INTERACTION: Jurnal Pendidikan Bahasa Vol. 13, No.1; Maret 2026
P-ISSN: 2406-9558; E-ISSN: 2406-9566

Impact of AI Virtual Tutor 'DeepSeek' on Students' Writing Proficiency

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ABSTRACT

This study investigated the impact of the AI virtual tutor *DeepSeek* on students' writing proficiency among tenth-grade students of a Madrasah Aliyah in Pamulang, Indonesia, using a quantitative pre-test–post-test design with a sample of 31 students. Students completed five essay-based writing tasks measuring content, organization, vocabulary, language use, and mechanics. Their scores were analyzed using the Wilcoxon Signed Rank Test to determine the significance of improvement after four weeks of DeepSeek-assisted practice. The results showed a statistically significant increase in overall writing performance, indicating that real-time feedback from DeepSeek supported students' self-regulation, accuracy, and clarity in writing. The novelty of this study lies in examining DeepSeek—an emerging AI tutor that has received very limited empirical investigation—within an authentic classroom setting, offering new evidence of its pedagogical value compared to more commonly studied tools such as ChatGPT or Quillbot. The study concludes that DeepSeek is a valuable instructional aid and recommends its integration into English writing instruction to complement traditional teaching.

Keywords: DeepSeek; AI Virtual Tutor; EFL Students, Writing Proficiency

INTRODUCTION

In recent years, Artificial Intelligence (AI) has rapidly developed across various sectors, including education, where it is increasingly used to enhance learning efficiency and create more personalized instructional environments (Harry, 2023). AI in education aims to support an intelligent learning ecosystem in which students can learn "anyone, anywhere, anytime," with adaptive materials, individualized support, and innovative teaching strategies (Yang & Bai, 2020). As digital learning demands continue to rise, AI has been recognized as a promising solution to improve accessibility, enrich learning experiences, and reduce teacher workload (Tapalova & Zhiyenbayeva, 2022).

Among the emerging applications of AI in education, AI-based virtual tutors have gained growing attention for their ability to provide automated guidance and real-time feedback. DeepSeek, the tool examined in this study, utilizes Natural Language Processing (NLP) and tailored algorithms to assist learners by identifying

errors, offering corrections, and supporting the development of writing skills. Prior studies have shown that AI tutors can enhance students' grammar accuracy, vocabulary use, and sentence structure by delivering instant and individualized feedback (Al-Raimi et al., 2024; Porayska-Pomsta, 2024). This form of support is especially relevant for writing instruction, an essential skill that contributes to academic success and prepares learners for professional communication (Kocakaya et al., 2016; Chen et al., 2018).

Despite the increasing number of AI-related writing studies, most existing research has focused on well-established tools such as ChatGPT, Quillbot, Grammarly, or You.com. These studies primarily investigate automated feedback quality, paraphrasing features, and grammar correction (Özdere, 2025; Amanda et al., 2023; Farahian, 2024; Losi et al., 2024). However, empirical investigations on DeepSeek remain very limited, particularly in authentic school settings and in the context of EFL writing instruction. This lack of classroom-based evidence represents a gap that this study aims to address.

The research problem guiding this study arises from the persistent challenges faced by EFL learners in writing descriptive text, including weak content development, poor organization, limited vocabulary range, grammatical inaccuracies, and mechanical errors difficulties that traditional instruction alone has not fully resolved. DeepSeek, with its real-time feedback system, offers potential support to these challenges, yet its effectiveness has not been empirically measured.

Therefore, the objective of this study is to examine the impact of the AI virtual tutor DeepSeek on students' writing proficiency, specifically focusing on improvements in content, organization, vocabulary, language use, and mechanics. The novelty of this research lies in evaluating DeepSeek an emerging AI tutor that has not been widely studied within a real classroom context, contributing new empirical evidence to AI-assisted writing instruction. By addressing this research gap, the study aims to provide insights into how AI tools can complement traditional teaching and support students' writing development.

LITERATURE REVIEW

Previous Related Studies

Several studies have examined the role of AI-powered tools in supporting students' writing development. Özdere (2025) evaluated the effectiveness and scoring consistency of AI-generated feedback using ChatGPT and You.com in EFL academic writing. The findings indicated that although AI tools can provide practical feedback, students still experienced inconsistencies depending on task type and prompt complexity. Similarly, Losi et al. (2024) reviewed multiple AI-supported writing applications and reported that features such as grammar correction, predictive text, and similarity detection help students improve surface-level writing accuracy; however, these tools often fail to address deeper aspects

such as coherence, organization, and idea development. Amanda et al. (2023) further highlighted that Quillbot assists learners in paraphrasing, sentence restructuring, and refining grammar, yet the tool primarily focuses on rewriting rather than supporting students through the full writing process.

