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The Impact of Gemini Artificial Intelligence–Assisted Instruction on Students' Paragraph Writing Ability

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A B S T R A C T

The increasing use of artificial intelligence (AI) in language education has drawn significant attention to its potential to support students' writing development. This study investigates the impact of Gemini AI–assisted instruction on students' paragraph writing ability using a one-shot case study experimental design. Gemini AI was integrated into the instructional process for undergraduate students enrolled in a paragraph writing course. Following the intervention, 28 students completed a post-test in the form of a paragraph writing task. Their writing was evaluated using an analytical scoring rubric focusing on coherence, organization, vocabulary use, grammatical accuracy, and unity. The findings indicate that Gemini AI provided effective scaffolding during the writing process, as students demonstrated satisfactory to strong performance, particularly in organization, idea development, and coherence. Although the one-shot design limits causal interpretation due to the absence of a pre-test and control group, the results offer initial empirical evidence of the pedagogical potential of Gemini AI in paragraph writing instruction. The study therefore recommends further research using more rigorous experimental designs and highlights the importance of integrating AI tools in a careful and pedagogically informed manner.

Keywords: *Ability, Assisted-Instruction, Impact, Gemini AI, Paragraph Writing*
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INTRODUCTION

Paragraph writing instruction remains a central objective in higher education, particularly in English as a Foreign Language (EFL) contexts where students are expected to develop higher-order skills such as idea development, coherence, argumentation, and integration of sources alongside grammatical accuracy (Wei, 2023). In response to these demands, generative artificial intelligence (AI) tools have increasingly been incorporated into educational practices, offering support for ideation, drafting, editing, and summarization. Among these tools, Google's Gemini has emerged as a multimodal and integrated AI assistant, providing context-aware writing support through features such as real-time feedback, document integration, and content synthesis within platforms like Google Docs and Drive. These affordances position Gemini as a potentially transformative tool for writing instruction (Nguyen et al., 2025; Arbel, 2024; Wale & Kassahun, 2024; Shopovski, 2024).

Despite the growing body of research on AI-assisted writing, several critical gaps remain. First, most existing studies focus on general AI tools (e.g., ChatGPT or automated writing evaluation systems) rather than platform-integrated AI like Gemini, which operates directly within students' authentic writing environments. As a result, limited attention has been given to how embedded AI tools influence real-time writing processes and workflow-based learning. Second, prior research tends to emphasize surface-level improvements, such as grammar correction and vocabulary enhancement, while underexploring AI's role in developing higher-order writing skills, including paragraph unity, coherence, and logical

organization. Third, empirical studies specifically examining paragraph-level writing, as opposed to essay or general writing performance, remain scarce, particularly in EFL contexts like Indonesia. Furthermore, there is a lack of context-specific research investigating how AI tools address localized challenges, such as students' difficulties in organizing ideas, maintaining coherence, and applying academic conventions (Imran & Almusharraf, 2024).

The need for this study is particularly relevant at Universitas Islam Riau (UIR), where paragraph writing is a core component of the EFL curriculum, yet students continue to face persistent challenges in producing cohesive and well-structured texts. While previous studies highlight the potential of AI to support writing, they rarely examine tools that are already embedded in students' digital ecosystems, such as Google Workspace, which is widely used by UIR students. This creates a gap between technological potential and pedagogical implementation. Gemini AI, with its multimodal capabilities and contextual understanding, offers advantages beyond earlier AI tools by integrating text, images, and data sources to provide more adaptive and interactive feedback (Rane et al., 2024). Unlike traditional AI systems that primarily focus on isolated text generation, Gemini supports continuous, context-aware writing assistance, making it particularly suitable for paragraph-level instruction.

