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Research Article

AI-Assisted Writing and Student Proficiency: Argumentation and Problem-Solving Skills of Undergraduate Students in Bengkulu, Indonesia

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Abstract

Previous research on AI-assisted writing tools has predominantly used quantitative methodologies, emphasizing students' performance and learning outcomes. It largely overlooks students' qualitative experiences, particularly with respect to argumentation and problem-solving skills. To address this gap, this study investigates the influence of AI-facilitated writing tools on writing proficiency, with a specific focus on problem-solving and argumentation skills among 10 Indonesian undergraduates in Bengkulu, Indonesia, using Grammarly, ChatGPT, and QuillBot. Employing a qualitative exploratory design, data were collected through semi-structured interviews and analyzed using thematic analysis to identify patterns in cognitive and metacognitive engagement. Argumentation was assessed through students' accounts of refining claims, evaluating the logical relevance of supporting ideas, and identifying fallacies. Problem-solving skills were defined as the ability to address rhetorical challenges and revise structural inconsistencies. Findings revealed that AI tools significantly supported students in developing clear arguments, recognizing logical fallacies, and resolving writing-related challenges. Participants indicated that AI-facilitated tools contributed to the development of higher-order writing skills and promoted critical thinking and metacognitive awareness, alongside improvements in argumentation and problem-solving features. These findings indicate that, when mediated by effective pedagogy, AI-assisted writing tools can function as cognitive scaffolding in academic writing, supporting independent thought and sound reasoning. The research advocates for the integration of AI technologies into writing instruction, emphasizing the necessity of pedagogical balance to enhance deep learning by fostering independent metacognitive sensitivity. The study highlights the significance of employing AI technologies as supportive resources within balanced instructional strategies, rather than as replacements for traditional teaching methods.

Keywords: AI-assisted writing tools, writing proficiency, argumentative skills, problem-solving skills

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As a productive skill, writing is indispensable to acquire under the umbrella of English as a Foreign Language learning. Writing proficiency is a pivotal basis in education, as it is critical for academic achievement, personal expression, and professional accomplishment (Walsh, 2010). Robust writing skills are fundamental for students to complete assignments, articulate their understanding, and earn a higher grade (Taye & Mengesha, 2024; Wale & Bogale, 2021). Good writing proficiency in professional life enables individuals to communicate effectively, which is vital for leadership, collaboration, and workflow operations (Grise-Owens & Crum, 2012; Lee & Schmidgall, 2020). In a more specific context, students' ability to articulate ideas clearly during problem-solving and argumentation is another essential for navigating the complexity of the learning environment. A proficient student in writing is not only able to form sentences but also to think critically (Çavdar & Doe, 2012), solve particular problems (Sari et al., 2021), and present a logical argument (Iordanou & Rapanta, 2021).

In the era of digital advancement, artificial intelligence (AI) is increasingly employed in academic settings. AI-assisted writing tools, such as QuillBot, ParagraphAI, ChatGPT, and Grammarly, have become increasingly popular in recent years because they help students identify logical fallacies, organize ideas, and correct grammar, thereby enabling them to address writing problems (Aladini et al., 2025; Reginio, Ingilan, & Asrifan, 2026). Additionally, AI offers novel inspirations and ideas for advanced students, which enhance their ability to solve problems they face during the writing process (Zawacki-Richter et al., 2019). In developing students' argumentative ability, AI-assisted writing tools provide authentic feedback on the strengths and weaknesses of their arguments (Song & Song, 2023). AI ensures that arguments are well-connected and that text flow is logically developed (Nguyen Thanh et al., 2023), thereby helping students learn to write clear arguments.

Several recent studies have examined how AI-assisted writing aids affect students' writing skills and have documented both their advantages and disadvantages. While students who rely on unstructured use of ChatGPT score better in language mechanics, controlled use of ChatGPT can improve the coherence and clarity of students' arguments (Luckin & Holmes, 2016; Suh, Bang, & Han, 2025). While teachers and students recommend changes to the tool's design, AI tools such as CGScholar improve students' overall writing development (Zheldibayeva et al., 2025). The benefits pertain to the quality of writing, particularly in terms of substance and organization (Nurseha, 2023; Selim, 2024). Although they highlight concerns about diminishing critical thinking, they also emphasize the value of such tools in helping students complete writing tasks (Dangin & Hikmah, 2024). Although writing with the help of AI improves student performance, students do not fully understand the function of the instrument (Taloza et al., 2024).

While prior research has established the potential benefits of AI-assisted writing tools for enhancing students' writing performance, most studies have concentrated on measurable outcomes, surface-level writing quality, or general perceptions, typically employing quantitative or mixed-methods approaches. Consequently, there is a limited qualitative understanding of how AI tools affect students' cognitive processes during academic writing, particularly in problem-solving and argument development. Notably, few investigations have examined how students interpret, engage with, and respond to AI-generated feedback when constructing arguments and addressing writing-related challenges.