Although prior studies highlight the advantages of AI tools for improving certain aspects of writing, most existing research focuses on general-purpose AI applications (e.g., ChatGPT, You.com, Quillbot) rather than platforms designed specifically to function as virtual tutors. Moreover, earlier studies tend to emphasize isolated features such as grammar correction or paraphrasing, with limited investigations into how AI can holistically support students through real-time, guided feedback across content, organization, vocabulary, language use, and mechanics. Research examining DeepSeek as a dedicated AI virtual tutor remains scarce, especially in the context of secondary-level EFL learners. Therefore, this study addresses this gap by investigating the impact of DeepSeek on students' overall writing proficiency through a structured pre-test–post-test design. By evaluating improvement across all key writing components, this study contributes new empirical evidence on DeepSeek's role as a comprehensive instructional support tool an area that remains underexplored in the existing literature.

DeepSeek

The integration of AIR from traditional teaching shows a positive change. This study applies the concept of Vgotsky's sociocultural theory to explain DeepSeek as a virtual tutor that helps students bridge the gap between their current writing ability and their potential future results. This concept is in line with the Zone of Proximal Development (ZPD) which emphasizes that students make good progress if supported by experts in their fields. In this case, DeepSeek acts as a role model that allows students to modify or change their writing, develop their language style and vocabulary choices, and finally revise their writing with teacher supervision (Lantolf & Pohner, 2023).

This study draws on Vygotsky's Sociocultural Theory, which emphasizes the importance of mediated learning and social interaction in cognitive development. The Zone of Proximal Development (ZPD) states that learners progress most effectively when supported by a more knowledgeable other. In the context of this study, DeepSeek functions as a virtual tutor that guides students to bridge the gap between their current writing ability and their potential performance. Through feedback and modeling, DeepSeek allows students to revise writing, refine vocabulary choices, and strengthen language structures under teacher supervision (Lantolf & Poehner, 2023).

Constructivist learning theory, as emphasized by Sallam et al. (2023), highlights the importance of active learner involvement in constructing knowledge. DeepSeek supports this process by enabling students to repeatedly engage in drafting, revising, and refining ideas, which promotes deeper understanding and encourages

continuous improvement in sentence clarity, idea development, and writing consistency.

The use of DeepSeek is also aligned with Cognitive Load Theory, which underscores the need to optimize mental effort during complex tasks such as academic writing. Writing in a foreign language requires substantial cognitive processing in ideation, organization, and coherence. As noted by Fan et al. (2024), AI-assisted tools can reduce unnecessary cognitive load by providing immediate suggestions and corrective input. This allows students to focus more effectively on higher-order thinking, such as generating creative ideas and constructing logical arguments, while relying on DeepSeek to support mechanical and linguistic accuracy.

METHOD

Design and Samples

This study used a pre-experimental design with a pre-test and post-test to measure the effect of the AI virtual tutor, DeepSeek, on students' writing skills. This design involved one group of students being given a written test before and after four weeks of using DeepSeek during regular English lessons. This approach was selected to accommodate school limitations while exploring how AI assistance could be integrated into traditional classroom instruction. The quantitative design enabled statistical comparisons aligned with the study's objective of assessing the impact of AI-based guidance in classroom learning. This design was chosen to accommodate the limitations of the school environment, while also focusing on investigating how AI assistance might be integrated into traditional classroom learning. The use of quantitative data provides a basis for statistical comparisons, in line with the goal of assessing the impact of AI instruction in the classroom environment. From the total population, a sample of one class consisting of 31 students was selected to participate in the research. Purposive sampling was used for this study, allowing the researcher to select students who met criteria, such as active participants in class and students who attended English lessons in class. The selected students were considered representative of the broader population of tenth-grade students, in terms of their writing skills and their opinions on AI-based learning tools and technology, such as DeepSeek.

Instrument and Procedure

The primary data instruments for this study were the pre-test and post-test, both of which required students to compose descriptive paragraphs according to the tenth-grade English curriculum. The pre-test was conducted before students used DeepSeek to determine their initial writing proficiency. The post-test took place after four weeks of guided practice with DeepSeek, conducted outside regular class hours but under the supervision of the teacher. All writing tasks were administered in-class under standardized conditions.

