LinguaEducare: Journal of English and Linguistic Studies
ISSN: 3064-0547 (e)
2025, Vol. 2, No. 1, page 11-18
https://journal.ciptapustaka.com/index.php/LEC

OPEN ACCESS

Investigating the Efficacy of the Papago AI Application in Enhancing Vocabulary Proficiency Among Secondary School Students

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ABSTRACT

This quasi-experimental study investigated the efficacy of the AI-powered Papago application in enhancing vocabulary acquisition among tenth-grade students at SMAN 7 Bandar Lampung. The research aimed to address common student difficulties in vocabulary retention and application by leveraging AI's potential for personalized, contextually accurate, and interactive learning. Focusing on five key vocabulary categories—nouns, adjectives, adverbs, verbs, and conjunctions, particularly within the context of descriptive texts—the study employed a quantitative research design to assess Papago's impact. Data were collected via pre-tests and post-tests, supplemented by qualitative feedback from students and teachers regarding the application's usability. Statistical analysis using SPSS 27 revealed a significant difference ($p=0.004<0.05$) in vocabulary mastery among students who utilized Papago. This outcome supports the alternative hypothesis, indicating that the intervention effectively improved students' vocabulary mastery. The findings suggest that AI applications such as Papago hold considerable promise in surmounting prevalent vocabulary-learning challenges and fostering greater student engagement.

ARTICLE INFO

Keywords:
Artificial Intelligence;
Language Learning;
Papago;
Vocabulary Mastery

Article History::
Received: 30 April 2025
Revised: 06 June 2025
Accepted: 06 June 2025
Published: 07 June 2025

How to Cite in APA Style:
Kholid, M. F. N., Adillia, A., & Suryawati, S. S. (2025). Investigating the Efficacy of the Papago AI Application in Enhancing Vocabulary Proficiency Among Secondary School Students. *LinguaEducare: Journal of English and Linguistic Studies, 2*(1), 11-18. https://doi.org/10.63324/lec.2v.1i.64

Introduction

In the rapidly evolving digital era, technology has profoundly transformed educational practices, ushering in new paradigms for teaching and learning. Within the realm of second language acquisition, vocabulary acquisition stands as a crucial component, forming the bedrock upon which all other language skills—reading, writing, listening, and speaking—are developed (Wulyani et al., 2024). Despite its foundational importance, many students continue to grapple with effectively mastering and applying new vocabulary, particularly within the confines of traditional classroom settings. These conventional environments often struggle to provide the personalized, dynamic, and contextually rich learning experiences essential for robust lexical development and long-term retention (Hastomo et al., 2025).

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To mitigate these persistent challenges, the integration of Artificial Intelligence (AI) into language learning emerges as a highly promising alternative. AI-powered applications, such as Papago, developed by Naver, offer an array of innovative features designed to revolutionize vocabulary instruction (Kim, 2023). These functionalities include real-time translation, which immediately bridges linguistic gaps; context-based word suggestions, which aid in understanding nuanced meanings; and pronunciation assistance, critical for accurate spoken production. Individually and collectively, these features aim to immerse students in a learning environment that is not only engaging and interactive but also deeply contextual, thereby fostering more effective and meaningful vocabulary acquisition. The adaptive nature of AI allows for personalized learning paths, catering to individual student needs and learning paces, which is often difficult to achieve in a large classroom setting (Slamet, 2024).

This study was specifically designed to investigate the effectiveness of using the AI-based Papago application on the vocabulary mastery of tenth-grade students at SMAN 7 Bandar Lampung. The research employed a rigorous quasi-experimental design, a methodology well-suited for educational interventions in real-world settings. This design involved the administration of pre-test and post-test assessments to meticulously evaluate changes in students' vocabulary knowledge and application. By comparing the performance of students who utilized Papago with those who did not, the research aimed to determine whether the integration of this AI tool significantly enhances students' understanding and practical usage of English vocabulary.