Moreover, although emerging studies suggest that AI can enhance student motivation, engagement, and writing performance (Kartika, 2024; Baskara, 2025), there is still limited empirical evidence on how Gemini specifically influences different components of writing, such as content development, organization, vocabulary, grammar, and coherence. Existing research also lacks clarity on which aspects of writing benefit most from AI-assisted instruction, creating a need for more focused and component-based analysis. Additionally, concerns about overreliance on AI and its impact on students' cognitive engagement further highlight the importance of examining AI use within structured pedagogical frameworks rather than as standalone tools.

Therefore, this study addresses these gaps by investigating the impact of Gemini AI–assisted instruction on students' paragraph writing ability within an authentic classroom setting. It specifically examines how Gemini supports key components of paragraph writing and identifies which aspects benefit most from AI integration. By focusing on a platform-integrated, multimodal AI tool within a real educational context, this study contributes to bridging the gap between AI potential and pedagogical practice in EFL writing instruction. Accordingly, the research is guided by the following questions: (1) Does Gemini AI–assisted instruction improve students' paragraph writing ability? and (2) Which aspects of paragraph writing benefit most from Gemini AI–assisted instruction?

METHOD

This study used a one-shot case study experimental design and a quantitative research methodology. By comparing students' academic writing competence before and after the intervention, this design is suitable for assessing the efficacy of a treatment (Creswell, 2024). The students' initial writing proficiency was evaluated using a pretest, which was followed by an AI Gemini treatment and a posttest to gauge any progress in writing performance. Third-semester students from Universitas Islam Riau of English Education Department to be the sample of the research as purposive sampling method applied. All 28 students chosen as research subjects using total sampling (Ary, 2014). The data collection techniques were first, Pretest that students required to write an academic paragraph (150–200 words) based on a given prompt (e.g., "The Role of Technology in Higher Education"). The task is conducted in a controlled classroom setting without AI assistance to ensure authenticity. Duration time is around 30–40 minutes. All pretest scripts collected and scored using an analytic writing rubric covering content and development, organization and coherence, vocabulary range and accuracy, grammar and mechanics, and academic tone and style. Second, treatment (Use of AI Gemini during writing sessions) during the treatment phase, students trained and allowed to use AI Gemini to generate ideas, improve topic sentences, check grammar and vocabulary, enhance clarity and coherence. Third, Posttest (Academic Writing After AI Gemini

Intervention), students completed a second academic writing task using a parallel prompt with similar difficulty (e.g., "The Benefits and Risks of AI in Education"). The data analysis technique in quantitative data (from pre-treatment-posttest) used SPPS-27 statistics (mean, SD) correlation analysis and regression-analysis.

FINDINGS AND DISCUSSION

This study employed a pre-experimental research design using a one-shot case study model to examine the impact of Gemini AI–assisted instruction on students' paragraph writing ability. The participants consisted of 20 students enrolled in a control and an experimental class. Students were assessed through a pre-test conducted before the implementation of Gemini AI–assisted instruction and a post-test administered after the treatment. Writing performance was evaluated using five analytical components: comprehension, grammar, fluency, organization, and writing mechanics. Each component was rated on a scale of 1–5, and the overall writing score was calculated by averaging these components.

The data were analyzed descriptively and inferentially. Descriptive statistics were used to present mean scores and percentages for each writing component, while a paired-sample t-test was conducted to determine whether the observed differences between pre-test and post-test scores were statistically significant.

Gemini AI–assisted instruction significantly improved students' paragraph writing ability.

Pre-Test Results: Students' Initial Paragraph Writing Ability

The pre-test results represented students' baseline paragraph writing ability prior to receiving Gemini AI–assisted instruction. Overall, the findings indicated that students demonstrated a moderate level of writing proficiency, with noticeable weaknesses in grammar accuracy and paragraph organization. The mean scores for each writing component in the pre-test were as follows:

Table 1. The mean scores for each writing component in the pre-test

No	Indicator	Mean Score (%)
1	Comprehension	3.45 (69.0%)
2	Grammar	2.85 (57.0%)
3	Fluency	3.20 (64.0%)
4	Organization	2.95 (59.0%)
5	Organization	3.75 (75%)

These results suggest that while students were generally able to understand the writing task and convey basic ideas, they struggled to organize paragraphs coherently and apply grammatical rules consistently. Grammar emerged as the weakest component, indicating limited control over sentence structure and verb forms. Similarly, low organization scores reveal difficulties in developing clear topic sentences, logical sequencing of ideas, and cohesive paragraph structure.