To fill this gap, the current study aims to explore the impact of AI-assisted writing on students' problem-solving and argumentative skills. It aimed to address the following extensive questions: (1) How does the use of AI writing tools influence the student's approach to argumentation in writing?; and (2) What problem-solving strategies emerge or change when AI tools are integrated into the writing process?

This study offers in-depth insights into the complex ways in which AI technology affects students' individual thinking and writing processes through a qualitative, exploratory methodology. In addition to improving writing skills at the surface level, these findings can help educators, curriculum designers, and technology developers incorporate AI more effectively into writing training to enhance high-level thinking and reasoning skills that are critical for academic achievement.

Methodology

This study investigates the impact of AI-assisted writing on Indonesian students' argumentation and problem-solving abilities. A qualitative approach was selected to facilitate an in-depth exploration of students' experiences, perceptions, and cognitive processes (Creswell & Poth, 2016). Given the increasing prevalence of AI-assisted writing in higher education, an exploratory design was adopted to provide nuanced insights into how students engage with AI-assisted writing tools during academic writing tasks.

The study sample comprised ten undergraduate students enrolled in the English Language Education program at a public higher education institution in Bengkulu Province, Indonesia. English serves as the primary medium of instruction, and the curriculum emphasizes academic literacy. Participants were selected through purposive sampling to ensure recruitment of individuals with substantial, relevant experience aligned with the research objectives (Yin, 2009). Recruitment involved an open invitation to students in upper-level writing courses. From an initial pool of 20 students, 10 were chosen based on the following inclusion criteria: (1) completion of an academic writing project requiring argumentation, such as essays and reports; (2) consistent and active use of AI writing tools, including QuillBot, Grammarly, and ChatGPT; and (3) provision of written informed consent for participation in interviews. The final sample consisted of three males and seven females, primarily in their fifth semester of study, with an estimated English proficiency at the intermediate level. Although the sample size was limited, data saturation was reached by the tenth interview. At this point, no new codes or distinct thematic patterns emerged, indicating that the collected data were sufficiently comprehensive to address the research questions in this pedagogical context.

Data were collected through semi-structured interviews to capture participants' writing processes, perceptions, and experiences in using AI-assisted writing tools for tasks involving argumentation and problem-solving. Semi-structured interviews were conducted through a secure online platform between the 13th and 17th of May, 2025. The interview takes place in a quiet and private environment and lasts about 45-60 minutes, following the interview guidance framework as presented in Table 1. The interview was audio-recorded with the participants' permission and thenceforth transcribed verbatim for analysis. If needed, further clarification is sought to ensure the data are accurate and complete.

The semi-structured interview protocol, comprising 42 questions, was developed to elicit in-depth qualitative insight into students' cognitive and metacognitive processes. The domains were theoretically grounded in the Cognitive Process Theory of Writing (Flower & Hayes, 1981) and Metacognitive Scaffolding frameworks, thereby ensuring close alignment with the study's research questions on argumentation and problem-solving. Each domain connects the overarching research questions to the specific indicators identified during the writing process.

Table 1

Interview Guidance Framework

No.	Cognitive Domain	Theoretical Linkage	Indicators	No. of Questions
1	Problem Recognition	Problem-Solving	The extent to which students can identify, recognize, and evaluate challenges encountered in academic writing.	6
2	Analytical Reasoning	Argumentation	The degree to which students gather relevant information, assess alternative perspectives, and select appropriate evidence to support their writing.	6
3	Synthesis and Organization	Metacognition	The capacity of students to organize ideas by determining which concept to include, revise, or exclude during the writing process.	7
4	Argument Construction	Argumentation	The ability of students to construct, develop, and refine arguments within academic writing.	6
5	Pattern Recognition and Coherence	Cognitive Processing	The extent to which students identify patterns, relationships, and coherence within text and supporting sources.	5
6	Metacognitive Reflection	Metacognition	The level of students' metacognitive awareness, including their reflection on feedback, evaluation of revision, and understanding of conceptual development in writing.	6
7	Conceptual Articulation	Cognitive Processing	The ability of students to clearly articulate theoretical concepts and abstract ideas in written form.	6

To improve methodological clarity and eliminate conceptual redundancy, the interview indicators were designed into seven core dimensions that represent problem-solving, argumentation, and metacognitive processes in academic writing. This refinement aimed to enhance analytical clarity and minimize repetition across interview prompts, while maintaining sufficient flexibility to explore participants' experiences in depth during semi-structured interviews.