The pre-test was administered before the students were introduced to DeepSeek to determine their initial writing proficiency. The post-test was conducted after four weeks of guided writing practice using DeepSeek, outside regular class hours but under teacher supervision. All writing tests were held in-class under standardized conditions to ensure fairness and consistency. In addition to the tests, a writing assessment rubric will be used as the scoring instrument. The rubric focuses on five key components: content, organization, vocabulary, language use, and mechanics as mentioned by (Ahmad & Sadeghi, 2021). This rubric provides a reliable and objective framework for evaluating student writing performance across both testing phases.

To support the quantitative data, non-intrusive observations were carried out during the writing sessions in the classroom. The researcher used an observation checklist to monitor students' engagement, interaction with the AI virtual tutor DeepSeek, and their behavior during writing tasks. During the treatment phase, students used DeepSeek as a virtual writing tutor to assist them during their writing tasks. The AI tool provided several types of feedback:

1. Grammar and Sentence Structure Feedback – DeepSeek highlighted grammatical errors, suggested corrections, and offered alternative sentence structures to improve clarity and accuracy.
2. Vocabulary Suggestions – The tool recommended more suitable or precise vocabulary options, especially when students used repetitive or less accurate terms.
3. Coherence and Organization Guidance – DeepSeek notified students when ideas lacked logical flow and suggested transitions or improvements in paragraph organization.
4. Content Enhancement – When students' sentences lacked detail or development, DeepSeek provided guiding prompts or model examples to help strengthen the content.
5. Mechanics Correction – Errors in spelling, punctuation, and capitalization were identified and corrected automatically.

Students interacted with DeepSeek by typing their drafts into the platform, reviewing the feedback, revising their sentences, and resubmitting improved versions. The teacher monitored this process to ensure students used the tool appropriately, avoided overdependence, and understood the reasoning behind the corrections. In addition to test data, classroom observations were conducted using an observation checklist to document student engagement, responsiveness to AI feedback, and behavior during writing activities.

Data Analysis

The collected data were analyzed using descriptive and inferential statistics through Microsoft Excel and SPSS. Students' pre-test and post-test scores were compared to determine whether significant improvement occurred after the intervention. Because the data were not normally distributed, the Wilcoxon Signed Rank Test

was used for inferential analysis to identify statistically meaningful differences in writing performance between the two testing phases.

RESULT AND DISUSSION

This section summarizes the results obtained from the pre-test and post-test to examine the impact of DeepSeek on students' writing proficiency. The pre-test was conducted before students were introduced to the AI virtual tutor, while the post-test was administered after four weeks of guided writing practice using DeepSeek under teacher supervision. Both tests required students to produce descriptive paragraphs assessed using five components: content, organization, vocabulary, language use, and mechanics (Ahmad & Sadeghi, 2021).

Table 1. The Results of Pre-Test and Post-Test

	Mean	N
Pre-test	44,1	31
Post-test	65,42	31

Table 1 shows that the mean score of the pre-test was 44.10, reflecting that students were generally performing at a low level in writing proficiency before using DeepSeek. Most students belonged to the *Poor* and *Very Poor* categories, demonstrating weaknesses in developing ideas, forming coherent paragraphs, and applying correct grammar and mechanics. After the treatment, the post-test mean increased to 65.42, indicating substantial improvement across all writing aspects.