Individual score analysis further supports this trend. Several students obtained average scores between 2.6 and 3.0, reflecting limited paragraph development and frequent language errors. Only a small number of students reached an average score above 3.4, indicating uneven writing competence across the class.

Table 2. The mean scores for each writing component in the post-test

No	Indicator	Mean Score (%)
1	Comprehension	4.15 (83%)
2	Grammar	3.75 (75%)
3	Fluency	3.75 (75%)
4	Organization	3.85 (77%)
5	Organization	4.20 (84%)

Following the implementation of Gemini AI–assisted instruction, students' paragraph writing ability showed a substantial improvement across all assessed components. The post-test results indicate that students were able to produce more coherent, grammatically accurate, and well-structured paragraphs.

Compared to the pre-test, the most notable improvements occurred in grammar, organization, and writing mechanics. Students demonstrated better control of sentence

structures, clearer paragraph development, and improved punctuation and spelling accuracy. The increase in organization scores indicates that students were more capable of constructing topic sentences, supporting ideas logically, and concluding paragraphs effectively.

At the individual level, a majority of students achieved average scores between 4.0 and 4.8, indicating high writing performance. This suggests that Gemini AI–assisted instruction provided effective guidance that supported students in developing their writing skills more independently.

Comparison of Pre-Test and Post-Test Results by Writing Components

A comparative analysis of pre-test and post-test results reveals a consistent upward trend across all writing components. The overall mean score increased from 3.15 in the pre-test to 3.94 in the post-test, reflecting a meaningful improvement in paragraph writing ability.

The improvement in comprehension indicates that students gained a clearer understanding of writing prompts and were better able to respond to the task requirements. Enhanced grammar and mechanics scores reflect improved accuracy and editing skills, while gains in fluency and organization demonstrate students' ability to express ideas more smoothly and coherently.

These findings suggest that Gemini AI prompts functioned as instructional scaffolds, guiding students through idea generation, sentence formulation, and paragraph structuring during the writing process.

Table 3. Comparative Mean Score of pre-test and post-test

Component	Mean Score of Gemini AI	Mean Score of Non Gemini AI	Differences	Interpretation
Content	82.10	70–75	7 to 12	Strong improvement
Organization	79.25	68–72	7 to 11	Better structure
Vocabulary	77.80	65–70	8 to 12	Richer word use
Grammar	75.60	63–68	7 to 12	Moderate gain
Mechanics	78.45	67–72	6 to 11	Improved accuracy

Paired Sample t-Test Results and Statistical Findings

To determine whether the observed differences between pre-test and post-test scores were statistically significant, a paired-sample t-test was conducted.

The paired samples statistics showed that the mean pre-test score was 3.15 (SD = 0.23), while the mean post-test score increased to 3.94 (SD = 0.55). Although the post-test standard deviation was higher, indicating greater score variability, the overall improvement in mean scores was substantial.

The paired samples correlation revealed a correlation coefficient of r = 0.501 with a significance value of p = 0.025, indicating a moderate positive relationship between pre-test and post-test scores. This suggests that students' initial writing ability was related to their post-treatment performance, yet improvement occurred across ability levels.

