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Developing Critical Thinkers: Integrating Inquiry with BMKII in Scientific Writing

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Abstract

This research is significant because critical thinking and scientific writing abilities are crucial for student success. The study aims to investigate the impact of using BMKII instructional materials on students' critical thinking skills in scientific writing. The research methodology involves quantitative analysis (pretest and posttest) and qualitative methods (semi-structured interviews and reflective journals). Findings indicate a significant improvement in scientific writing skills post-intervention, with the average posttest score (78.72) significantly higher than the pretest score (53.36), supported by Paired Samples T-Test statistical analysis. Interviews and reflective journals provide insights into students' perceptions of the inquiry-based approach to scientific writing, a crucial stage in BMKII. Triangulation of quantitative and qualitative findings strengthens the conclusion regarding the effectiveness of BMKII. The study suggests practical implications for instructors and acknowledges limitations, such as instructor readiness and strategies for effective research-based learning implementation. Additionally, the article outlines the stages of critical thinking involved in scientific writing, emphasizing that each stage demonstrates critical thinking abilities. This research presents strong evidence that the use of BMKII contributes to enhancing students' critical thinking skills in scientific writing and preparing students to meet the demands of the 21st-century.

Keywords Scientific Writing; Inquiry-Based; BAMKII; Writing Instruction; Critical Thinking

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1. INTRODUCTION

In the 21st century, critical thinking ability has emerged as a pivotal and essential topic (Greenhill, 2015; Changwong et al., 2018; Binkley et al., 2015; Rainie & Anderson, 2017). This topic has evolved into a higher-order cognitive skill (Sahin & Dogantay, 2018)) and has become an essential requirement for human endeavors in independent decision-making (Epçaçan, 2019). As a high-level skill, critical thinking is a reflective way of thinking that makes sense or is based on reasoning focused on determining what to believe and do (Escobar (2017). Education aims to nurture thinking, and critical thinking skills are crucial for assessing and selecting accurate information (Harsiati et al., 2019). A foundational understanding of critical thinking skills in higher education facilitates students in

enhancing their abilities and adapting to future learning endeavors (Marni et al., 2019). These skills are paramount for evaluating information sources and selecting relevant data. Consequently, high-level thinking skills become essential components in science and technology (Mahanal & Zubaidah, 2017), enabling the testing of significance between predictions and expected outcomes (Zakaria et al., 2021)

Critical thinking skills can be developed by examining the problem in depth. Critical thinkers will analyze, evaluate, and refine their thoughts on everything encountered (Sari et al., 2019). There is a report stating that Learning that is constructed through problem-solving will improve critical thinking skills (Miner-Romanoff et al., 2019 & Harsono et al., 2024), increase the acuity of analysis and interpretation (Zhou, 2018), and improve students' cognitive abilities (Salari et al., 2018). Examining problems increases understanding, improves thinking logically and analytically, and makes wiser decisions (Seibert, 2021). This understanding is rooted in the experiences and reflections contained in the inquiry approach. Inquiry pedagogy contains big questions described as problems, projects, or challenges (Albion, 2021); even inquiry-based pedagogy has better results than other approaches (Madhuri et al., 2012). ÖZCAN et al. (2017) stated that problem-solving and inquiry have a positive and significant relationship.

Critical thinking and inquiry are two things that often go together when solving problems in Learning. The inquiry process provides opportunities for learners to develop and apply critical thinking skills. Inquiry-based Learning can facilitate the learning process of students learning to think critically and develop critical awareness (Cookson & Stirk, 2019). The presentation of these arguments can be used as a basis for changing the paradigm from transferring knowledge content to critical thinking (Gholam, 2019). A paradigm shift can be made because inquiry becomes a learner-centered learning approach with active involvement (Shanmugavelu et al., 2020). The involvement of learners in the discovery process is an effective pedagogical form of higher education (Serekoane et al., 2022).

While prior research emphasizes critical thinking and inquiry in education, the specific impact of inquiry-based academic writing on developing students' critical thinking skills in higher education remains unclear. Existing literature lacks a comprehensive exploration of its contributions and global implications. This study addresses this gap by presenting in-depth findings to broaden our understanding of the significance and practicalities of applying inquiry in academic writing.