The anticipated findings of this study are expected to yield valuable insights into the practical implementation of AI tools in language education. Beyond merely confirming the efficacy of Papago, the research intends to illuminate the specific ways in which AI can address long-standing challenges in vocabulary learning, potentially informing pedagogical strategies and curriculum development. Furthermore, the results are poised to contribute to the broader academic discourse on the role of technology in fostering improved student learning outcomes in second language acquisition. Ultimately, this research seeks to underscore the transformative potential of AI applications like Papago in creating more dynamic, personalized, and effective language learning environments for students in the digital age.

Method

Research Design

This study employed a quantitative research method (Creswell, 2012) with a quasi-experimental design to evaluate the effectiveness of integrating the AI-powered Papago application in enhancing students' English vocabulary mastery. The research was conducted at SMAN 7 Bandar Lampung, with tenth-grade students comprising the study's population. To ensure a representative sample while accommodating practical classroom settings, two classes were randomly selected using cluster sampling: class X.7 was designated as the experimental group, receiving instruction augmented by the Papago application, while class X.2 served as the control group, continuing with conventional vocabulary instruction.

Research Procedures

The research procedures were meticulously structured to ensure a robust comparison between the two instructional approaches. Initially, both the experimental and control groups were administered a pre-test to establish their baseline vocabulary knowledge. Following this, the experimental group commenced an intervention phase where the AI-powered Papago application was seamlessly integrated into their vocabulary learning curriculum. This integration leveraged Papago's diverse features, including Word Cards for systematic memorization, Phrasebook for contextual understanding, and Voice Translation for pronunciation practice and real-time comprehension. Concurrently, the control group proceeded with their standard, conventional vocabulary instruction, which typically relies on textbooks, teacher-led drills, and traditional exercises without AI assistance. Over a series of designated sessions, students in the experimental group actively engaged with Papago by translating various descriptive texts, practicing the pronunciation of new words, and completing vocabulary-focused tasks directly within the application's interface. At the culmination of this intervention period, a post-test was administered to both groups to measure the extent of improvement in their vocabulary mastery, thereby allowing for a direct comparison of learning outcomes.

Instrument and Data Collection

The instruments and materials critical to this study's execution included pre-test and post-test assessments meticulously developed based on validated blueprints. These assessments specifically targeted five core vocabulary categories: nouns, verbs, adjectives, adverbs, and conjunctions, with an emphasis on their application within descriptive text contexts (Waziana et al., 2024). To ensure the psychometric soundness of these instruments, they underwent a prior trial phase to establish both validity and reliability. In addition to the primary assessments, a quiz platform, Quizizz, was employed for formative assessments throughout the intervention, providing ongoing feedback on student progress. Supporting materials encompassed detailed lesson plans, comprehensive vocabulary lists, and carefully selected descriptive texts that served as the linguistic context for vocabulary acquisition. Detailed specifications of these instruments and materials are provided in the appendices of the full research report.

Data Analysis

For data analysis, all collected data were processed using SPSS version 27. To comprehensively compare the pre- and post-test results both within and between the groups, a paired sample t-test was utilized for intra-group comparisons, while an independent sample t-test was applied for inter-group comparisons. Prior to these analyses, tests of normality and homogeneity were conducted to verify that the data met the necessary statistical assumptions for parametric testing, thereby ensuring the robustness and validity of the findings (Jeon, 2024). This rigorous methodological approach was designed not only to definitively determine whether the AI Papago

application could significantly enhance students' vocabulary acquisition compared to traditional methods but also to explore dimensions of student engagement and the app's overall usability, offering a comprehensive understanding of its pedagogical value.

Results and Discussion

Results

This study aimed to investigate the effectiveness of the AI Papago application in improving students' vocabulary mastery. Data were collected through pre-test and post-test in both the experimental and control classes.

1. Pre-Test and Post-Test Results in Experimental Class

As shown in Table 1, the average score of the experimental class increased significantly after the treatment using the Papago application.