Following the six-stage framework of Braun and Clarke (2012), the data were examined using thematic analysis: (a) **data familiarization and transcription:** The first and second authors transcribed the recordings verbatim. Both researchers then read the transcripts multiple times to immerse themselves in the Indonesian cultural and educational nuances of the participants' responses; (b) **initial coding:** The third and Fourth researchers performed open coding on three pilot transcripts to establish a preliminary codebook. We specifically tagged "meaningful units" where students described their tactical interactions with AI; (c) **theme development:** The fourth and fifth researchers then develop themes. Codes were clustered into candidate themes centered on problem-solving trajectories and argumentative refinement; and (d) **reviewing and refining:** The research team met to compare independent codes. Disagreements in coding were resolved through collaborative discussion and re-examination of the original interview context until 100% consensus was reached.

This study followed the ethical standards of the English Tadris Study Program at Institut Agama Islam Negeri Curup in Bengkulu. Before data collection, participants received an information sheet outlining the study's purpose and their right to withdraw at any time. Each student provided written consent to participate in the semi-structured interviews and to have their recordings digitally

recorded. To ensure confidentiality, all personal identifiers were replaced with pseudonyms (e.g., Student 1) during data analysis.

Results and Discussion

Within the umbrella of English language learning, students are encouraged to continuously improve their writing to promote their academic and professional development. The current qualitative exploratory study explores the impact of AI-assisted writing tools on students' argumentative and problem-solving skills in writing. The interview results portray students' experience in using AI-assisted writing tools toward their ability to identify and analyze the problems, ability to assemble appropriate information, ability to evaluate a series of options, ability to make decisions about the information to be applied, and finally, ability to evaluate the information obtained to improve writing. Through the optimization of AI-assisted writing tools, students also reported gaining a deeper understanding of ideas and arguments and were able to interpret and draw conclusions from the information, ideas, and thoughts they received.

Figure 1 presents a thematic map that summarizes the relationships among the key themes identified in the analysis. This map visually illustrates the perceived support that AI-assisted writing tools provide for students' cognitive engagement during academic writing tasks.

Figure 1

Thematic Analysis of Students' Experiences with AI-Assisted Writing Tools

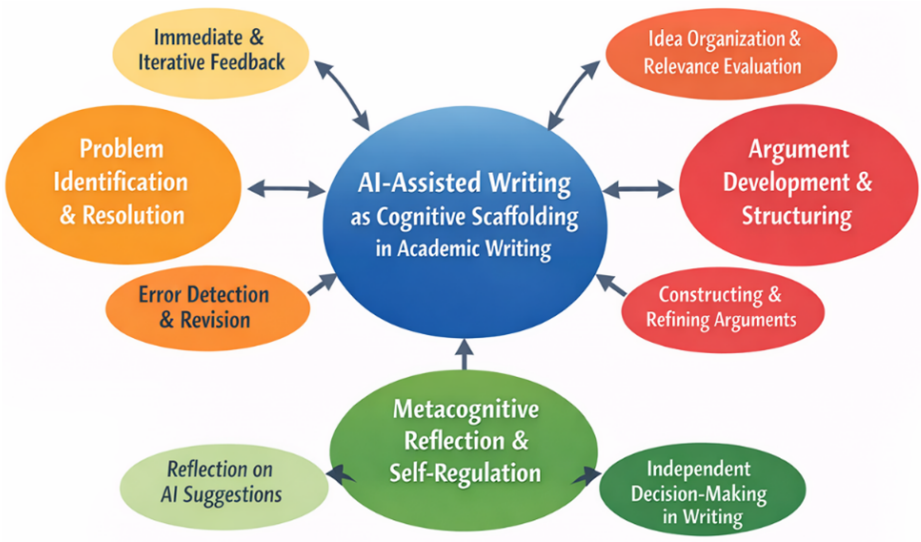

Figure 1 presents the thematic relationships identified through qualitative analysis. AI-assisted writing tools serve as cognitive scaffolding, facilitating students' problem-solving, argumentation, and metacognitive processes in academic writing. The figure articulates that iterative feedback and reflective engagement mediate students' utilization of tools throughout the writing and revision process.

AI-Assisted Writing Tools as Argument-Structuring Scaffolds

Interview analysis shows that AI-assisted writing tools help students structure arguments, organize opinions, support claims with evidence, and maintain logical coherence. These tools go beyond grammar correction by aiding argument correction. Argumentative skills are fundamental to writing and help develop strong academic arguments and demonstrate critical thinking.