This study promotes an inquiry-based approach in academic writing to strengthen students' critical thinking. It emphasizes integrating inquiry throughout the writing process, from planning to editing, fostering technical writing skills and deeper critical thinking. The research goes beyond improving writing quality, highlighting how each inquiry-driven stage contributes to students' intellectual growth. It underscores the value of inquiry-based academic writing in fostering critical thinking skills, potentially leading to new theoretical and practical understandings in educational contexts.

Writing scientific papers effectively enhances critical thinking skills (Harsono et al., 2022). The writing process requires applying critical thinking skills and plays a crucial role in developing an individual's critical thinking abilities (Zhan, 2021 & Malmarugan, 2022). Engaging in the process of writing scientific papers can significantly improve one's critical thinking abilities (Bereiter & Scardamalia, 2014). Dostál (2015) suggests that critical thinking is an integral part of problem-solving skills that can be developed through writing, utilizing knowledge and facts. Throughout the writing process, authors are challenged to analyze and solve problems (Khairuddin et al., 2022). Critical thinking can be manifestations in the writer's argumentative expressions (Tahira & Haider, 2019), reflecting the cognitive processes and thinking undertaken by the writer (Q. K. Fu et al., 2019). Critical thinking skills not only influence the process and outcomes of writing but also serve as an indication of students' depth of thinking (H. Fu & Wang, 2021). Bing (2022) reinforces that critical thinking skills can be applied in the pre-writing stage, during writing, and in providing feedback during writing.

The application of inquiry in writing scientific papers has been recognized as a basis for forming students into critical thinkers. Research conducted by experts in the context of inquiry in writing,

especially in scientific work, highlights its essential role. The results of Wale & Bishaw (2020) research in the context of the influence of inquiry-based Learning on EFL (English as a Foreign Language) students' critical thinking skills also provide a meaningful picture. In this research, it was found that the application of the inquiry method significantly improved students' critical thinking abilities. Meanwhile, in separate research conducted by Wale and Bogale (2021), inquiry-based writing instruction to improve academic writing skills also showed promising results. The study investigates the effects of inquiry-based writing instruction on students' academic writing skills. Conducted with 62 first-year pharmacy students at Woldia University, Ethiopia, it employs a pretest-posttest quasi-experimental design. The experimental group received inquiry-based writing instruction, while the control group learned via conventional methods. Data from tests, focus group discussions, and reflective journals indicate significant improvements in the experimental group's academic writing skills, emphasizing task achievement, coherence, cohesion, lexical resource, grammatical range, and accuracy. The study advocates adopting inquiry-based writing instruction in academic settings to enhance writing skills.

The implementation of BAMKII products in scientific paper writing represents a significant innovation in the field of education. This instructional material embodies comprehensive integration into every writing process, marking a breakthrough in the learning paradigm. This approach not only shapes students' writing skills but also fosters the profound development of critical thinking abilities. Students' roles transition from mere information consumers to active agents engaged in inquiry, analysis, and forming evidence-based solid arguments. With the inquiry phases embedded within BAMKII and applied in every stage of writing, this research lays a solid foundation for enhancing the quality of scientific writing. It addresses technical aspects of writing and fosters a vital harmony between skilled writing processes and increasingly mature critical thinking skills. The uniqueness of this research lies not only in enhancing writing quality but also in how each writing step, driven by the inquiry phase, contributes to comprehensive intellectual growth in students, making the integration of inquiry into scientific paper writing not only a new learning method but also a revolution and perspective on the learning process that impacts the advancement of critical, analytical, and even students' creativity in the academic realm.

2. METHODS

This research examines the impact of using inquiry-based instructional materials, known as BAMKII (Inquiry-Based Scientific Paper Writing Instructional Material), on students' critical thinking abilities in scientific writing. An explanatory-sequential approach that combines quantitative and qualitative methods is employed to achieve this objective (Creswell & Clark, 2017). The pre-experimental design of a one-group pre-test-post-test is chosen to measure changes in students' scientific writing abilities after participating in inquiry-based Learning (Fraenkel, Wallen, & Hyun, 2021). A phenomenological method is also applied to understand students' experiences using BAMKII instructional materials for scientific writing. The subjects of this study are 25 undergraduate students majoring in Mathematics Education at Madura University and taking the mandatory curriculum course (MKWK) in Bahasa Indonesia. Data collection is conducted over 8 weeks. Pretests and posttests in the form of scientific writing tests are used as quantitative data collection methods, while semi-structured interviews with selected students from low, medium, and high achievement levels are used as qualitative data collection methods. Additional data is obtained through student reflection journals. Quantitative data analysis compares pretest and posttest results using paired t-tests (Fraenkel, Wallen, & Hyun, 2021). Qualitative data analysis will utilize thematic and content analysis to identify themes, patterns, categories, and subcategories emerging from interview results and reflection journals).