Table 1. Pre-Test and Post-Test Scores in Experimental Class

Test Type	Mean	Minimum	Maximum	N
Pre-Test	64.13	55	75	31
Post-Test	82.48	70	90	31

Table 1 presents descriptive statistics for pre-test and post-test scores, likely from an experimental group in an educational study. For the pre-test, the mean score was 64.13, with scores ranging from a minimum of 55 to a maximum of 75, for a sample size (N) of 31 participants. Following an intervention, the post-test results show a noticeable improvement, with the mean score increasing to 82.48. The minimum post-test score observed was 70, while the maximum reached 90, also for a sample size of 31. These statistics suggest an upward trend in performance from the pre-intervention phase to the post-intervention phase.

2. Pre-Test and Post-Test Results in Control Class

Table 2. Pre-Test and Post-Test Scores in Control Class

Test Type	Mean	Minimum	Maximum	N
Pre-Test	64.13	55	75	31
Post-Test	82.48	70	90	31

Table 2 presents descriptive statistics for pre-test and post-test scores, likely from a control group in an educational study. For the pre-test, the mean score was 63.58, with individual scores ranging from a minimum of 55 to a maximum of 75, for a sample size (N) of 31 participants. Following a period of conventional instruction, the post-test results show a slight improvement, with the mean score increasing to 69.32. The minimum post-test score observed was 60, while the maximum reached 80, also for a sample size of 31. These statistics suggest a modest upward trend in performance from the pre-intervention phase to the post-intervention phase for this group.

3. Independent Sample t-Test Result

To determine the effectiveness of the treatment, an independent sample t-test was conducted. The result is summarized in Table 3.

Table 3. Independent Sample t-Test Result

Group	Mean	Std. Deviation	Sig. (2-tailed)
Experimental	82.48	4.83	0.004
Control	69.32	5.21	

Table 3 displays the statistical comparison between the experimental and control groups, likely derived from an independent samples t-test. The experimental group achieved a mean score of 82.48 with a standard deviation of 4.83. In contrast, the control group had a lower mean score of 69.32 and a standard deviation of 5.21. Crucially, the significance (2-tailed) value for the comparison between the groups is 0.004. This low p-value suggests a statistically significant difference between the mean scores of the experimental and control groups.

Discussion

1. The Effect of AI Papago Application on Vocabulary Mastery

The empirical data from this study unequivocally demonstrate a significant enhancement in students' vocabulary mastery following the integration of the AI Papago application. This improvement is vividly evidenced by the substantial increase in the experimental group's mean post-test score, which rose to 82.48 from a pre-test mean of 64.13. This considerable gain starkly contrasts with the more modest progression observed in the control group, where the mean vocabulary score only marginally increased from 63.58 to 69.32 after exposure to conventional instructional methods. Such a pronounced difference underscores Papago's efficacy as an instructional tool, aligning strongly with pedagogical principle that effective vocabulary learning is inherently tied to contextualized and meaningful language use (Brown, 2007). Papago's robust suite of multimodal features, including text, voice, and image translation capabilities, along with its comprehensive contextual phrasebooks, facilitates this principle by enabling students to move beyond isolated word memorization and actively apply vocabulary within authentic linguistic contexts, thus deepening comprehension and retention (Lee et al., 2024).

Furthermore, these findings resonate with the theoretical underpinnings of Artificial Intelligence, particularly concerning the role of intelligent systems in augmenting human cognitive processes such as pattern recognition and context analysis (Shikun et al., 2024). Papago's sophisticated ability to accurately translate entire phrases and adapt to varying contexts provided students with a more nuanced understanding of how words function within real communicative scenarios. This outcome is also consistent with prior research, which have highlighted the positive impact of mobile applications like Duolingo on vocabulary acquisition through interactive and gamified learning experiences (Sari et al., 2023). However, this study contributes a distinct dimension to the existing literature by focusing on Papago, an application characterized by its more advanced translation and context recognition

features, thereby offering novel insights into the specific benefits of sophisticated AI tools in language education.

