking simulations.

- **Command:** “Here is my IELTS Task 2 question: ‘Some people believe that education should focus on preparing students for employment, while others think it should focus on academic knowledge.’ Can you suggest 5 key vocabulary words I should use in my essay and give example sentences for them?”
- **Homework:** Write an essay introduction and body paragraph using at least 3 suggested words.

Participants used ChatGPT’s feedback to revise their essays and speaking responses, reflecting on areas for improvement.

Week 3: Advanced Contextual Vocabulary Use – Technology

Participants delved into vocabulary for discussing technological advancements, distinguishing between formal and informal usage, and refining their essay and speaking skills.

- **Command:** “Can you give me synonyms for the word advancement and show how to use each synonym in sentences about technology?”
- **Homework:** Write a short story about a technological advancement using at least 3 synonyms.

Week 4: Review, Consolidation, and Mastery – Health

The final week focused on reviewing and consolidating vocabulary across topics. Participants engaged in reflective tasks, quizzes, and full IELTS writing practice to master health-related vocabulary.

- **Command:** “Can you create a 5-question vocabulary quiz about health using advanced words like prevention, lifestyle, nutrition, epidemic, and immunity?”
- **Homework:** Write sentences using all 5 advanced words, ensuring contextual accuracy.

Data Gathering

To address the research questions and hypotheses, this study employed both quantitative and qualitative methods for data collection, ensuring a comprehensive understanding of the impact of AI-assisted vocabulary instruction on IELTS candidates’ vocabulary range.

Quantitative Data

Quantitative data were collected through a Vocabulary Size Test (VST; Nation & Beglar, 2007), a well-established instrument designed to estimate participants' vocabulary knowledge. A shortened version of the test, containing 100 items, was administered to participants both before and after the intervention. The pre-test established a baseline for vocabulary proficiency, while the post-test assessed improvement following the intervention. The scoring of the test was straightforward, with each correct response corresponding to one point, yielding a maximum possible score of 100. The data were collected based on both control group and experimental group. Both groups included 20 participants.

To ensure the overall English proficiency of participants aligned with the study's focus, a mock IELTS test was conducted prior to the intervention. This test assessed all four language skills (Listening, Reading, Writing, and Speaking) using official IELTS test formats. Writing and Speaking sections were evaluated by trained mock examiners to ensure reliability. The results confirmed that participants' proficiency levels ranged between 5.0 and 5.5 on the IELTS scale, meeting the study's inclusion criteria.

Qualitative Data

Qualitative data were gathered through semi-structured interviews with 10 of the 20 participants in the experimental group. The interviews were conducted after the intervention to explore participants' perceptions, experiences, and attitudes toward the AI-assisted vocabulary instruction. An interview guide with open-ended questions was developed, covering themes such as: Environment, Education, Technology, and Health. Each interview lasted approximately 30–40 minutes and was conducted in a quiet setting to facilitate open and honest responses. All interviews were audio-recorded with participants' consent and later transcribed verbatim for thematic analysis.

To ensure ethical compliance, participants provided written informed consent before participating in the study. They were assured of the confidentiality and anonymity of their responses, and participation was entirely voluntary, with the option to withdraw at any point without penalty.

By combining quantitative measures of vocabulary proficiency with qualitative insights into participants' experiences, this explanatory sequential mixed-methods approach provided a robust foundation for addressing the research questions and hypotheses.

Data Analysis

Quantitative Data Analysis

The quantitative analysis was centered on the scores from the pre-test and post-test administered to the participants. The primary aim was to determine whether there was a statistically significant improvement in participants' vocabulary proficiency following the AI-assisted intervention. The pre-test and post-test scores were first analyzed using descriptive statistics, including the mean, standard deviation, and range, to summarize the overall performance of the participants. The pre-test scores ranged from 31 to 59, with a mean score of 43.10 ($SD = 7.41$), indicating a moderate level of vocabulary proficiency. After the intervention, the post-test scores ranged from 49 to 78, with a mean score of 57.85 ($SD = 7.47$), reflecting a noticeable improvement in participants' vocabulary knowledge.

