

AI-ASSISTED CRITICAL READING IN ENHANCING EFL STUDENTS' ARGUMENTATIVE WRITING: A MIXED-METHODS STUDY

Fitria Rahmawati¹, Lutfiyah², Tara Mustikaning Palupi³ Aliya Noor Cahyani⁴
Atalisi Zalukhu^{5*}

¹Universitas Muhammadiyah Yogyakarta (UMY)

^{2,4}Universitas Esa Unggul

³Universitas Negeri Jakarta

⁵Institut Bisnis dan Komputer Indonesia

atalisizalukhu2000@gmail.com

ABSTRACT

This study investigates the effect of AI-assisted critical reading on EFL students' argumentative writing performance. Although previous studies have explored AI in language learning, limited research has specifically examined its role in integrating critical reading with argumentative writing in EFL contexts, particularly using a mixed-methods approach. Employing a mixed-methods approach with an explanatory sequential design, the study involved 50 undergraduate students from Institut Bisnis dan Komputer Indonesia, divided into an experimental group and a control group. The experimental group received instruction through AI-assisted critical reading, while the control group was taught using conventional methods. Data were collected through writing tests (pre-test and post-test) and semi-structured interviews. The quantitative data were analyzed using paired and independent sample t-tests, while the qualitative data were analyzed thematically. The findings revealed that the experimental group showed significantly greater improvement in writing performance compared to the control group, with a large effect size. The results also indicated that AI-assisted critical reading enhanced students' ability to analyze texts, generate ideas, and organize arguments effectively. In addition, students reported positive perceptions, including increased engagement, confidence, and motivation in learning. This study contributes to the growing body of literature by demonstrating the effectiveness of AI as a cognitive and pedagogical tool that supports the integration of reading and writing processes in EFL contexts.

Keywords: AI-Assisted Learning; Critical Reading; Argumentative Writing; EFL Students; Mixed-Methods

INTRODUCTION

The rapid advancement of artificial intelligence (AI) has increasingly transformed educational practices, including English as a Foreign Language (EFL) learning. Recent developments in generative AI such as ChatGPT and intelligent writing assistants have introduced new possibilities for language instruction by providing immediate feedback,

adaptive scaffolding, and interactive learning environments. Consequently, AI is no longer viewed merely as a technological innovation but as a pedagogical tool with the potential to reshape how language skills are developed.

A growing body of empirical research has demonstrated that AI-assisted tools can enhance students' writing performance. Jiang (2022) argues that AI-supported feedback significantly improves students' grammatical accuracy in writing. Similarly, Grabe & Zhang (2016) emphasize that technological feedback tools contribute to better textual organization and coherence. In addition, Li et al. (2024) find that AI assistance enhances lexical sophistication and overall writing quality.

More recent investigations further highlight the broader pedagogical impact of AI. Li et al. (2024) also report that AI tools support learner autonomy through continuous revision opportunities. Pawestri & Pratolo (2024) note that AI fosters student engagement by providing interactive and responsive feedback. Furthermore, Jeon (2025) highlights the role of AI in promoting self-regulated learning behaviors, while Mekheimer (2025) demonstrates that AI-assisted environments encourage iterative writing practices and personalized learning experiences.

However, despite these promising findings, existing studies largely conceptualize AI as a post-writing support tool, primarily focusing on surface-level text improvement rather than the cognitive processes underlying writing development. This tendency reflects a limited pedagogical perspective, where writing is treated as an isolated product rather than a complex process involving idea generation, reasoning, and knowledge transformation.

This limitation becomes particularly evident in the context of argumentative writing, which requires higher-order thinking skills such as analyzing claims, evaluating evidence, synthesizing information, and constructing logical arguments. Graham (2018) points out that EFL learners often struggle with the cognitive demands of writing, particularly in generating and developing ideas. In line with this, Banihashem et al. (2024) highlight that learners also face difficulties in organizing coherent and logically structured arguments. These challenges suggest that improving writing performance cannot rely solely on corrective feedback but must address the cognitive foundation of writing.