2. Interpretation Through the Lens of Problem-Based Learning (PBL)

The effectiveness of the AI Papago application was further amplified by its synergistic integration with the Problem-Based Learning (PBL) pedagogical model within this research setting. PBL is a student-centered approach that encourages deep learning, collaboration, and independent inquiry by challenging students to solve complex, real-world problems (Kim, 2023). In the context of this study, students were actively guided to address genuine communication challenges, such as translating or describing daily situations, which directly contributed to increased student motivation and enhanced vocabulary retention. The inherent structure of PBL fostered an environment of collaborative and exploratory learning, which, in turn, significantly heightened student engagement and responsibility in utilizing Papago to successfully complete their learning tasks.

This finding aligns with prior research,which suggests that PBL markedly enhances vocabulary learning outcomes when students are exposed to contextualized problems and are required to interact with authentic linguistic materials (Coperías-Aguilar, 2019). The active and problem-solving nature of the learning process encouraged students to seek out and apply new vocabulary in a purposeful manner. Moreover, the consistently positive responses and active participation documented from students during the Papago-integrated PBL sessions indicated that this combined approach was effective not only in improving cognitive outcomes, such as vocabulary mastery, but also in addressing crucial affective needs. By offering an engaging and supportive learning environment, the model addressed factors like motivation and confidence, aspects often underemphasized or overlooked in more traditional instructional paradigms (Khalid Othman, 2023).

3. Reflection and Implications

While the results of this study are indeed promising and strongly support the efficacy of the AI Papago application combined with PBL, it is imperative to acknowledge certain limitations observed during the implementation phase. A small number of students initially encountered difficulties in navigating the application's interface or in discerning the nuanced differences between accurate and overly literal translations provided by the AI. These challenges underscore the critical importance of providing adequate teacher guidance and robust digital literacy support to students, particularly when integrating advanced technological tools into standard classroom instruction. Such support can mitigate initial learning curve issues and ensure that students can fully leverage the capabilities of AI applications (Mandasari et al., 2025).

In conclusion, the findings of this study unequivocally demonstrate that the strategic use of the AI Papago application, when synergistically combined with the Problem-Based Learning model, leads to a significant enhancement in students' vocabulary mastery. This integrated pedagogical approach provides a learning experience that is highly personalized, context-aware, and engaging, aligning well with

contemporary educational objectives that prioritize active and meaningful learning. These compelling findings contribute substantially to the growing body of research advocating for the judicious and thoughtful integration of AI-based tools into formal educational settings, paving the way for more innovative and effective language acquisition methodologies in the future.

Conclusion

This research sought to investigate the effectiveness of the AI Papago application in enhancing vocabulary mastery among tenth-grade students at SMAN 7 Bandar Lampung. Consistent with the initial problem formulation, the findings unequivocally demonstrated that the application exerted a significant impact on students' vocabulary acquisition, as evidenced by the notably higher post-test scores observed in the experimental group compared to the control group.

The interpretation of these results, firmly grounded in theoretical frameworks such as H.D. Brown's principles of contextual vocabulary learning and John McCarthy's theories of AI-assisted education, posits that Papago transcends its basic function as a translation tool, emerging as a valuable educational medium. Its effectiveness is further amplified when employed in conjunction with active learning models, such as Problem-Based Learning (PBL). This synergistic approach facilitates a deeper understanding of vocabulary, promotes its contextual usage, and significantly boosts learner engagement.

The study's outcomes underscore the inherent compatibility between advanced technological capabilities and contemporary educational methodologies. The successful integration of Papago within a formal classroom setting indicates promising prospects for the broader application of AI in enhancing language learning outcomes. As AI technologies continue their rapid evolution, tools like Papago possess considerable potential for further development, extending their support beyond vocabulary to encompass grammar, listening, and speaking skills.

Prospectively, future research endeavors could build upon these findings by exploring aspects such as the long-term retention of vocabulary acquired through AI tools, assessing their impact across diverse student proficiency levels, or conducting comparative analyses with other language learning applications. Furthermore, the results of this study can serve as valuable empirical evidence for curriculum designers and educators, emphasizing the critical importance of judiciously combining digital tools with student-centered pedagogical strategies to achieve maximal educational effectiveness. In essence, this study concludes that the AI Papago application represents an effective, practical, and engaging medium for vocabulary learning, holding substantial potential to become an integral component of 21st-century language instruction.

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