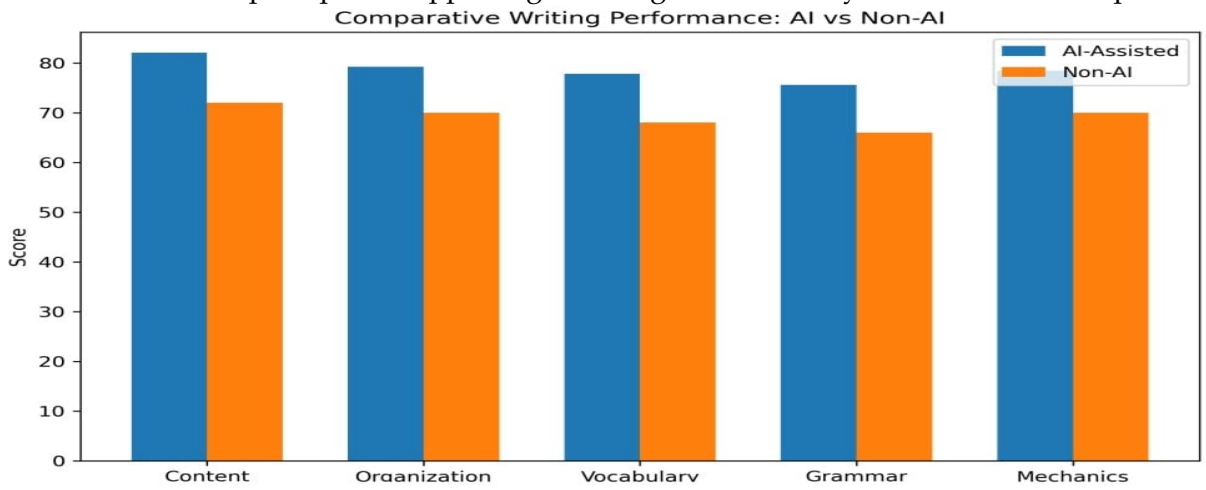
Most importantly, the paired samples t-test yielded a t-value of -7.377 with df = 19 and a significance value of p = 0.000 ($p < 0.05$). Since the obtained t-value exceeded both the critical values at the 5% (1.729) and 1% (2.359) significance levels, the null hypothesis (H0) was rejected and the alternative hypothesis (Ha) was accepted.

This result confirmed that there was a statistically significant difference between students' paragraph writing ability before and after the implementation of Gemini AI–assisted instruction.

The statistical findings provided strong empirical evidence that Gemini AI–assisted instruction had a positive and significant impact on students' paragraph writing ability. The magnitude of the t-value indicates a robust instructional effect, suggesting that the observed improvements were not due to chance.The confidence interval for the mean difference (-1.014 to -0.566) further supports this conclusion, as it does not cross zero. This indicates that the post-test scores were consistently higher than the pre-test scores across participants.

Graphical Representation of Results

Graph 1 illustrates the comparison between pre-test and post-test mean scores across the five writing components. The graph shows a clear upward shift in all components following the Gemini AI–assisted instruction, visually reinforcing the statistical findings. Writing mechanics and comprehension exhibit the highest post-test gains, highlighting the effectiveness of AI prompts in supporting both linguistic accuracy and content development.



Graph 1. Comparative Writing Performance among using AI and Non-AI

The results of this study show that Gemini AI-assisted instruction improves students' capacity to write paragraphs, as seen by the mean score of 78.64, which is higher than the institutional benchmark and shows that the majority of students attained good to exceptional performance levels. This improvement shows that Gemini AI successfully improve writing proficiency, especially in EFL contexts where students frequently have trouble coming up with ideas, organizing their thoughts, and using language. These results are in line with recent empirical studies that show Gemini AI technologies greatly enhance learner engagement, revision techniques, and overall writing quality. For example, a study on AI-assisted feedback discovered that students who used AI tools had better writing scores and showed more frequent revisions, which improved coherence, organization, and content (Wei, 2023; Wale & Kassahun, 2024).