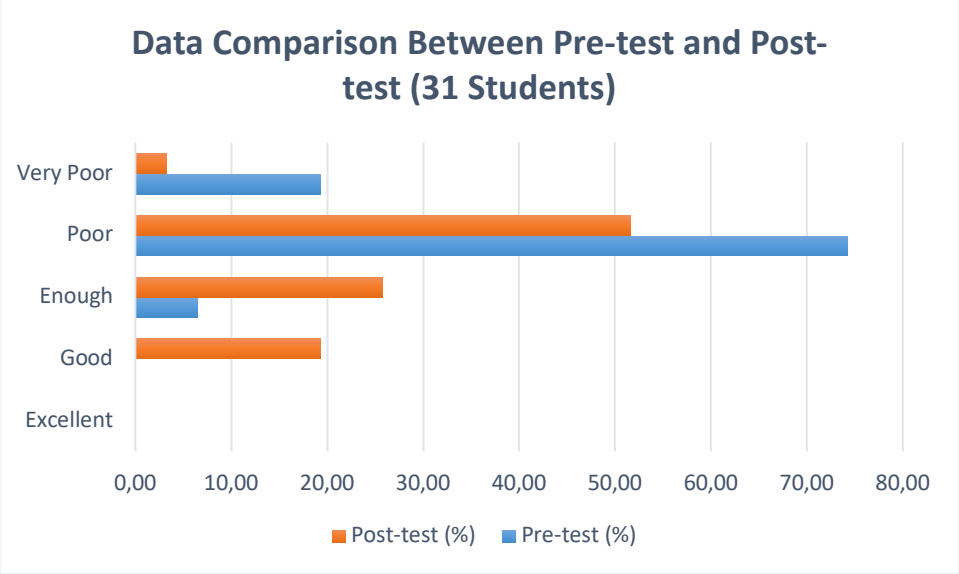

Figure 1. The Results of Pre-Test and Post-Test

Figure 1 provides a clearer visualization of the shifts in performance categories. In the pre-test, the majority of students fell into the lower achievement categories (*Very Poor* and *Poor*). After using DeepSeek, these categories declined sharply,

while the *Enough* and *Good* categories increased significantly. This visual evidence confirms the numerical findings in Table 1, demonstrating that DeepSeek helped students not only raise their average scores but also move into higher proficiency categories. Students showed notable improvements in content development, paragraph organization, vocabulary accuracy, and grammatical correctness. These gains suggest that DeepSeek's instant feedback enabled students to revise errors immediately while drafting, allowing them to internalize correct writing conventions more effectively than through delayed traditional feedback.

Statistical Analysis

To analyze the collected data, this study employed both descriptive and inferential statistical techniques using Microsoft Excel and SPSS. Descriptive statistics were used to summarize students' writing scores in terms of means and score distributions for both the pre-test and post-test. Before selecting an appropriate inferential test, a normality check was conducted using the Shapiro–Wilk test, which is recommended for small sample sizes. The results indicated that the pre-test scores were normally distributed, while the post-test scores were not, as the significance value for the post-test was below 0.05. Because the dataset violated the assumption of normality, a parametric paired-sample t-test was not appropriate. Therefore, the Wilcoxon Signed-Rank Test, a non-parametric alternative for paired data, was chosen to determine whether there were statistically significant differences between students' writing scores before and after the treatment. This test is particularly suitable for ordinal or non-normally distributed interval data.

To ensure the reliability of scoring, students' writing performance in both tests was assessed using a validated analytic rubric adapted from Ahmad and Sadeghi (2021), which evaluates content, organization, vocabulary, language use, and mechanics. Prior to scoring, the researcher conducted a calibration session using sample student writings to maintain consistency in interpreting rubric criteria. Inter-rater reliability was strengthened by consulting with an English teacher who independently scored a subset of student papers. The correlation between the two scorers was examined to ensure scoring consistency, and discrepancies were discussed and resolved. This process ensured that the scoring procedure remained objective, stable, and aligned with established assessment standards.

Normality Test

The Shapiro–Wilk test indicated that pre-test scores were normally distributed (Sig. = 0.128 > 0.05), while post-test scores were not (Sig. = 0.010 < 0.05). Because one dataset violated the normality assumption, the paired-sample t-test could not be used. Therefore, the Wilcoxon Signed-Rank Test an appropriate non-parametric alternativewas selected for hypothesis testing.

Wilcoxon Signed-Rank Test

The Wilcoxon test produced a significance value of 0.000, lower than $\alpha = 0.05$. Therefore, the null hypothesis (H_0) was rejected and the alternative hypothesis (H_1) was accepted. This confirms that there was a statistically significant difference between students' writing scores before and after using DeepSeek. The result strengthens the conclusion that DeepSeek contributed positively to improving students' writing proficiency.

The findings of this study show that the use of DeepSeek as an AI virtual tutor significantly enhanced students' writing proficiency across all assessed components, including content, organization, vocabulary, language use, and mechanics. Students demonstrated clearer idea development, more coherent paragraph structure, and improved accuracy in grammar and word choice after receiving DeepSeek's real-time and individualized feedback. The immediacy of AI-generated suggestions helped students revise their writing more effectively compared to traditional delayed feedback, allowing them to engage more actively in the drafting process. These results align with previous studies highlighting the effectiveness of AI-assisted writing tools in improving EFL learners' grammatical accuracy, vocabulary diversity, and overall text quality, confirming that integrating DeepSeek into classroom instruction can provide meaningful support to students' writing development.