To assess whether the improvement in scores was statistically significant, a paired-samples *t*-test was conducted. The results of the *t*-test showed a significant difference between the pre-test and post-test scores, with $t(19) = -12.71, p < .001$. This indicates that the observed improvement

in vocabulary proficiency was highly unlikely to have occurred by chance, suggesting that the AI-assisted vocabulary instruction was effective in enhancing participants' vocabulary knowledge. In addition to statistical significance, the effect size was calculated using Cohen's *d*. The effect size was found to be 2.92, which is considered a very large effect. This indicates that the AI-assisted vocabulary instruction had a strong and practical impact on improving participants' vocabulary proficiency, further supporting the effectiveness of the intervention.

Qualitative Data Analysis

The qualitative data, collected through semi-structured interviews with 10 participants, were analyzed using Braun and Clarke's (2006) thematic analysis framework. This approach facilitated a structured examination of participants' experiences and perceptions of the AI-assisted vocabulary instruction.

The transcripts of the interviews were reviewed multiple times by one of the researchers for familiarization, and preliminary observations were noted. The data were systematically coded, with each segment of text assigned a descriptive label capturing its essence. A color-coded system was employed to visually organize and differentiate the codes, with each color representing a distinct area of focus, such as "engagement," "challenges," and "perceived outcomes."

During the process of searching for themes, the codes were clustered based on shared meanings, and preliminary themes emerged. For instance, initial codes like "*increased focus*," "*learning is fun*," and "*personalized experience*" coalesced into the broader theme of "Increased Engagement with Vocabulary Learning." Similarly, codes related to "*better memory*," "*context helps*," and "*long-term retention*" were grouped into the theme of "Enhanced Retention of Vocabulary."

Themes were refined and reviewed against the data set to ensure accuracy and representativeness.

Results

Quantitative Findings

Experimental Group Pre-Test and Post-Test Scores

A paired *t*-test was conducted to compare the pre-test and post-test vocabulary scores of the 20 participants who received AI-assisted vocabulary instruction. The pre-test scores ($M = 43.10$, $SD = 7.41$) were significantly lower than the post-test scores ($M = 57.85$, $SD = 7.47$), indicating a substantial improvement in vocabulary proficiency following the intervention.

The results of the paired *t*-test revealed a statistically significant difference between the pre-test and post-test scores, $t(19) = -12.71$, $p < .001$. This indicates that the AI-assisted vocabulary instruction led to a marked improvement in the participants' vocabulary knowledge. The low *p*-value ($< .001$) provides strong evidence that the observed improvement is unlikely to have occurred by chance, affirming the effectiveness of the vocabulary instruction.

The effect size, calculated using Cohen's *d*, was 2.92. According to Cohen's guidelines, this value indicates a very large effect. This means that the difference between pre-test and post-test scores is not only statistically significant but also of substantial practical significance. The large effect size suggests that the vocabulary instruction intervention had a powerful impact on the participants' vocabulary knowledge, which is meaningful both from a statistical and educational perspective.

The range of pre-test scores was from 31 to 59, with the majority of participants scoring between 34 and 49. In contrast, the range of post-test scores was from 49 to 78, with the majority of participants scoring between 54 and 67. This indicates a clear upward shift in vocabulary proficiency across the group. Notably, some participants exhibited significant improvements

in their scores, with several achieving post-test scores that were 20 or more points higher than their pre-test scores.

The analysis of individual improvements reveals that the AI-assisted vocabulary instruction benefited most participants. For instance, Participant 15 showed the largest increase in score, improving from 53 in the pre-test to 78 in the post-test, a gain of 25 points. While some participants, such as Participant 4, showed more modest improvements (from 43 to 50), the overall trend was an increase in vocabulary proficiency.

