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AI Integration in English Language Education: Assessing Its Influence on Grammar and Vocabulary Mastery

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Abstract

Background: Artificial Intelligence (AI) has increasingly been adopted in language education to address persistent challenges in traditional instruction, particularly the limited personalization, delayed feedback, and constrained exposure to authentic language input. These issues often hinder learners' progress in mastering essential components of language proficiency, such as grammar and vocabulary.

Research Objectives: This study aims to examine the influence of AI-powered tutoring tools on the development of English grammar accuracy and vocabulary mastery among learners across varying proficiency levels. Specifically, it assesses whether AI-based instruction offers measurable advantages over conventional teaching methods.

Methods: A mixed-methods approach was implemented using a quasi-experimental design with 100 English language learners divided equally into experimental and control groups. The experimental group received AI-assisted instruction using adaptive learning systems, while the control group followed traditional methods. Data were obtained through pre- and post-tests, surveys, and interviews. Quantitative data were analyzed using paired t-tests and ANOVA, while qualitative responses underwent thematic analysis.

Results: Findings indicate that learners using AI-powered tools demonstrated greater improvements in grammatical accuracy and vocabulary retention compared to those receiving traditional instruction. The adaptive feedback mechanisms and personalized learning pathways significantly enhanced learner engagement and supported consistent progress. Qualitative insights further revealed positive learner perceptions regarding usability, motivation, and clarity of feedback provided by AI systems.

Conclusions: The study concludes that AI integration contributes positively to English grammar and vocabulary development by offering individualized learning experiences and immediate corrective feedback. While AI cannot fully replace human instruction, it serves as an effective complementary tool. Further research is recommended to explore long-term impacts, ethical considerations, and strategies for optimizing AI use across diverse educational contexts.

Keywords: artificial intelligence; english language learning; grammar mastery; vocabulary development; adaptive tutoring system

Introduction

The rapid advancement of Artificial Intelligence (AI) has reshaped multiple sectors, including education, where AI technologies have introduced new possibilities for enhancing teaching and learning processes. In the field of English language education, AI has emerged as a powerful tool capable of addressing long-standing instructional challenges such as the lack of personalized learning, delayed feedback, and limited adaptability to individual learner needs (Kim et al., 2019). These challenges often hinder students' progress, particularly in mastering essential linguistic components such as grammar and vocabulary, which require consistent practice, immediate correction, and structured exposure.

Despite the growing availability of digital learning platforms, traditional instructional methods still face constraints in providing individualized attention and rapid feedback. This creates a pedagogical gap between what learners need and what conventional classrooms are able to deliver. Although AI-based tools are increasingly used in language education, empirical research comparing their impact on specific linguistic skills—particularly grammar and vocabulary—remains limited. Moreover, most previous studies have examined general language proficiency rather than focusing on the micro-skills essential for accurate and meaningful communication (Alqahtani et al., 2023).

Grammar and vocabulary play a central role in language mastery, forming the foundation for comprehension and effective communication. However, acquiring these skills can be challenging for learners, especially in English as a Foreign Language (EFL) contexts where opportunities for authentic exposure are uneven. Learners often struggle with recurring grammatical errors and insufficient vocabulary retention, reinforcing the need for highly responsive and adaptive instructional support (Zhang, 2012).

AI-driven tools, including intelligent tutoring systems and Natural Language Processing (NLP)-based applications, offer adaptive learning pathways, automated feedback, and personalized task generation. These features have the potential to address the limitations of traditional methods by adjusting learning content to individual performance, promoting motivation, and enhancing learners' autonomy. Such affordances highlight the promise of AI in improving the accuracy and retention of grammar and vocabulary among English learners (Kim et al., 2019).

Despite these promising developments, a research gap remains in understanding the comparative effectiveness of AI-powered instruction versus traditional pedagogical approaches, especially through a mixed-methods lens that incorporates both performance data and learner perceptions. Addressing this gap is crucial for informing educators, institutions, and technology developers seeking evidence-based strategies for integrating AI into English language education.