From a theoretical perspective, writing development is closely linked to reading, particularly through critical reading processes. Drawing on cognitive theory, reading provides the input necessary for knowledge construction, while writing serves as an output process that transforms and reorganizes that knowledge. In parallel, socio-cognitive perspectives emphasize that learning occurs through interaction, scaffolding, and mediated tools, which support learners in developing higher-order thinking skills. Within this framework, critical reading enables learners to analyze, interpret, and evaluate texts, thereby supporting the construction of well-reasoned arguments in writing.

Grabe & Zhang (2016) provide empirical evidence that students who engage in reading-based activities tend to produce more coherent and better-organized written texts. Similarly, Graham (2018) demonstrates that critical reading contributes to the development of analytical thinking, which in turn improves the quality of students' argumentative writing.

In the Indonesian EFL context, several studies have highlighted the importance of integrating reading and writing processes. For instance, Zalukhul et al. (2026) demonstrated

that multimodal reading exposure enhances students' ability to generate ideas and construct arguments, while Atalisi Zalukhu et al. (2025) found that technology-assisted learning improves writing quality, particularly in content development and organization. While these studies underscore the importance of both reading input and technological support, they tend to examine these elements independently rather than as an integrated process.

This reveals a critical gap in the literature. On one hand, AI research in EFL contexts predominantly focuses on writing outcomes, with limited attention to how AI can support reading processes that underpin writing. On the other hand, studies on reading-writing integration emphasize cognitive processes but rarely incorporate advanced AI technologies as mediating tools. As a result, there is still limited understanding of how AI can facilitate the integration of reading and writing through cognitive scaffolding, particularly in the context of critical reading.

Furthermore, although emerging studies suggest that AI has the potential to enhance higher-order thinking skills, including critical thinking, Salido et al. (2025) argue that AI-assisted learning environments can support the development of students' critical thinking through interactive and adaptive feedback. Similarly, Chaparro-Banegas et al. (2024) demonstrate that AI tools can facilitate analytical reasoning by engaging learners in tasks that require evaluation and reflection.

However, its role as a cognitive mediator remains underexplored. Most existing approaches position AI as either a corrective tool or a content generator, rather than as a scaffold that actively guides learners through complex cognitive processes such as argument analysis, evidence evaluation, and idea synthesis. This under-theorization limits our understanding of AI's pedagogical potential in fostering deeper learning.

Addressing this gap is particularly important in EFL contexts, where students frequently encounter difficulties in both reading comprehension and writing production. Integrating AI-assisted critical reading into writing instruction offers a more process-oriented and cognitively grounded approach, in which learners engage with texts analytically before transforming their understanding into written arguments. In this sense, AI can function as a mediational tool that supports both comprehension and production, bridging the gap between reading input and writing output.

This study aims to investigate the role of AI-assisted critical reading in enhancing EFL students' argumentative writing performance. Specifically, it examines the extent to which AI-assisted critical reading improves students' writing performance, explores how AI influences their critical thinking in constructing arguments, and analyzes students' perceptions of using AI tools to support their reading and writing processes.

The novelty of this study lies in its integration of artificial intelligence, critical reading, and argumentative writing within a unified cognitive framework. Unlike previous studies that have examined these elements in isolation, this study conceptualizes AI as a cognitive and pedagogical mediator that scaffolds the interaction between reading and writing processes. By adopting this integrated perspective, the study contributes to a more comprehensive understanding of technology-enhanced language learning and provides pedagogical insights for developing cognitively oriented AI-assisted instruction in EFL contexts.

METHODS

Research Design

This study employed a mixed-methods approach using an explanatory sequential design to examine the effect of AI-assisted critical reading on EFL students' argumentative writing performance. The use of a mixed-methods design was justified by the need to obtain both quantitative evidence of effectiveness and qualitative insights into students' cognitive and learning experiences. While quantitative data alone can demonstrate whether an intervention is effective, it often fails to explain *how* and *why* such effects occur. Therefore, the qualitative phase was conducted to provide a deeper interpretation of the statistical results and to capture students' perceptions of AI-assisted learning.