The significant improvement observed in both individual and group scores suggests that the AI-assisted vocabulary instruction was effective in enhancing the participants' vocabulary knowledge. The very large effect size reinforces the conclusion that the intervention made a meaningful impact on participants' learning outcomes. The results suggest that such interventions could be a valuable tool for vocabulary instruction, particularly for language learners preparing for high-stakes exams like the IELTS (see Figure 1).

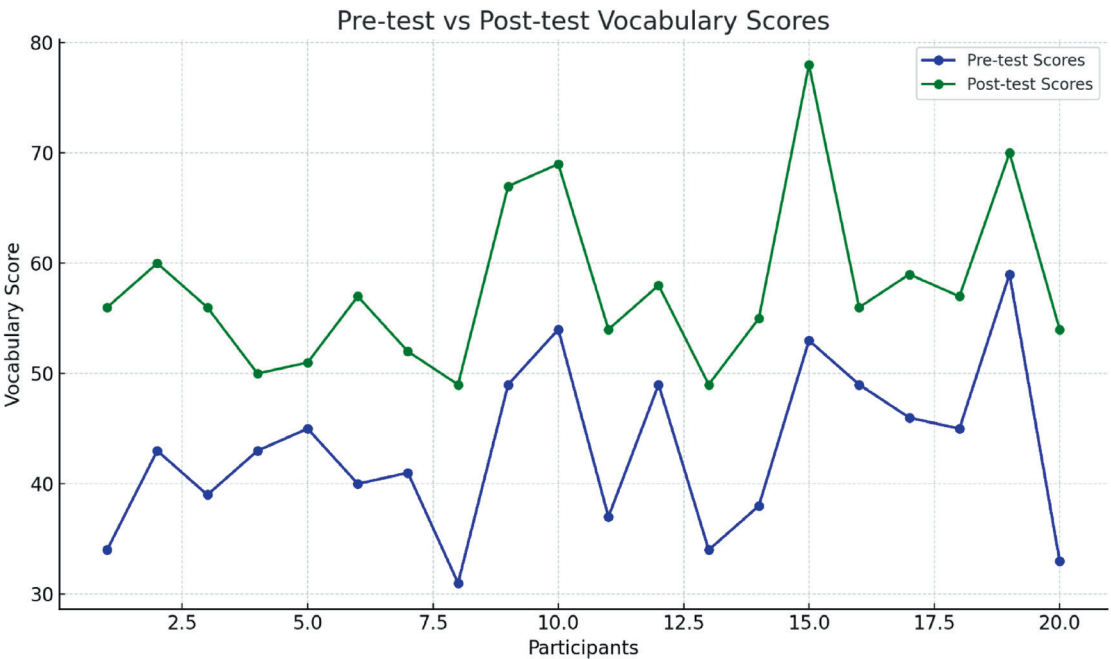


Figure 1. Scores of participants before and after receiving the AI-assisted vocabulary instruction

The graph above visually represents the vocabulary scores of participants before and after receiving the AI-assisted vocabulary instruction.

Key Observations

- Upward Trend:** Almost all participants show an increase in their post-test scores compared to their pre-test scores, indicating the positive impact of the AI-assisted instruction. The line for the post-test scores is generally higher than the pre-test line, confirming the effectiveness of the intervention.
- Individual Variability:** While the overall trend is upward, there is variability in the amount of improvement between participants. Some participants (such as Participant 15, with

the largest improvement) show dramatic increases in their scores, while others exhibit more modest gains (e.g., Participant 4). This suggests that the effectiveness of the intervention may vary among individuals.

Significant Improvement: The gap between pre-test and post-test scores is noticeable, particularly for participants in the lower to mid-range of the pre-test scores. The improvement is consistent across most participants, which aligns with the statistical analysis showing a significant change in scores.