Based on the students' statements, AI-assisted writing tools help them maintain a consistent argument structure and ensure logical flow. As one of the students remarked:

> *"I use the AI-assisted writing tools to check the consistency of my arguments and also to identify unclear sentences and improve the flow of ideas, for example, in my essays."*
> *—Student 5*

In developing a strong, consistent argument, students can use a pattern and a connection among the information provided by AI-assisted writing tools. By utilizing it, students can deliberately create arguments that are not just solid and consistent but also thoughtful and well-supported by using AI-assisted writing tools to find and capitalize on patterns and connections among facts. It influences the method they construct arguments and ideas, as one of the students said:

> *"The ability to recognize patterns and relationships between information obtained through AI-assisted writing tools greatly influences the way I structure and develop arguments. I can use these patterns to strengthen my argument and ensure consistency in my writing."*
> *—Student 1*

Moreover, another student confirms that recognizing patterns and connections among arguments supports them in considering their arguments and supportive evidence, as he expressed, *"Recognizing patterns and relationships helps me develop coherent arguments by logically linking supporting evidence" (Student 2).* Considering these statement patterns, the AI-assisted writing delivers analysis of clarity, cohesion, and significance of arguments. Furthermore, several features, such as argument strength assessment, logical flow scrutiny, and notion plotting, assist in emerging strong arguments, which were frequently mentioned by students. Student 2, for example, explained that these AI tools *"assist in the construction of arguments by identifying logical gaps, endorsing corroborating data, and proposing strong argument structures"*, thus strengthening the argumentative worth of their writing. Likewise, Student 6 acknowledged that AI-assisted writing tools *"help students acquire excellent argument-building abilities, including text structure analysis, automated summarizing, and identifying essential points."*

All things considered, AI-assisted writing tools serve as argumentation scaffolding and grammar correctors, helping students connect their thoughts logically, assess the applicability of the material, and strengthen the argument's persuasiveness.

By giving students structured feedback on the coherence and consistency of their ideas, AI-assisted writing tools also significantly contribute to the development of powerful, convincing arguments. As a writing mentor, the tools provide students with real-time feedback so they can improve their arguments and strengthen their evidence.

Participants highlighted how the tools' feedback addressed deeper structural and logical problems in their argumentative writing, in addition to fixing superficial errors. Student 5, for example, commented that:

> *"The AI-Assisted Writing Tools tool assesses the coherence, relevance, and consistency of information to assist students in crafting compelling arguments in their writing."*
> *—Student 5*

The statements indicate that AI-assisted writing tools enable students to gain an effective strategic approach to developing an argument. On the other hand, Student 6, through this interview, confirmed:

> *"The primary characteristics of AI-assisted writing tools are grammar analysis, grammatical mistakes, writing clarity, argument consistency, and suggestions for improving writing quality."*
> *—Student 6*

In real-world applications, students actively used artificial intelligence (AI) tools to analyze texts on their subjects and extract pertinent information and arguments to support their claims. For example, Student 3 explained:

> *"With this tool, I can easily see the arguments made by other writers and can also judge whether the arguments are strong or weak based on the information provided."*
> *—Student 3*

The tool was also used by Student 6 to *"enhance the quality of their arguments in their writing by using these AI-assisted writing tools to evaluate texts that either back up or contradict the claims" (Student 6)*, allowing for a more critical and well-rounded integration of viewpoints.

These experiences demonstrate that students are using the resources to enhance their arguments, choosing, assessing, and integrating material to improve their rhetorical effectiveness rather than merely passively taking criticism. Thus, the AI application functions as a generative and evaluative tool, assisting students in methodically improving the structure and content of their arguments.

A consistent argument must be supported by empirical evidence. Regarding these terms, students found that using AI-assisted writing tools provides valuable insights into evaluating ideas and the evidence that strengthens arguments. Several features of AI-assisted writing tools allow students to *"aid in assessing and classifying workable ideas by determining their merits, drawbacks, and connection to the main point" (Student 2).* In addition to evaluating ideas and evidence, the students argued that AI-assisted writing tools are beneficial since

> *"… AI-assisted writing tools assist me in evaluating and classifying ideas so that I can determine which ideas are worthy of being written about."*
> *—Student 4*

Meanwhile, another student added that AI guides students to focus on relevant thoughts using *"several key features, including the ability to flag unclear arguments, identify contradictory thinking, and make suggestions for improving argument structure. All of these help me develop the ability to construct strong arguments" (Student 1).* Students found that using AI-assisted writing tools helped them develop critical analysis and persuasive writing skills. Students expressed greater capacity to recognize flaws in their arguments and enhance the overall coherence and persuasiveness of their writing.

Student 2 underlined how *"the process of using AI-Assisted Writing tools developed my critical skills in identifying and fixing weaknesses in my writing independently" (Student 2).* This autonomy not only improved their critical thinking skills but also increased their confidence in self-editing. Similarly, Student 4 stated that:

> *"The process of using AI-assisted writing tools helps students develop their critical skills by providing structured and objective feedback on problems in their writing, allowing them to learn from mistakes, and improving their overall writing ability."*
> *—Student 4*

According to this student, receiving continuous critical criticism helped them to reflect on their mistakes, learn writing concepts, and improve their persuasive strategies over time.