The study was conducted in two sequential phases. The first phase employed a quasi-experimental design with a non-equivalent control group to measure the impact of the intervention. This design was selected due to practical constraints in educational settings, where random assignment is often not feasible, while still allowing for comparison between groups. The second phase involved qualitative inquiry through semi-structured interviews to explain and contextualize the quantitative findings.

Participants

The participants in this study were 50 undergraduate students enrolled in the English program at Institut Bisnis dan Komputer Indonesia. They were divided into two groups: an experimental group (n = 25) and a control group (n = 25).

A purposive sampling technique was employed to ensure that participants met specific criteria aligned with the study objectives. These criteria included having comparable levels of English proficiency, prior completion of foundational courses in reading and writing, and limited prior exposure to AI-assisted learning tools. This sampling approach was considered appropriate as it enabled the selection of pedagogically relevant and relatively homogeneous participants, thereby minimizing potential confounding variables and enhancing the validity of the findings.

Prior to data collection, informed consent was obtained from all participants. Participation was voluntary, and ethical principles, including confidentiality and anonymity, were strictly upheld throughout the research process.

AI Tools and Learning Platform

The experimental group utilized a generative AI platform, such as ChatGPT, accessed through a web-based interface to support students' critical reading and writing activities. The selection of this tool was grounded in its capacity to provide interactive, adaptive, and immediate feedback, which aligns closely with the study's emphasis on cognitive scaffolding.

To ensure that the AI functioned as a cognitive support tool rather than merely a content generator, the researchers systematically developed a set of structured prompts. These prompts were designed based on principles of critical reading and higher-order thinking, with particular emphasis on analysis, evaluation, and synthesis.

The prompt development process consisted of three stages. First, in the theoretical alignment stage, prompts were derived from established critical reading frameworks, focusing on argument identification, evaluation of evidence, and the construction of counterarguments. Second, during expert validation, two specialists in EFL pedagogy and writing instruction reviewed the prompts to ensure their clarity, relevance, and alignment with the intended learning objectives. Third, in the pilot testing stage, the prompts were implemented with a small group of students to assess their usability and effectiveness, leading to minor revisions where necessary.

Examples of the prompts included asking students to identify the main argument of a text and evaluate its supporting evidence, as well as to generate and assess counterarguments to a given claim. Through this structured approach, the use of AI was directed toward fostering active engagement and critical thinking, rather than encouraging passive reliance on automatically generated responses.

Implementation Procedure

The study was conducted over a six-week period and comprised four sequential stages: pre-test, treatment, post-test, and interview. During the pre-test phase, both the experimental and control groups completed an argumentative essay of 250–300 words to establish their baseline writing ability.

The treatment phase involved the implementation of different instructional approaches for each group. The experimental group engaged in AI-assisted critical reading activities, which included reading argumentative texts, analyzing arguments through AI-guided prompts, generating ideas and outlines via interaction with the AI, and producing written drafts based on their analysis. In contrast, the control group received conventional instruction characterized by teacher-led explanations, guided text discussions, and independent writing without AI support.

Following the intervention, both groups completed a post-test using a comparable writing task to measure any changes in writing performance. Subsequently, semi-structured interviews were conducted with selected participants from the experimental group to explore their experiences and perceptions of AI-assisted learning.

Instruments

This study employed three instruments: a writing test, an interview protocol, and structured AI-assisted learning tasks. The writing test, administered as both a pre-test and post-test, required students to produce an argumentative essay. Students' essays were evaluated using an analytic scoring rubric encompassing content, organization, vocabulary, grammar, and mechanics. To ensure scoring reliability, two independent raters assessed the essays, and inter-rater reliability was calculated using Cohen's kappa, which indicated a high level of agreement ($\kappa > 0.75$), reflecting strong reliability.