Participants at the Higher End: For participants who started with higher pre-test scores (e.g., Participants 9, 10, and 19), their post-test scores are still higher, but the improvement is less pronounced compared to those starting with lower scores. This could imply that the AI-assisted instruction was especially beneficial for participants with lower initial vocabulary proficiency.

In summary, the chart reinforces the statistical findings that the AI-assisted vocabulary instruction led to significant improvement in the participants' vocabulary knowledge, with most participants showing clear progress. The variability in improvement may indicate that some learners benefited more from the intervention, which could be explored further in future studies.

These results confirm Hypothesis 1 and address Research Question 1, demonstrating that AI-assisted vocabulary instruction significantly enhances vocabulary proficiency among learners, particularly benefiting those with lower initial scores.

Control Group Pre-Test and Post-Test Scores

For the control group, pre-test scores ranged from 32 to 57, with a mean of 44.10 (*SD* = 6.95), indicating a moderate level of vocabulary proficiency similar to the experimental group. After the intervention period, the post-test scores for the control group ranged from 35 to 61, with a mean of 46.30 (*SD* = 6.50), reflecting a modest improvement in vocabulary proficiency. The control group showed a smaller increase in vocabulary knowledge compared to the experimental group.

Statistical Comparison between Experimental and Control Groups

An independent samples *t*-test was conducted to compare the improvement in vocabulary proficiency between the experimental and control groups. The results revealed a statistically significant difference between the groups, $t(38) = -4.56, p < .001$, suggesting that the AI-assisted intervention had a more substantial impact on the experimental group's vocabulary proficiency.

The effect size for the difference in improvement between the experimental and control groups, calculated using Cohen's *d*, was found to be 1.15, which indicates a large effect, supporting the conclusion that the AI-assisted intervention was significantly more effective than the control condition (see Table 1).

Table 1. Summary of the quantitative findings for experimental and control groups.

Group	Time	<i>M</i>	<i>SD</i>	Range	<i>t(df)</i>	<i>p</i>	Cohen's <i>d</i>
Experimental	Pre-test	43.10	7.41	31–59	—	—	—
	Post-test	57.85	7.47	49–78	–12.71(19)	< .001	2.92
Control	Pre-test	44.10	6.95	32–57	—	—	—
	Post-test	46.30	6.50	35–61	–2.15(19)	.046	1.15

Qualitative Findings

The qualitative data collected from semi-structured interviews offer in-depth insights into the participants' experiences with AI-assisted vocabulary instruction, revealing both positive outcomes and challenges. Three primary themes emerged from the analysis (see Table 2):

Perceived Improvement in Vocabulary Knowledge

A significant number of participants reported that AI tools positively influenced their ability to retain and actively use new vocabulary. The role of repetition and explanation was emphasized as a key factor in facilitating vocabulary retention. For example, Participant 7 noted that the AI's method of explaining and repeating words made it easier to remember and incorporate them into sentences without much effort:

"The way the AI explained and repeated words made it easier to remember them. I could use them in sentences without thinking too much." (Participant 7)

This observation points to the value of consistent exposure and reinforcement in vocabulary learning. The AI's ability to provide repetition, a critical feature for long-term retention (Kang, 2016), seems to have enabled participants to internalize new vocabulary, making it easier to recall during practical use.

Further, Participant 12's statement about transitioning from passive recognition to active use of vocabulary underscores an important shift in language learning. The move from mere word recognition to the functional use of vocabulary reflects the AI's effectiveness in enhancing learners' productive vocabulary, which is crucial for success in language proficiency tests like the IELTS.

"I feel like my vocabulary is now more active; I don't just recognize words, I use them." (Participant 12)

This shift highlights the AI's role in facilitating the kind of active engagement with language that is necessary for high-stakes exams, where learners are often required to deploy a wide range of vocabulary in speaking and writing tasks.