3. FINDINGS AND DISCUSSIONS

This study demonstrates a significant improvement in the academic writing scores of Mathematics Education students who took the mandatory Indonesian Language course curriculum after utilizing the Inquiry-Based Scientific Writing Teaching Materials (BAMKII). Using BAMKII, students engage in an inquiry process involving exploration, research, and analysis in academic writing. The findings of this research provide evidence that the inquiry-based learning approach within BAMKII effectively enhances students' academic writing skills.

Quantitative Findings

Following the learning process utilizing inquiry-based teaching materials for academic writing in the Indonesian Language course within the Mathematics Education program, students in the class have produced papers as tangible evidence of their Learning. These papers were assessed using the scoring scale indicated in Figure 2 below. The research findings indicate a significant improvement in academic writing test scores following the intervention with BAMKII, with an average pretest score of 53.36 and an increased average posttest score of 78.72.2.

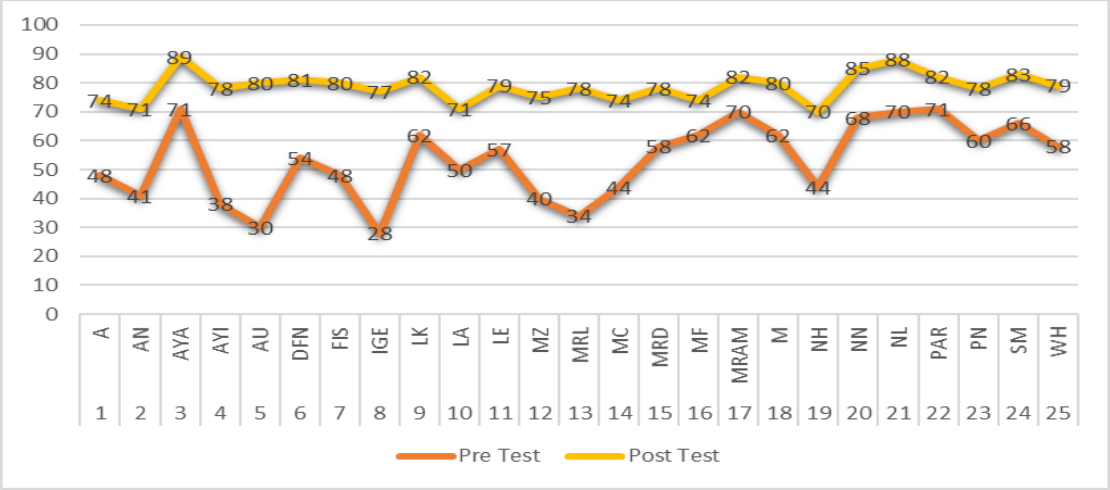

Figure 1. Ability to Write Scientific Papers with BAMKII

From the data above, it can be concluded that there is an increase in learning outcomes for writing papers in the Mathematics Education study program classes using inquiry-based scientific writing teaching materials. The data normality test was carried out using the One-Sample Kolmogorov-Smirnov Test to find out whether the data distribution is normally distributed so that it could determine the different test techniques to be used. The results of the normality of the data from writing scientific papers using teaching materials for writing inquiry-based papers are presented as follows.

Table 1. Normality Test Results

One-Sample Kolmogorov-Smirnov Test			
		Pre_Test	**Post_Test**
N		25	25
Normal Parameters[a,b]	Mean	53.36	78.72
	Std. Deviation	13.307	4.886
Most Extreme Differences	Absolute	.128	.121
	Positive	.092	.091
	Negative	-.128	-.121

Test Statistic	.128	.121
Asymp. Sig. (2-tailed)	.200[c,d]	.200[c,d]

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. This is a lower bound of the true significance.

Table 1 above presents the results of the normality test. If the significance value is > 0.05, then the data are normally distributed; if the significance value is < 0.05, then the data are not normally distributed. The results above indicate a significance value of 0.200, meaning significance > 0.05. Thus, it can be concluded that the data distribution in this study is expected.

The normality test above shows that the pretest and posttest data have a normal distribution. That is, testing the effectiveness of the data can use a different sample paired test (Paired Sample T-Test). The results of the different tests on the value of writing inquiry-based scientific papers can be seen in the following table 2.