Content validity of the writing test and scoring rubric was established through expert judgment involving two specialists in EFL writing and assessment. Similarly, the interview protocol was reviewed to ensure its alignment with the research objectives. In addition,

structured AI-assisted learning tasks were systematically developed to standardize the instructional procedures and maintain consistency across learning sessions.

Data Analysis

Quantitative data were analyzed using descriptive statistics (mean and standard deviation) and inferential statistics. Prior to hypothesis testing, assumption tests were conducted, including tests of normality (Shapiro–Wilk) and homogeneity of variance (Levene’s test).

Paired-sample t-tests were used to examine within-group improvements, while independent-sample t-tests were conducted to compare differences between the experimental and control groups. Effect size was calculated using Cohen’s d to determine the magnitude of the intervention effect.

Qualitative data from the interviews were analyzed using thematic analysis following three stages: data familiarization, coding, and theme development. To enhance trustworthiness, the analysis employed member checking and peer debriefing. These procedures ensured credibility, dependability, and confirmability of the qualitative findings.

RESULTS

Quantitative Results

The quantitative data were derived from students’ scores on the pre-test and post-test of argumentative writing in both the experimental and control groups. Descriptive statistics were calculated to examine the overall performance and improvement of each group.

Table 1. Descriptive statistics of students’ writing scores

Group	Test	N	Mean	SD
Experimental	Pre-test	25	62.40	5.12
Experimental	Post-test	25	78.60	4.85
Control	Pre-test	25	61.80	5.35
Control	Post-test	25	68.20	5.10

As presented in Table 1, both groups demonstrated an increase in their mean scores from pre-test to post-test. The experimental group improved from a mean score of 62.40 to 78.60, indicating a substantial increase of 16.20 points. In contrast, the control group showed a more modest improvement, with mean scores increasing from 61.80 to 68.20, resulting in a gain of 6.40 points. These results suggest that students who participated in AI-assisted critical reading activities exhibited greater improvement in their argumentative writing performance compared to those who received conventional instruction.

To further examine whether the observed improvements were statistically significant, paired sample t-tests were conducted for both groups.

Table 2. Paired sample t-test results

Group	Mean Difference	t-value	Sig. (p)
Experimental	16.20	12.45	0.000
Control	6.40	5.12	0.000

The results of the paired sample t-tests indicate that the improvement in both groups was statistically significant ($p < 0.05$). However, the magnitude of improvement in the experimental group was considerably higher, as reflected by the larger mean difference and t-value. This finding indicates that while conventional instruction contributes to writing development, AI-assisted critical reading provides a more substantial enhancement.

To determine whether there was a statistically significant difference between the two groups after the treatment, an independent sample t-test was conducted on the post-test scores.

Table 3. Independent sample t-test (post-test comparison)

Group	Mean	t-value	Sig. (p)
Experimental	78.60	6.87	0.000
Control	68.20		

The independent sample t-test results reveal a statistically significant difference between the experimental and control groups ($p < 0.05$). The higher mean score of the experimental group indicates that students who were exposed to AI-assisted critical reading outperformed those in the control group in terms of argumentative writing performance. In addition, the effect size was calculated using Cohen's d to determine the magnitude of the treatment effect. The result showed a large effect size ($d = 1.25$), indicating that the implementation of AI-assisted critical reading had a strong impact on students' writing performance.

Qualitative Results

The qualitative data obtained from semi-structured interviews were analyzed using thematic analysis. The analysis revealed three major themes that explain how AI-assisted critical reading influenced students' learning processes.

Development of Critical Reading Skills

Participants reported that the use of AI tools helped them better understand texts by identifying main ideas, recognizing arguments, and evaluating supporting evidence. The AI-assisted activities enabled students to engage more deeply with reading materials, which contributed to their ability to construct more logical and evidence-based arguments in writing.