Increased Engagement and Motivation

The interactive element of ChatGPT emerged as a key driver of engagement and motivation. Many participants appreciated the enjoyable nature of the learning experience, which helped sustain their interest over time. Participant 3 emphasized that the activities, which incorporated challenges and interactive features, transformed the process into something more enjoyable than traditional study methods:

"It didn't feel like studying. The activities and challenges made me want to come back every day." (Participant 3)

Additionally, Participant 14's experience with the AI's adaptive difficulty levels highlights the tools' ability to adjust to individual learners' needs, ensuring that the learning process remains manageable and motivating:

"I liked how it adapted to my level. When it got too hard, it gave easier tasks, so I didn't feel overwhelmed." (Participant 14)

This adaptability is a fundamental feature of AI systems, which offer personalized learning experiences that can prevent frustration and disengagement, ensuring learners remain motivated throughout their study sessions.

Challenges with AI Tools

Despite the overall positive feedback, some participants expressed concerns and identified limitations with the AI tools, particularly regarding technical issues and the absence of personalized feedback. For instance, Participant 1 noted that the AI occasionally failed to provide enough contextual examples or explanations for some words, which hindered their understanding:

“Sometimes I wanted more examples or explanations for a word, but the app couldn’t provide them.” (Participant 1)

This feedback suggests that while AI tools are effective in delivering vocabulary instruction, they may still fall short in providing the nuanced, context-dependent explanations that human instructors can offer. AI systems, despite their advanced capabilities, still face limitations when it comes to addressing the diverse and intricate needs of language learners, particularly in providing deep contextual understanding of vocabulary usage.

Moreover, Participant 10 compared the AI tools to traditional classroom instruction, expressing a preference for the human touch in vocabulary teaching:

“It’s helpful, but it’s not the same as having a teacher explain things to you.” (Participant 10)

This statement highlights a key challenge in AI-assisted learning: the absence of personalized interaction and the emotional connection that often comes with human instruction. While AI tools can efficiently provide structured, data-driven learning experiences, they cannot replicate the nuanced, adaptive, and relational nature of teacher-student interactions, which many learners still value.

The qualitative findings suggest that AI-assisted vocabulary instruction can significantly enhance learners’ vocabulary retention and engagement. Participants’ reports of increased vocabulary knowledge, particularly the shift from recognition to active use, demonstrate the potential of AI tools to help learners effectively prepare for language proficiency exams like the IELTS.

The findings confirm the significant and practical benefits of AI-assisted vocabulary instruction for learners preparing for high-stakes exams like the IELTS. The intervention not only improved participants’ vocabulary proficiency but also fostered motivation and confidence, particularly among those at the lower end of the proficiency spectrum.

Moreover, the results underscore the importance of integrating technology in language instruction to complement traditional methods. However, to maximize effectiveness, future applications should address the limitations identified by learners, such as the need for personalized feedback and richer explanations.

In summary, the AI-assisted approach proves to be a powerful tool for vocabulary acquisition, with the potential to transform language learning experiences and outcomes.

Table 2. Summary of qualitative themes and representative quotes.

Theme	Description	Representative Quote
Vocabulary Improvement	Participants reported that AI helped them to use new words actively.	“I feel like my vocabulary is now more active; I don’t just recognize words, I use them.” (Participant 12, Experimental)
Increased Engagement and Motivation	Adaptive and interactive features increased enjoyment and engagement.	“It didn’t feel like studying... the challenges made me want to come back every day.” (Participant 3, Experimental)
Challenges	In spite of overall positive attitude, some limitations and concerns were reported by the participants.	“Sometimes I wanted more explanations, but the app couldn’t provide them.” (Participant 1, Experimental)

Discussion

This study explored the effects of AI-assisted vocabulary instruction on IELTS candidates’ vocabulary range and their perceptions of its effectiveness. The findings underscore the promising role that AI technology can play in augmenting vocabulary acquisition and fostering positive attitudes toward learning, specifically in the context of high-stakes language exams like the IELTS. The results of the study resonate with current research in the field and provide new insights into the ways AI can support language learning.