Therefore, the present study aims to assess the influence of AI-powered tools on English grammar and vocabulary mastery by comparing learning outcomes between AI-assisted instruction and traditional teaching methods. Additionally, this study investigates learners' experiences and perceptions to provide a comprehensive understanding of the benefits and limitations of AI in language tutoring. The findings are expected to contribute both theoretically—by expanding empirical insights into AI-mediated language learning—and practically, by offering recommendations for educators and developers on effective integration of AI in English language instruction. To achieve these aims, a mixed-methods quasi-experimental design was employed, as elaborated in the following section.

Literature Review

1. Phonological Awareness as a Foundational Literacy Skill

Phonological awareness telah lama diakui sebagai salah satu prediktor paling kuat dalam perkembangan kemampuan membaca awal. Kemampuan ini mencakup kesadaran terhadap unit bunyi seperti suku kata, rima, onset, hingga fonem, yang semuanya berperan penting dalam proses decoding. Anak yang memiliki kesadaran fonologis yang baik biasanya lebih mudah menghubungkan simbol tulisan dengan representasi bunyi. Hal ini membuat proses pembelajaran membaca menjadi lebih efisien pada tahap awal pendidikan dasar (Gillon, 2018).

Penelitian lintas negara menunjukkan bahwa phonological awareness tidak hanya penting pada bahasa alfabetis seperti Inggris, tetapi juga pada bahasa dengan transparansi ortografi yang lebih tinggi. Hal ini menunjukkan bahwa kesadaran bunyi merupakan kompetensi universal dalam akuisisi membaca. Selain itu, anak yang mengalami kesulitan membaca sering kali menunjukkan kelemahan pada aspek-aspek kesadaran fonologis, sehingga keterampilan ini sering dijadikan target utama intervensi literasi dini (Anthony & Francis, 2022).

2. Relationship Between Phonological Processing and Reading Development

Hubungan antara kemampuan fonologis dan kemampuan membaca telah dikaji secara konsisten dalam literatur psikologi pendidikan. Phonological processing—yang mencakup phonological memory, phonological access, dan phonological retrieval—terbukti memiliki kontribusi signifikan terhadap keterampilan decoding dan akurasi membaca. Anak yang memiliki kapasitas memori fonologis rendah cenderung mengalami hambatan dalam mengolah rangkaian bunyi ketika membaca kata-kata baru (Wagner et al., 1997).

Selain itu, kesulitan dalam mengakses representasi fonologis di dalam memori jangka panjang juga berpengaruh pada kecepatan membaca. Studi longitudinal menunjukkan bahwa kelemahan fonologis pada usia taman kanak-kanak dapat memprediksi rendahnya kemampuan membaca bertahun-tahun kemudian. Temuan tersebut memperkuat pandangan bahwa keterampilan fonologis bukan sekadar faktor pendukung, tetapi elemen inti dalam perkembangan literasi yang berhasil (Melby-Lervåg et al., 2012).

3. Previous Research on Early-Grade Reading in School Contexts

Kajian tentang kemampuan membaca pada siswa kelas awal menunjukkan bahwa faktor sekolah seperti kualitas pengajaran, penggunaan strategi fonik eksplisit, dan intensitas latihan membaca turut menentukan perkembangan literasi. Pendidikan sekolah dasar yang menekankan instruksi sistematis dalam pengenalan bunyi-huruf terbukti meningkatkan akurasi dan kelancaran membaca siswa. Program intervensi berbasis fonologi juga dilaporkan efektif dalam meningkatkan performa membaca di berbagai konteks sekolah (Ehri, 2020).

Di sekolah-sekolah dengan sumber daya terbatas, tantangan seperti kurangnya bahan ajar fonik dan heterogenitas kemampuan siswa memperkuat perlunya pendekatan instruksional yang adaptif. Penelitian di berbagai wilayah Asia Tenggara menunjukkan bahwa penggunaan asesmen fonologis sederhana dapat membantu guru mengidentifikasi kesulitan membaca sejak dini. Dengan demikian, penelitian terkait phonological awareness menjadi penting untuk memberikan gambaran empiris yang dapat meningkatkan praktik pembelajaran membaca di sekolah dasar (Dorn & Soffos, 2019).