"The AI helped me understand the text more deeply because it guided me to identify the main idea and evaluate the arguments step by step." (Participant 5)

“Before using AI, I only focused on reading. Now, I can analyze whether the argument is strong or not.” (Participant 8)

Improvement in Idea Generation and Organization

Another emerging theme was the improvement in students’ ability to generate and organize ideas. Students indicated that AI tools provided guidance in structuring their thoughts, which helped them develop clearer and more coherent arguments. This support was particularly beneficial during the planning stage of writing, where students often experienced difficulty in organizing their ideas.

“AI helped me organize my ideas. It gave suggestions on how to arrange my arguments logically.” (Participant 2)

“When I didn’t know what to write, AI gave me ideas and helped me start my essay.” (Participant 10)

Increased Engagement and Confidence

Students also expressed positive perceptions of using AI in their learning process. They reported that AI-assisted activities made learning more interactive and engaging. In addition, students felt more confident in both reading and writing tasks, as AI tools provided immediate support and reduced uncertainty during the learning process.

“Learning with AI is more interesting and interactive. I feel more confident when writing.” (Participant 6)

“AI gives immediate feedback, so I don’t feel confused anymore.” (Participant 1)

DISCUSSION

The findings of this study provide strong evidence that AI-assisted critical reading significantly enhances EFL students’ argumentative writing performance. However, the significance of these findings extends beyond the observed improvement, as they reveal how AI reshapes the underlying cognitive and learning processes involved in writing development.

A key contribution of this study lies in its conceptualization of AI as a cognitive scaffold, rather than merely a feedback or text-generation tool. While previous studies have consistently shown that AI improves writing accuracy and revision quality (Li et al. 2024; Mekheimer 2025), such research tends to emphasize post-writing support. In contrast, the present findings suggest that AI can intervene earlier in the writing process by facilitating idea generation, argument evaluation, and organizational planning through critical reading activities. This distinction is important because it shifts the pedagogical role of AI from *corrective assistance* to *process-oriented cognitive mediation*, thereby extending current understandings of AI in language learning.

From a socio-cognitive perspective, writing involves the integration of multiple higher-order processes, including analysis, synthesis, and evaluation. The results indicate that AI-assisted critical reading reduces cognitive load by guiding learners in processing textual

input before transforming it into written output. This supports and extends the findings of Li et al. (2024) and Chapelle (2016), who highlight the role of AI in supporting iterative writing processes, but goes further by demonstrating that AI can scaffold pre-writing cognitive engagement, which is often underexplored in previous research.

Furthermore, the findings reinforce the theoretical assumption that writing development is fundamentally linked to reading engagement. This result is consistent with William Grabe & Zhang (2016), who argue that reading provides essential input for writing, particularly in idea generation and argument construction. Similarly, Steve Graham (2018) emphasizes the critical role of reading as a foundation for writing development. However, unlike earlier studies that treat reading and writing as interconnected yet separate processes, the present study demonstrates that AI can actively mediate and operationalize this connection. In other words, AI does not simply support reading or writing independently, but facilitates the dynamic transformation of reading input into written output, representing a more integrated and process-oriented instructional model.

Another important dimension of the findings is the enhancement of students' critical thinking skills. The qualitative data reveal that students were better able to evaluate multiple perspectives, construct counterarguments, and develop logically coherent reasoning. This aligns with recent systematic reviews by Simon Chaparro-Banegas et al. (2024) and Darwin (2024), which suggest that AI has the potential to foster higher-order thinking. However, the current study adds a critical nuance: the effectiveness of AI in promoting critical thinking depends on how it is pedagogically structured. Specifically, the use of guided prompts in this study ensured that students engaged actively with the AI, thereby preventing passive reliance and promoting deeper cognitive processing. This finding highlights the importance of instructional design in maximizing the educational value of AI.