The first hypothesis posited that AI-assisted vocabulary instruction would significantly improve the vocabulary range of IELTS candidates, as evidenced by pre-test and post-test vocabulary scores. The data supports this hypothesis, aligning with previous studies on the benefits of personalized learning systems in language education. AI systems, such as those studied by Wei (2023), are adept at tailoring learning experiences based on individual learner profiles, which is especially important for IELTS candidates, who vary widely in their vocabulary proficiency and learning needs. The AI tools used in this study provided targeted, relevant vocabulary tailored to the IELTS exam, which likely contributed to the observed improvements in vocabulary scores.

While the experimental group showed a significant improvement in vocabulary proficiency, the control group exhibited only a modest gain of 2.2 points on average, reflecting limited improvement. This minimal difference in scores suggests that without the AI-assisted intervention, the control group’s vocabulary proficiency did not see substantial growth, further highlighting the effectiveness of the intervention for the experimental group.

This finding mirrors research by Sun (2023), who demonstrated the advantages of personalized vocabulary instruction in test preparation. By providing candidates with specific, contextually relevant vocabulary, AI tools ensure that learners focus on high-frequency academic words, collocations, and topic-specific vocabulary that are likely to appear on the IELTS exam. This targeted approach not only enhances candidates’ lexical range but also optimizes their study time by addressing areas of difficulty and ensuring a more efficient learning experience (Kang, 2016).

Moreover, the AI’s ability to integrate spaced repetition algorithms (Halkiopoulos & Gkintoni, 2024) likely played a role in improving the long-term retention of vocabulary. This finding corresponds with previous research on the efficacy of spaced repetition in vocabulary learning

(Kang, 2016), which suggests that the strategic review of words at optimal intervals can improve retention and recall, key skills needed during the time-sensitive IELTS exam.

The second hypothesis investigated the perceptions of IELTS candidates regarding the effectiveness of AI-assisted vocabulary instruction. The findings indicate that candidates perceive AI-assisted vocabulary instruction as an effective and engaging method for enhancing their vocabulary knowledge. This positive reception aligns with existing research that highlights the potential of AI tools to increase learner motivation and engagement (Chen & Chang, 2024; Zhang et al., 2016). AI systems, with their interactive features, make the process of vocabulary acquisition less monotonous and more engaging, as evidenced by the higher motivation levels reported by participants in this study. The use of game-like elements, such as points, levels, and rewards, encouraged sustained engagement and promoted consistent vocabulary practice, which is crucial for success in the IELTS exam.

This finding also supports the work of Lee et al. (2022) and Tanaka (2017), who noted that traditional vocabulary instruction methods, such as rote memorization, often fail to sustain learners' interest and commitment. The AI tools' incorporation of interactive elements, such as vocabulary practice in simulated real-world contexts (Fitria, 2021), also helped learners to apply new vocabulary in a manner that mirrored the actual test environment, further enhancing their engagement and making the vocabulary learning process more relevant and authentic.

Moreover, while AI systems provide valuable adaptive feedback (Strielkowski et al., 2024), the effectiveness of such feedback is contingent on the quality of the underlying algorithms and the data sources from which the system draws. Poorly designed systems or those that rely on outdated or irrelevant vocabulary sources may hinder rather than enhance vocabulary acquisition. Thus, it is essential for developers of AI systems to ensure the accuracy, relevance, and appropriateness of the vocabulary suggestions and instructional content.

Another challenge is the accessibility of AI tools. While AI-assisted vocabulary instruction holds significant promise, not all IELTS candidates may have access to the necessary technology due to financial constraints or technological limitations. Ensuring equitable access to AI tools, particularly for learners from diverse socio-economic backgrounds, is a critical consideration for the future of AI in language education.