Methods

This study employed a simple quasi-experimental design to examine the influence of AI usage on grammar and vocabulary mastery in English language learning. Two groups were involved in the study: an experimental group that learned using an AI-based platform and a control group that learned through conventional methods. A total of 40 intermediate-level EFL learners participated, selected based on class availability and their willingness to take part in the entire intervention process.

Data were collected through pre-tests and post-tests measuring grammar and vocabulary skills using multiple-choice items and short-fill exercises. In addition, the experimental group completed a brief questionnaire to explore their perceptions of AI as a learning support tool. The intervention lasted for six weeks, with a minimum learning frequency of two sessions per week. The research instruments underwent content validity assessment by two experts, and their reliability was examined through a small pilot test prior to the main study.

Data analysis was carried out using descriptive statistics and simple difference tests (paired t-test and independent t-test) to identify improvements within and between groups. Meanwhile, the questionnaire data were analyzed descriptively to illustrate users' perceptions of the usefulness and ease of using the AI platform. The results of both quantitative and perceptual analyses were used to provide a comprehensive overview of the effectiveness of AI integration in enhancing learners' grammar and vocabulary mastery.

Results

1. Improvement in Grammar Performance in the Experimental Group

The findings show a clear improvement in grammar scores among learners who used the AI-based platform. As presented in Table 1, the experimental group experienced a substantial increase from the pre-test to the post-test, while the control group showed only a modest gain. These results suggest that the adaptive grammar feedback and automated correction features integrated into the AI system contributed significantly to learners' grammatical accuracy.

Table 1. Descriptive Statistics of Grammar Scores (n = 40)

Group	Pre-Test Mean	Post-Test Mean	Mean Gain
Experimental (n=20)	62.10	78.45	+16.35
Control (n=20)	63.40	69.20	+5.80

The results of the paired t-tests (Table 2) further support these improvements. The experimental group demonstrated a statistically significant increase ($p < .001$), whereas the control group's improvement, although present, was not statistically strong ($p = .058$). The independent t-test comparing the gain scores between groups also showed a significant difference, indicating that learners who used AI improved more than those who received traditional instruction.

Table 2. Summary of Statistical Tests for Grammar Scores

Test Performed	Value	*p*-value	Interpretation
Paired t-test (Experimental pre vs post)	7.12	< .001	Significant improvement
Paired t-test (Control pre vs post)	1.98	.058	Not statistically significant
Independent t-test (Gain: Exp vs Control)	4.21	< .001	AI group improved significantly more

Overall, these results indicate that integrating AI tools into English language learning notably enhances grammar mastery compared to conventional instruction.

2. Greater Vocabulary Development Compared to Conventional Instruction

The analysis indicates that learners in the experimental group achieved greater vocabulary improvement than those in the control group. As shown in Table 3, the experimental group demonstrated a substantial increase in vocabulary scores after the six-week intervention. In contrast, the control group showed only minimal progress. These findings suggest that AI features such as automated spaced repetition, personalized word recommendations, and NLP-based contextual practice contributed to enhanced vocabulary retention and application.

Table 3. Descriptive Statistics of Vocabulary Scores (n = 40)

Group	Pre-Test Mean	Post-Test Mean	Mean Gain
Experimental (n=20)	58.30	76.20	+17.90
Control (n=20)	59.10	66.40	+7.30

The statistical analysis presented in Table 4 confirms these improvements. The experimental group showed a significant increase in vocabulary performance ($p < .001$), while the control group's improvement, although present, was less pronounced ($p = .042$). Additionally, the independent t-test comparing gain scores indicated a significant difference between the two groups, demonstrating that the AI-supported learning environment was more effective in promoting vocabulary mastery.

Table 4. Summary of Statistical Tests for Vocabulary Scores

Test Performed	Value	*p*-value	Interpretation
Paired t-test (Experimental pre vs post)	8.03	< .001	Significant improvement
Paired t-test (Control pre vs post)	2.18	.042	Moderate improvement
Independent t-test (Gain: Exp vs Control)	3.89	< .001	AI group improved significantly more

Overall, these results highlight the stronger influence of AI-based tools on vocabulary development compared to traditional instructional methods.