Students consistently highlight that AI-assisted writing tools play a pivotal role in enhancing their critical thinking and persuasive writing abilities. Students reported that engaging with these tools sharpened their skills in analyzing writing structure, improving content relevance, and strengthening coherence.

Student 5 explained that *"the process of using the AI-assisted writing tools helped me develop critical skills by sharpening the ability to analyze the structure of the writing and also to evolve the fit of the content to the topic and improve coherence in the delivery of the video" (Student 5).* This suggests that the benefits of AI tools extend beyond text-based writing, influencing students' ability to organize and present ideas clearly across different formats.

In addition, Student 10 noted that the critical engagement fostered by the tools influenced their ability to selectively evaluate emerging ideas from writing exercises.

> *"…students use new topics or ideas that arise from AI, and critical students are certainly selective in choosing which topics or ideas are valid and can be used as strong arguments for the continuation of ideas."*
> *—Student 10*

This discerning approach indicates a maturing critical mindset that goes beyond surface-level content creation to thoughtful argumentation and idea validation. These findings demonstrate that AI-assisted writing tools supported students' argumentative development by acting as cognitive scaffolds. The tools enabled students to analyze, organize, and refine arguments with structured feedback. This contributed to greater awareness of argumentative coherence, relevance, and logical reasoning during writing.

AI-assisted Writing Tools' Impacts on Students' Problem-Solving Skills in Writing

The analysis further revealed that AI-assisted writing tools acted as cognitive supports. They helped students with problem-solving during academic writing. Participants consistently reported that the tools identified writing problems, supported the evaluation of revisions, and aided informed decisions to improve clarity, coherence, and relevance.

Students asserted the utilization of the tools to detect various issues, including clarity, coherence, and grammatical errors. AI tools enable a deeper analysis of students' writing by examining both content and stylistic components, since it *"…helps students identify and analyze problems in my writing by using artificial intelligence technology to analyze my content structure and writing style" (Student 5).* This analytical ability supports students in their improvement areas, helping them identify what might otherwise go unnoticed in revision. Similarly, another student provided a detailed statement on how specific features within the AI-assisted writing tools contribute to problem identification.

> *"The features contained in the AI-Assisted Writing Tools application that can help students analyze problems in their writing are to improve the structure of punctuation and also the structure of writing-writing of each sentence in the paragraph—and also to level the main features in the AI-Assisted Writing Tools application that allow students to analyze problems in depth, and also the application helps students by improving the writing structure in the form of punctuation and also the structure for writing paragraphs and forming correct paragraphs."*
> *—Student 9*

Based on this statement, the AI tool provides a rough analysis of punctuation use, sentence-level structure, and paragraph organization. These features support the construction of well-formed paragraphs, helping students refine the flow and logic.

The process of writing problem-solving commonly begins with the AI tool's diagnostic capabilities. Flagging problematic areas is key to formulating tool prompts that engage students more critically with their work, enabling deeper reflection and more thoughtful enhancements. In the interviews, students revealed that AI-assisted writing is critical for collecting, evaluating, and synthesizing information to enhance writing quality. Students described how the tools facilitated not just surface-level corrections but also deeper engagement with the content, as in the following excerpt.

> *"AI-assisted writing tools help students analyze information more deeply by highlighting important details and visualizing the relationships between different concepts. This makes it easier to identify relevant patterns and relationships."*
> *—Student 1*

This visualization simplifies the detection of patterns and connections among ideas, which, in turn, supports more coherent, evidence-based writing. Likewise, Student 5 highlighted that the *"tools app helps improve our ability to analyze information and provides visualization and evaluation tools that use its users, I mean, to identify patterns and relationships between information and writing" (Student 5).* Reinforcing this theme, another student confirmed how information is collected and evaluated with the assistance of AI to improve writing quality when it was directly applied.

> *"The process of using the AI-Assisted Writing Tools application certainly helps students develop their critical skills by providing very detailed feedback on the weaknesses and strengths of their writing and by understanding and fixing the problems in their writing. Well, the student can improve the analytical and problem-solving skills in writing."*
> *—Student 6*

This statement strengthens the claim that AI enables students to conduct more planned revisions, grounded in an understanding of how each piece of information is appropriately contributed to the argument or is narratively well-structured.