In addition to cognitive gains, the study also reveals significant affective benefits. Students reported increased engagement, motivation, and confidence when using AI-assisted learning tools. These findings are consistent with recent research suggesting that AI can create more interactive and supportive learning environments (Jeon 2025). However, this study extends prior work by demonstrating that affective improvements are closely linked to cognitive engagement. That is, students' increased motivation appears to stem not only from the novelty of AI but also from their enhanced ability to understand texts and construct arguments more effectively.

Importantly, this study offers a distinct contribution to the literature by addressing a key fragmentation in previous research. Existing studies on AI in EFL contexts tend to focus either on writing outcomes (e.g., grammar, revision) or on general learning engagement, while research on reading-writing integration rarely incorporates advanced technologies. By integrating AI, critical reading, and argumentative writing within a single framework, this study provides a more comprehensive understanding of how AI can function as a mediating tool that bridges cognitive processes. This integrative perspective represents a novel contribution, moving beyond tool-based or skill-based approaches toward a process-oriented and cognitively grounded model of AI-assisted learning.

Despite these contributions, several limitations should be acknowledged. First, the relatively small sample size and single institutional context may limit the generalizability of

the findings. Second, the short duration of the intervention may not fully capture the long-term impact of AI-assisted learning on writing development. Third, the study focuses exclusively on argumentative writing; therefore, future research should examine whether similar effects can be observed across different writing genres and proficiency levels.

In light of these findings, several pedagogical implications emerge. Educators are encouraged to integrate AI not only as a writing assistant but also as a tool for supporting critical reading and pre-writing processes. Instruction should emphasize the interconnected nature of reading and writing, while also incorporating structured prompts to guide students' interaction with AI. Moreover, teachers should promote critical and responsible use of AI to ensure that it enhances, rather than replaces, students' cognitive engagement.

Overall, this study highlights the potential of AI-assisted critical reading as an innovative and effective approach to improving EFL students' argumentative writing. By supporting both cognitive and affective dimensions of learning, AI can contribute to more meaningful, integrated, and sustainable language development.

CONCLUSION

This study demonstrates that AI-assisted critical reading is not only effective in improving EFL students' argumentative writing performance but also transformative in how writing development is conceptualized and supported. Rather than functioning merely as a supplementary tool, AI operates as a cognitive and pedagogical mediator that facilitates the integration of reading and writing processes, enabling learners to construct more coherent, analytical, and evidence-based arguments.

The key implication of these findings lies in the need to reconceptualize the role of AI in language education. Instead of limiting its use to post-writing feedback or text generation, this study highlights the value of integrating AI into pre-writing and critical reading stages. Such an approach allows students to engage more deeply with textual input, thereby strengthening the cognitive processes underlying writing. This suggests that effective AI integration depends not on the technology itself, but on how it is pedagogically designed and implemented to support higher-order thinking.

From a theoretical standpoint, this study contributes to the literature by advancing an integrated model of AI-assisted learning that bridges the traditionally separated domains of reading and writing. By positioning AI as a mediating tool within a socio-cognitive framework, the study extends existing research that has largely focused on AI as a corrective or productivity-enhancing instrument. This contribution offers a more comprehensive perspective on how AI can support language learning at both cognitive and process-oriented levels.

Pedagogically, the findings suggest that educators should adopt a more strategic and guided use of AI, particularly through structured prompts that encourage analysis, evaluation, and synthesis. This has practical implications for curriculum design, where reading and writing should be taught as interconnected processes supported by technology. Additionally, fostering students' critical and responsible use of AI is essential to ensure that these tools enhance, rather than replace, learners' cognitive engagement.

Despite its contributions, this study is not without limitations. The relatively small sample size and short duration of the intervention may restrict the generalizability of the findings. Future research should therefore investigate the long-term impact of AI-assisted critical reading, involve more diverse learner populations, and explore its application across different writing genres and educational contexts.

In sum, this study underscores the potential of AI-assisted critical reading as an innovative, cognitively grounded, and pedagogically meaningful approach to EFL instruction. By emphasizing process integration and higher-order thinking, it provides a foundation for more effective and sustainable uses of AI in language education.

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