Table 2. Paired Samples Statistics

		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
Pair 1	Pre_Test	53.36	25	13.307	2.661
	Post_Test	78.72	25	4.886	.977

The paired sample statistics in Table 4 above indicate that the mean score of the pretest is 53.36, while the mean score of the posttest is 78.72. This shows a difference in the mean scores between the posttest and pretest, or the scores before and after. N indicates the number of participants, which is 25. The standard deviation indicates that the standard deviation of the pretest scores is 13.307, and the standard deviation of the posttest scores is 4.886. The correlation between the pretest and posttest is depicted as follows.

Table 3. Paired Samples Correlations

		N	**Correlation**	**Sig.**
Pair 1	Pre_Test & Post_Test	25	.604	.001

Table 3 above shows the correlation test or the relationship between the two data, indicating that they are correlated or associated with 0.604 with a significance of 0.001, meaning it is highly significant.

Table 4 below presents the results of the paired samples test, which assesses the significance of differences between two related groups or conditions. This analysis focuses on evaluating whether there are any changes or differences between pretest and posttest scores within the same group of participants. Paired differences depict the variation between scores obtained before and after an intervention or treatment.

Table 4. Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre_Test - Post_Test	-25.360	11.064	2.213	-29.927	-20.793	-11.461	24	.000

Table 4 above is utilized to ascertain whether the hypothesis in the study is accepted, namely, whether there is a significant difference between pretest and posttest scores. The assumption is that if the significance value is < 0.05, then the hypothesis is accepted or a difference occurs, whereas if the significance value is > 0.05, then the hypothesis is rejected or no difference occurs. In the second table, paired sample statistics indicate that the mean score of the posttest> the mean score of the pretest, namely 78.72 > 53.36, indicating a difference. However, the proof lies in examining the significance value, as explained earlier.

The analysis results in the table above show a significance value of 0.000, which means the significance value is < 0.05. Therefore, it can be concluded that the hypothesis is accepted, indicating a significant difference in students' mean scores on the pretest and posttest in writing inquiry-based scientific papers.

Qualitative Findings

The interviews and journal reflections in this study were conducted with six students of varying levels of success, with each group (low, medium, and high) comprising three students each. Initials identified each student: AN and NH for the low group, MRL and MC for the medium group; and AYA and SM for the high group. The interviews and journal reflections results include the ability to write scientific papers using an inquiry-based approach that enhances students' critical thinking skills. The interview results are presented as follows.

The Ability to Write Scientific Papers

a. Essence of Scientific Works

In academic discourse, the essence of scholarly work results from a systematic and accurate investigative process supported by strong empirical evidence. Respondents assert that scholarly work is not merely a string of words but a representation of well-structured intellectual endeavors. They emphasize the importance of data validity and authenticity as critical elements in upholding the integrity of scholarly work while acknowledging its valuable contribution to advancing understanding and knowledge across various fields of study. By upholding research ethics and adhering to applicable academic norms, scholarly work can broaden the horizons of human knowledge and provide a solid foundation for scientific development. The interviews conducted in March-April 2023 with Mathematics Education students who used BAMKII in their mandatory Indonesian Language curriculum revealed the following insights regarding the essence of scholarly work and the importance of maintaining data validity and adherence to research ethics in writing scientific papers.

"In my view, the essence of scholarly work is the result of thorough and structured investigation aimed at expanding knowledge in a specific field." (AYA)

"Scholarly work is not just documentation of research findings but also a reflection of dedication and commitment to maintaining the accuracy and integrity of data."(SM)

"When writing scholarly work, it is important to prioritize data validity and compliance with research ethics principles, which provide a solid foundation for the arguments presented." (MRL)

"In addition, scholarly work also serves as a means to share knowledge and understanding with the scientific community, stimulating new questions and fostering deeper discussions."(MC)

"In essence, scholarly work represents honorable and responsible intellectual efforts, involving meticulous research processes and accurate writing." (AN)

"The contribution of scholarly work to the development of science is invaluable, as it broadens human insight and helps solve challenges faced by society." (NH)

b. The Difference between Scientific Papers: Papers and Non-Papers

In understanding the distinction between papers and non-papers, it is crucial to recognize that their research approach and writing objectives differ. Papers focus more on empirical data and structured research methods, whereas non-papers provide more room for exploring conceptual ideas and creative concepts. Below are responses from interviews with students after using the BAMKII to distinguish between scholarly works of paper and non-papers.