During the interview, students also suggested that AI-assisted writing tools play a significant role in helping them decide whether the information is relevant to a given section. The tool's ability to weed out irrelevant or superfluous ideas while highlighting those with more value was praised by several students. For instance, a student shared, *"AI-assisted writing tools can help me with things like identifying the main ideas that should be emphasized, such as the importance of a communicative approach, and ignoring ideas that are less relevant or commonly known" (Student 2).* The AI's analytical capabilities helped students prioritize material that supported their ideas. Student 1 clarified that AI tools *"AI-assisted writing tools help students by providing automatic analysis of the thoughts or ideas they convey in a paragraph. It allows students to evaluate the clarity, consistency, and relevance of their thoughts" (Student 1).* This automatic evaluation was described as a beneficial feature for students who want to improve the clarity and impact of their arguments.

Student 7 expanded on the fundamental mechanics, observing that *"AI-assisted writing tools use algorithms to distinguish between relevant and irrelevant thoughts or ideas in one's academic writing."* This demonstrates how the tool's intelligent design considers not just language accuracy but also the substantial contribution of ideas in a particular environment.

Similarly, Student 6 stated how using the app to evaluate material immediately improved the quality of their work.

> *"It certainly helps me to improve the quality of my writing by ensuring that accurate and relevant data support arguments." This underscores the practical benefit of AI in promoting evidence-based writing and logical coherence."*
> *—Student 6*

Collectively, these results demonstrate that AI-assisted writing tools do more than simply provide mechanical corrections; they actively help students make informed judgments about topic relevance. This promotes stronger argumentative writing by helping students evaluate and refine the substance of their arguments, ultimately leading to clearer, more convincing academic compositions.

AI-Assisted Writing Tools in Fostering Metacognitive Awareness and Self-Regulated Writing

Based on the analysis, AI-assisted writing tools played a significant role in encouraging students' metacognitive awareness and self-regulated writing practices. Engaging with AI feedback encourages participants to reflect on their thinking processes, monitor writing quality, and take greater responsibility for revising their work autonomously. Students regularly reported that using AI-assisted writing tools increased their awareness of and ability to recognize and correct errors in their work. A major topic that emerged from the interviews was self-reflection, with students actively assessing their writing skills before and after using AI technologies. Student 1 reported a noticeable shift in their problem-solving ability:

> *"Before using AI-assisted writing tools, I often had difficulty recognizing flaws in my writing. However, after using this app, I became more skilled at identifying and analyzing issues such as unclear sentences or slightly chaotic structures."*
> *—Student 1*

This reflection demonstrates the tool's function in increasing self-awareness and facilitating more effective revision techniques. As external monitors, these tools make the implicit writing problem visible and prompt students to evaluate their writing more critically.

Similarly, a student underlined how the tools helped the articulation of complicated ideas, such as *"the use of AI-assisted writing tools affects my ability to better convey theoretical ideas and thoughts in my writing, as it helps me to identify and correct potential flaws in my written expression" (Student 8)*. This finding indicates that AI-assisted writing tools enhanced both technical accuracy and conceptual precision, prompting students to reevaluate the articulation and refinement of abstract ideas in academic writing.

Another important aspect contributing to students' metacognitive development was the promptness and consistency of feedback. Students regarded real-time AI-generated feedback as essential for facilitating ongoing self-monitoring and iterative improvement. As student 4 explained: *"The process of using AI-assisted writing tools helps students develop their critical skills by providing structured and objective feedback on problems in their writing, allowing them to learn from mistakes, and improving their overall writing ability" (Student 4)*. Student 7 also noticed the advantage of immediate, practical counsel, saying simply:

> *"AI helps students develop critical skills by providing instant feedback."*
> *—Student 7*

Collectively, these findings suggest that AI-assisted writing tools promote self-regulated writing by enabling students to monitor their progress, critically evaluate feedback, and independently implement informed revisions. The provision of rapid, targeted, and iterative feedback supports a continuous learning cycle, allowing students to exercise greater autonomy in their writing development. Figure 1 (p. 203) visually synthesizes interconnected processes, demonstrating how the

identified themes contribute to depicting AI-assisted writing tools as cognitive scaffolds that facilitate self-regulated writing and iterative learning.

The recent study explored the influence of AI-assisted writing tools on argumentative and problem-solving skills. The findings indicate that students viewed AI tools not solely as language-correction technologies but also as cognitive supports that facilitated idea development, structural organization, and reflective engagement throughout the writing process. These perspectives align with Luckin and Holmes' (2016) conceptualization of AI as an intelligent learning partner that, when pedagogically mediated, scaffolds learners' cognitive processes rather than replacing human reasoning. These novel findings suggest a more comprehensive pedagogical role for AI in writing instruction, expanding on previous research.

As one of many aspects of pedagogy, argumentative skills are considered important as a pathway in developing higher-order thinking skills (HOTS) and academic literacy, such as writing (Johan, 2024). Participants' views on the roles of AI-assisted writing tools in improving students' argumentative skills are presented in the interview process. Participants underlined that AI-assisted writing tools significantly influence their ability to construct logical, coherent, and persuasive arguments (Marzuki et al., 2023). As the backbone of effective writing, a logical argument ensures credibility and clarity. Moreover, logical argument and coherent writing are symbiotic elements. A logical argument and coherent writing are correlated with each other in effective written work (Foo & Lingard, 2023). A logical argument provides a strong foundation, and coherent writing ensures the ideas are communicated clearly.