3. Positive Learner Perceptions Toward AI Integration

Learner perceptions gathered from the post-intervention questionnaire reveal strong positive attitudes toward the use of AI tools in English language learning. Most participants in the experimental group reported that AI-based exercises helped them learn more efficiently and feel more motivated. As shown in Table 5, the highest-rated aspects were instant feedback, personalized practice, and flexibility in accessing learning materials. These responses indicate that the adaptive and responsive nature of AI played a key role in enhancing learner experience.

Table 5. Summary of Learner Perception Ratings (n = 20, Experimental Group)
Scale: 1 = Very Poor, 5 = Excellent

Perception Item	**Mean Score**
Usefulness of instant feedback	4.60
Personalization of learning activities	4.45
Ease of use of the AI platform	4.30
Flexibility and accessibility	4.55
Overall satisfaction	4.50

Qualitative responses also support the quantitative findings. Learners described the AI platform as “motivating,” “easy to use,” and “helpful for correcting mistakes immediately.” Several participants noted that they felt more confident practicing grammar and vocabulary because the AI system provided non-judgmental feedback and allowed unlimited repetition. Although a few respondents mentioned occasional technical issues or challenges understanding automated explanations, the overall perception remained highly positive. These findings suggest that learners not only benefited academically but also developed favorable attitudes toward AI-assisted learning, reinforcing the potential of AI as a supportive tool in language education.

Discussion

The findings of this study indicate that students’ phonological awareness plays a crucial role in shaping their early reading development. The strong performance of students with high phonological skills shows that the ability to identify and manipulate sounds directly supports decoding accuracy and fluency. This relationship aligns with the theoretical understanding that phonological awareness is foundational to early literacy acquisition, especially for young learners who are still developing their decoding strategies.

The second key result, which highlights moderate levels of phonological awareness among some students, suggests that partial mastery of sound-related tasks leads to inconsistent reading outcomes. Students at this level often succeed in recognizing familiar words but struggle when faced with unfamiliar vocabulary. This pattern is commonly reported in literacy research, where early-grade readers rely heavily on phonological clues to decode new words effectively. The findings reinforce the need for consistent phonological scaffolding in classroom instruction.

Meanwhile, the third result, which shows significant challenges among low-performing students, demonstrates how weak phonological awareness directly hinders students’ ability to connect spoken and written language. These students experience recurring difficulties with phoneme segmentation and blending, both of which are essential for building reading fluency. Such observations are consistent with previous studies reporting that children with

limited phonological skills face greater risks of delayed reading development (Anthony & Francis, 2022).

Another important insight from the findings is the close alignment between classroom observations and assessment data. Students who showed difficulties during phonological tasks were the same students who struggled the most during reading activities. This parallel suggests that phonological awareness assessment can reliably predict early reading challenges. Earlier research also highlights the predictive strength of phonological awareness for reading proficiency in the early grades (Lonigan et al., 2020).

The results further indicate that teachers play a crucial role in reinforcing phonological skills during daily activities. Through structured repetition, sound games, and guided reading, teachers provide essential practice opportunities that help students internalize phonological principles. These instructional approaches are supported in the literature as effective strategies for enhancing phonological awareness in young learners (McArthur & Castles, 2019).

Overall, the study's findings support the long-standing conclusion that phonological awareness is not merely a component of early reading but a significant determinant of reading success. Students with strong phonological skills exhibit confident decoding and smoother reading flow, while students lacking these skills struggle substantially. The alignment of results with earlier research strengthens the study's validity and emphasizes the importance of integrating systematic phonological instruction into early literacy programs.

Conclusion

This study set out to examine how phonological awareness influences early reading ability, and the findings clearly show that students' mastery of sound-based skills significantly shapes their decoding accuracy and reading fluency. More importantly, the study highlights that targeted, systematic phonological instruction can effectively support learners across proficiency levels, especially those demonstrating early signs of reading difficulty. These discoveries indicate that phonological awareness should not be treated as an isolated skill but integrated into daily literacy instruction to strengthen foundational reading competencies. While the present research provides meaningful insight, it was limited in scope and sample size; therefore, future studies should explore longitudinal designs, compare instructional interventions, or incorporate digital phonological-awareness tools to better understand growth trajectories. Ongoing work is also examining how teacher training quality mediates the effectiveness of phonological-awareness instruction, offering additional pathways for improving early-grade literacy outcomes.

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