The findings of this study demonstrate that DeepSeek significantly improved students' writing performance across five core components of descriptive writing—content, organization, vocabulary, language use, and mechanics—following four weeks of guided implementation. Students showed clearer idea development, more logical paragraph structure, richer vocabulary, and fewer grammatical and mechanical errors, indicating that the AI tutor effectively supported their writing process. These results align with recent studies showing that AI-based tutors enhance language output by providing immediate, personalized, and high-quality feedback (Losi et al., 2024; Farahian, 2024; Mahapatra, 2024), thereby accelerating students' writing development.

Explanation of the Improvement

The improvement can be attributed to DeepSeek's ability to deliver instant corrective feedback, which enables learners to revise their writing in real time. Unlike traditional feedback—often delayed due to teacher workload—AI-generated feedback allows students to identify errors, apply corrections, and reinforce learning immediately (Sallam et al., 2023; Al-Raimi et al., 2024). This immediacy supports cognitive processing and strengthens students' metalinguistic awareness, consistent with sociocultural and constructivist learning perspectives that emphasize guided support during task performance (Lantolf & Poehner, 2023; Chen et al., 2020). DeepSeek's suggestions on grammar, vocabulary, and organization helped students gradually internalize correct writing forms.

Relation to Previous AI Writing Studies

These results support earlier studies that confirm the positive contributions of AI writing tools to EFL learning. Previous research has shown that AI tools such as ChatGPT, Grammarly, and Quillbot significantly improve learners' grammar accuracy, vocabulary variation, and overall writing quality (Losi et al., 2024; Amanda et al., 2023; Özdere, 2025). Similarly, QuillBot has been found to facilitate effective revision strategies and improve text coherence (Farahian, 2024), while ChatGPT enhances academic writing outcomes through structured prompts and detailed feedback (Mahapatra, 2024). The improvement in this study indicates that DeepSeek functions comparably with these tools, confirming its pedagogical value in writing classrooms.

Pedagogical Implications

The integration of DeepSeek into classroom instruction demonstrates the potential for AI-assisted writing environments to complement traditional teaching. When used effectively, AI tools can reduce students' anxiety, motivate them to write more frequently, and support autonomous learning (Sallam et al., 2023; Sun & Zhang, 2022; Harry, 2023). AI feedback systems also align with personalized learning pathways described in AI-in-education frameworks (Tapalova & Zhiyenbayeva, 2022; Yang & Bai, 2020). With continued guidance from teachers, DeepSeek can serve as a supplemental tool to strengthen writing competency and promote long-term academic performance (Porayska-Pomsta, 2024; Fan et al., 2024).

Overall, DeepSeek proved to be a beneficial tool in improving students' writing proficiency, contributing to better content development, clearer organization, and enhanced linguistic features. These findings reinforce earlier conclusions that AI technologies can meaningfully support writing instruction when combined with classroom-based scaffolding. In this way, DeepSeek represents a promising addition to EFL pedagogy, helping students engage more confidently and effectively in academic writing tasks.

CONCLUSION

This study examined the impact of the AI virtual tutor DeepSeek on students' writing proficiency and found a clear improvement across all assessed components, including content, organization, vocabulary, language use, and mechanics. The significant increase in students' post-test performance indicates that real-time feedback from DeepSeek effectively supported their ability to generate ideas, construct clearer sentences, refine vocabulary choices, and improve grammatical accuracy. These findings highlight the potential of AI-powered virtual tutors as complementary tools in English writing instruction, offering learners more immediate, individualized, and accessible feedback than traditional methods alone.

Based on the results, several implications can be drawn. For teachers, DeepSeek can be integrated as a supplementary learning tool to support the drafting and revising stages of writing lessons. Teachers may use AI-generated feedback to guide classroom discussions, model revisions, or provide differentiated support for students who struggle with grammar, coherence, or vocabulary. It is recommended that teachers combine AI-assisted feedback with human instruction to maintain pedagogical balance and prevent overreliance on automated suggestions.

For future researchers, further studies may explore the long-term effects of AI tutoring, compare DeepSeek with other AI writing tools, or examine its impact across different genres of writing. Research involving larger samples, multiple school contexts, or mixed-method approaches would also provide deeper insight into how AI tools shape learner engagement, strategy use, and writing development. Investigating students' perceptions and challenges when interacting with AI tutors may further contribute to optimizing their classroom application. Overall, the findings of this study affirm that DeepSeek can serve as an effective instructional support tool in EFL writing, with promising potential for broader implementation in educational settings.

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