More precisely, the current study found that content development saw the greatest improvement, suggesting that Gemini AI efficiently facilitates the generation and development of ideas. This is consistent with research demonstrating that AI writing tools improve coherence and overall text quality by helping students construct supporting sentences and expand ideas during paragraph writing assignments (Phan & Tran, 2025).

Furthermore, the excellent organizational performance indicates that Gemini AI offers structural assistance that aids students in creating coherent paragraphs with distinct topic sentences and logical flow. Previous research has also shown that Gemini AI tools, which provide real-time suggestions and models for organizing thoughts, have a positive impact on the coherence and structure of students' writing (Imran & Almusharraf, 2024; Baskara, 2025).These results support the idea that Gemini AI serves as a cognitive scaffold to help students manage difficult writing tasks including planning, drafting, and rewriting.

The findings of improved vocabulary use provide further credence to AI's contribution to lexical development. AI-generated recommendations and substitutes that expose students to more complex language are responsible for the increased diversity and accuracy in word choice that students displayed. Additionally, prior research has shown that by offering context-sensitive lexical input and feedback, AI technologies assist students in increasing their vocabulary and improving their writing style. This findings in line with the following (Kartika, 2024; Lang et al., 2024; Perera & Lankathilaka, 2023; Imran & Almusharraf, 2024). In this way, Gemini AI helps students create more complex and varied expressions by acting as both a correction and a language enrichment tool.

Another important finding of this study is the absence of students in the "poor" category, which suggests that Gemini AI-assisted instruction helps reduce low performance and supports struggling. This can be explained by the ability of Gemini AI to provide immediate, individualized feedback, thereby reducing writing anxiety and enabling students to complete tasks more confidently. Research has shown that Gemini AI-assisted environments foster positive learner perceptions and improve academic writing quality by offering accessible and continuous support, this in line with the research done by Phan, 2025 that the necessity of implementing Gemini AI in a balanced and directed manner, where it serves as a supplement to autonomous thought rather than as a substitute. Teachers should therefore urge students to continue actively participating in the writing process and to critically assess Gemini AI-generated recommendations.

CONCLUSIONS

This study employed a one-shot case study design involving 28 students to investigate the effects of Gemini AI-assisted training on paragraph writing skills, revealing a positive and significant impact as indicated by mean scores exceeding institutional standards and most students achieving good to excellent competence levels. The findings demonstrate that Gemini AI serves as an effective pedagogical tool in enhancing key aspects of writing, including content development, organization, and language use. Specifically, improvements in content suggest that Gemini AI supports idea generation and the production of more cohesive paragraphs, while better organization reflects students' ability to structure their writing more logically, and increased vocabulary indicates richer lexical variety. However, relatively weaker performance in grammar highlights the need for complementary instructional strategies, as AI support alone may not sufficiently develop deep grammatical proficiency. Overall, the study confirms that Gemini AI functions as a cognitive scaffold that helps students overcome common EFL writing challenges, fosters confidence, and promotes more productive writing practices, with the absence of low-performing students suggesting more equitable learning outcomes through immediate and personalized support. Nevertheless, the effectiveness of Gemini AI depends on balanced pedagogical integration where it complements rather than replaces the teacher's role. Practically, EFL teachers can utilize Gemini AI across various stages of the writing process to support instruction. For future research, more rigorous experimental designs with control groups and pre-test–post-test measures are recommended to establish stronger causal relationships, alongside studies involving larger and more diverse samples to improve generalizability. Further investigation is also needed into the long-term effects of Gemini AI use, its impact on specific linguistic components such as grammar, and its role in fostering independent writing skills. Additionally, exploring students' cognitive and metacognitive processes, including their interaction with AI feedback, revision strategies, and critical thinking development, is essential, as well as examining potential challenges such as overreliance, reduced creativity, and ethical concerns. Ultimately, future studies should focus on developing and validating pedagogical frameworks for integrating Gemini AI in writing instruction to ensure it promotes active learning, learner autonomy, and meaningful engagement.

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