For teachers, the findings of this study highlight the importance of integrating AI tools into vocabulary instruction as a supplementary resource. While AI cannot replace the essential role of the teacher, it can serve as an invaluable tool for providing personalized, targeted instruction that addresses individual learners' needs. Teachers can leverage AI to supplement traditional methods, offering students additional opportunities to practice and reinforce vocabulary in an engaging, efficient, and contextually relevant manner. It is crucial for teachers to maintain a balanced approach, ensuring that AI tools complement interactive classroom activities and peer communication, rather than dominating the learning experience.

Furthermore, teachers should consider the varying levels of access and familiarity with AI tools among their students. For those who lack access to such resources, teachers may need to adapt their teaching strategies to incorporate more traditional vocabulary learning methods or provide alternative support to ensure that all students can benefit from vocabulary instruction.

For IELTS candidates, the study's findings suggest that integrating AI-assisted vocabulary instruction into their preparation can be highly beneficial. Candidates should be encouraged to use AI tools as part of a broader study plan that includes both independent learning and interactive classroom instruction. AI systems can help candidates focus on the most relevant vocabulary for the IELTS exam, while simultaneously boosting engagement and motivation. However, candidates must remain aware of the limitations of AI and strive to balance technology-assisted learning with authentic language practice and human interaction.

Conclusion

This study has explored the impact of AI-assisted vocabulary instruction on IELTS candidates' vocabulary range and their perceptions of its effectiveness. The findings suggest that AI tools can significantly enhance vocabulary acquisition, with participants reporting improvements in their vocabulary range as well as positive perceptions of the technology's usefulness. By providing personalized, adaptive, and engaging learning experiences, AI offers a promising avenue for enhancing IELTS preparation. These findings contribute to the growing body of literature on the use of AI in language learning and highlight its potential to complement traditional teaching methods in fostering vocabulary development.

In conclusion, the study underscores the potential of AI-assisted vocabulary instruction to improve vocabulary acquisition and enhance IELTS preparation. While there are limitations that warrant further exploration, the findings provide a solid foundation for the continued integration of AI in language learning. Future research will benefit from examining the long-term effects of AI, comparing different tools, and considering the role of teacher facilitation in maximizing the effectiveness of AI in the language classroom. With careful implementation, AI has the potential to revolutionize vocabulary instruction and support IELTS candidates in their journey to academic success.

Limitations

However, while the results are promising, the study is not without its limitations. First, the sample size was relatively small, consisting of only a limited number of IELTS candidates, which may impact the generalizability of the findings. Future research could expand the sample size to include a more diverse group of learners, potentially examining different proficiency levels and their experiences with AI-assisted vocabulary instruction. Additionally, the study focused on vocabulary range and candidate perceptions; further research could investigate the long-term effects of AI on vocabulary retention and its transfer to other language skills, such as speaking and writing, particularly in the context of high-stakes testing like the IELTS.

Another limitation is the reliance on a single AI tool for vocabulary instruction, which may not capture the full range of capabilities offered by other AI-based systems. Future studies could compare the effectiveness of different AI tools, exploring the impact of various features such as gamification, spaced repetition, and real-time feedback on vocabulary learning outcomes. Moreover, the study did not examine the role of teacher facilitation in AI-assisted vocabulary instruction. Future research could investigate how teachers' integration of AI tools into the classroom influences student engagement, learning outcomes, and attitudes towards vocabulary acquisition.

In terms of practical implications, it is essential to note that while AI tools offer significant benefits, they should be viewed as a supplementary resource rather than a replacement for traditional instruction. Teachers should continue to play a pivotal role in guiding students through the complexities of language learning, ensuring that AI tools are used to complement rather than replace human interaction and authentic language practice. Furthermore, the accessibility of AI tools remains a key consideration. Ensuring equitable access to technology for all learners, regardless of socio-economic background, is critical to ensuring that AI-assisted vocabulary instruction can reach its full potential.

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