In this context, students reported significant improvement in their ability to develop logical arguments and identify them in their written work, thanks to AI-assisted writing tools. The use of AI-assisted writing tools has a positive impact on the writing instruction process, particularly in constructing logical arguments and identifying writing patterns (Kim et al., 2024). These activities not only refine students' writing quality but also develop critical thinking and analytical skills that are pivotal in academic and professional life. They promote autonomy and confidence while helping students become more conscious of structure, coherence, and grammar. Importantly, by personalizing help and speeding up review cycles, AI enhances pedagogical practices rather than replacing instruction.

The integration of AI-assisted writing tools provides real-time feedback, supports coherent structure, fosters idea development, and helps learners construct metacognitive strategies for planning and revising their writing. Instead of replacing educators, AI complements traditional instruction by helping students identify linguistic conventions, correct structural errors, and visualize logical flows. However, a concern remains: the overreliance on and homogenizing of individual expression needs to be taken into account (Kim et al., 2024). Nevertheless, these benefits depend on guided and critical application, reflecting concerns in the literature about the potential for cognitive dependency arising from the unreflective use of AI tools (Zawacki-Richter et al., 2019).

Furthermore, in terms of problem-solving, AI-assisted writing tools significantly enhance this aspect by providing immediate feedback on paragraph coherence, relevance, and clarity during decision-making. It empowers learners to immerse themselves in and engage in deeper, more effective problem-solving by ensuring topic discussions remain relevant, actionable, and focused. As a writing assistant, AI assists students in analyzing and solving real-life problems, such as ethical dilemmas, and in fostering critical thinking to address specific problems (Cai, Msafiri, & Kangwa, 2025). AI tools also serve as cognitive scaffolds; they not only correct linguistic errors but also promote higher-order thinking skills, enhance idea development, and foster reflective reasoning (Yatani, Sramek, & Yang, 2024).

Recent AI systems are designed to foster cognitive development rather than just correct grammar or spelling errors. Modern AI tools, especially large language models (LLMs), can now encourage users to explore complex concepts, polish their reasoning, and analyze arguments (Singh et al., 2023). They also offer an adaptive tutoring system. This enables language learners to grasp advanced concepts in academic areas, such as writing. Modern AI further supports learners in brainstorming and artistic expression. It encourages them to engage in critical thinking. Metacognitively, modern AI assists language learners in analyzing and evaluating their thinking processes. These innovations align with pedagogical and cognitive theories. For example, Vygotsky's Zone of Proximal Development holds that language learners grow through guided problems.

AI-assisted writing tools are increasingly recognized as cognitive partners that provide information, promote higher-order thinking skills (HOTS), and support metacognitive development. These tools are designed to facilitate complex learning processes. These include analysis, evaluation, synthesis, and reflection. Recent studies have confirmed the expanding role of artificial intelligence in enhancing instructional practices aimed at developing these cognitive skills (Chang et al., 2023; Elim, 2024; Ersoy et al., 2024; Muthmainnah et al., 2023). As a result, AI contributes to educational practices by offering adaptive, personalized, and engaging instructional experiences. Collectively, these advancements foster a more comprehensive understanding and critical analysis of higher-order cognitive processes.

The integration of artificial intelligence in educational contexts, particularly in writing, closely aligns with Vygotsky's theory of scaffolding. This theory posits that effective learning occurs when students receive structured support that enables them to acquire knowledge beyond their current abilities (Vygotsky, 1978). Through collaborative writing activities with AI tools, students transition from relying on external guidance to becoming self-regulated writers (Song & Song, 2023). Such scaffolding provides learners with real-time feedback and allows them to progress at their own pace, thereby enhancing both motivation and skill development. Ultimately, AI-assisted writing tools serve as virtual scaffolds that support learners within their Zone of Proximal Development, facilitating the gradual internalization of writing skills and the development of autonomous learning.

From a practical perspective, integrating AI-assisted writing tools as a supplementary writing mentor is a powerful way to enhance students' engagement, argumentation skills, and problem-solving habits. AI tools cannot replace educators; instead, they serve as always-on, accessible mentors (Kohnke, Moorhouse, & Zou, 2023). In focusing on academic and persuasive writing, artificial intelligence can strengthen critical thinking and guide students through complex writing processes, including argument development and both textual and contextual revision. These partnerships enable educators to focus more on fostering deep comprehension, mentoring, and identifying students' unique needs.

Global studies on AI-assisted writing often emphasize technology, learning outcomes, and system-level efficiencies, with a focus on population-level outcomes and quantitative or mixed-methods research. This study instead provides a learner-centered, qualitative account of how students interpret and negotiate AI feedback through recursive cognitive processes such as argumentation and problem-solving, a perspective less visible in the broader literature (Alaqad, Al-Saggaf, & Ingilan, 2026). The key finding is that AI tools function as both corrective agents and cognitive mediators, supporting planning, evaluation, and revision in academic writing. Thus, this study expands theoretical debates beyond performance enhancement toward deeper processual engagement with AI. In the Indonesian policy context, where ethical, responsible, and pedagogically grounded technology use is prioritized, these findings align with frameworks supporting balanced AI adoption (Kemendiktisaintek, 2025). Overall, the context-sensitive results stress the need for guided, reflective AI use that aligns with Indonesia's goals for critical thinking, academic integrity, and autonomous learning, rather than

seeing AI as a replacement for instruction (Wakerkwa, Pertiwi, & Indriyani, 2023).

The recent study highlights students' experiences with AI-assisted writing tools and examines their impact on argumentative and problem-solving skills in writing instruction. However, the study has limitations: small sample sizes and a qualitative focus may restrict generalizability. Future research could use quantitative or mixed-method approaches to assess improvements in students' skills before and after using artificial intelligence. Additionally, a longitudinal study is suggested to examine the role of artificial intelligence in fostering critical thinking beyond writing instruction.

Conclusion

This qualitative exploratory study investigated perceptions of how AI-assisted writing tools influence students' argumentative and problem-solving practices in academic writing. Regarding the first research question, AI tools influence students' approach to argumentation by shifting their focus from surface-level editing to the structural integrity of their claims, specifically helping them identify logical fallacies and contradictory reasoning. For the second research question, the problem-solving strategies that emerged involved an iterative process in which students used AI feedback as a cognitive scaffold to identify rhetorical weaknesses and reconsider alternative perspectives.

Students reported that features such as immediate feedback, relevance checking, and argument structuring enhanced the visibility of reasoning and coherence during the writing process. As one participant stated, *"several key features, including the ability to flag unclear arguments, identify contradictory thinking, and make suggestions for improving argument structure. All of these help me develop the ability to construct strong arguments" (Student 1).* The evidence indicates that AI tools can support students' engagement with argumentative reasoning when applied critically and reflectively, with attention to logical structure and to the evaluation of evidence.

These findings require cautious interpretation. The perceived benefits reported by participants reflect context-specific experiences within a qualitative framework and do not indicate a universal causal effect of AI-assisted writing tools on writing proficiency. Instead of definitely improving critical thinking, AI tools appeared to enhance students' awareness of their writing decisions. This support enabled students to identify weaknesses, reconsider alternatives, and refine arguments through iterative revision. Such a process-oriented role is consistent with broader discussions of AI as cognitive scaffolding rather than as a substitute for human reasoning.

AI-assisted writing tools can serve as supplementary supports in writing instruction when integrated into structured learning environments. For educators, this underscores the need to explicitly teach students to critically evaluate and selectively use AI-generated feedback, thereby promoting digital literacy and upholding academic integrity. In the absence of such guidance, the risk of overreliance and uncritical acceptance of AI-generated content, a concern frequently highlighted in current debates on AI in education, persists. For students, responsible engagement with AI-assisted writing tools involves using these technologies as resources for learning and reflection, rather than as shortcuts for content production, thereby fostering autonomy and sustained involvement in the writing process.

Several directions for future research emerge from this study. Due to the qualitative and exploratory design of the current investigation, subsequent studies using fixed-method or longitudinal approaches are necessary to assess how sustained, pedagogically mediated use of AI-assisted writing tools affects the development of argumentative reasoning, problem-solving, and self-regulated learning over time. Additionally, comparative research across institutional contexts, proficiency levels, and instructional designs could provide a more nuanced understanding of the relationship

between AI-assisted writing and broader concerns such as academic integrity, digital competence, and autonomous learning in higher education.

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Conflict of Interest Statement

The authors state that there is no conflict of interest in the research, writing, or publication of this article. The entire research process, from data collection to thematic analysis, is carried out objectively and independently by the research team.

AI Disclosure

In preparing this study, Artificial Intelligence (AI) technology was used as a tool to support the thinking and writing processes. Research participants used tools such as Grammarly, ChatGPT, and QuillBot as cognitive scaffolding to identify writing problems, structure arguments, and improve metacognitive awareness. The researcher ensures that the use of AI tools in the data analysis and writing of this report is carried out critically and reflectively, where the final decision and human reasoning remain the full responsibility of the author to maintain the academic integrity and authenticity of the thoughts.

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