"I write papers with a greater focus on data and facts, whereas non-papers are more about ideas and concepts." (AYA)

"In writing papers, I have to adhere to a predefined structure, while non-papers give me more freedom." (SM)

"I employ research methods in papers, whereas non-papers are more about thinking and ideation." (MRL)

"I write papers intending to present empirical findings, whereas non-papers are more for creative thinking." (AN)

"In papers, I often cite research and data, whereas non-papers more frequently cite theories or opinions." (NH)

c. Planning to Write a Scientific Paper

Planning is the crucial initial stage in the writing process, allowing the writer to organize ideas and information in a structured manner before beginning to write. Below are the results of interviews with students about their understanding of planning after using BAMKII.

"I start by creating a list of steps I need to take before starting to write the paper." (AYA)

"In planning, I set a schedule for each writing stage so that I can manage my time efficiently."(SM)

"I create an outline by organizing the main points I want to discuss in the paper." (MRL)

"When planning, I determine the main message I want to convey to the reader to keep my writing focused." (MC)

"I also compile a list of reference sources that I will use in the paper." (AN)

"In planning, I determine how the overall structure of my paper will be arranged." NH)

d. Structuring a Paper Framework

In structuring the paper framework, students have laid a strong foundation for developing their scholarly work. Through careful planning, students have successfully created a well-organized framework, arranging main ideas and formulating the writing flow systematically. The outcomes of this stage provide a solid basis for the entire paper writing process by ensuring that each section has its appropriate place and is supported coherently, as reflected in the interview results below.

"I began by creating a basic framework for my paper, determining how the overall structure would

appear." (AYA)

"In structuring the framework, I decided how each section would be organized, including the introduction, discussion, and conclusion." (SM)

"I established the main points I wanted to address in each section of the paper to ensure that my writing was well-organized." (MRL)

"While structuring the framework, I also determined how I would arrange arguments and present information logically." (MC)

"I paid attention to the logical flow from one section to another within the paper framework to ensure coherence and continuity of the writing." (AN)

"In structuring the framework, I also considered how to integrate evidence and quotations into the text." (NH)

e. Developing Ideas and Paragraph Clusters

Developing ideas and organizing paragraph clusters are crucial aspects of ensuring smooth flow and clarity of arguments in a written work. Through careful efforts, students develop detailed main ideas and organize them into well-structured paragraph clusters. During interview sessions, students stated that the development of ideas and organization of paragraph clusters had been done effectively, as evidenced by the following responses.

"I start by identifying the main ideas I want to convey in my paper." (AYA)

"In developing ideas, I write down key points that I want to elaborate on in each section of the paper." (SM)

"I ensure each idea has its paragraph and is logically grouped within the appropriate section." (MRL)

"When developing ideas, I structure paragraphs starting with a main statement at the beginning, followed by further support and explanation." (MC)

"I pay attention to the logical flow between each paragraph to ensure coherence and continuity in my writing." (AN)

"In developing ideas, I also consider the need to provide evidence or quotes that support each statement I make." (NH)

f. Processing Quotations and Bibliography

Processing citations and compiling a bibliography are crucial steps in ensuring the accuracy and credibility of a written work. Through this stage, the author meticulously includes relevant quotations that support arguments and formulates a comprehensive and accurate bibliography following applicable academic writing rules. Here is an overview of what students have done in processing citations and compiling a bibliography.

"I start by noting down important quotes and relevant information from the sources I read." (AYA)

"In processing citations, I ensure to accurately record source details, including author names, titles, and publication years."(SM)

"I organize the quotes and information I gather according to the topics and subtopics I have predetermined." (MRL)
"When processing quotes, I evaluate the success of each quote in supporting the arguments and ideas I present."(MC)

"I ensure that each quote is accompanied by an explanation or brief analysis that elucidates its relevance to the topic being discussed."(AN)

"In compiling the bibliography, I use the desired writing style, such as APA, and ensure the accuracy of every reference detail." (NH)

g. Paper Editing

In the editing stage of the paper, efforts to refine and enhance the quality of writing become crucial in the paper-writing process. Through meticulous editing, students successfully identify and correct grammatical and writing mistakes and clarify the structure and smoothness of the flow of ideas in their writing. This is reflected in the following student responses.

"I begin by rereading my paper as a whole to identify grammatical errors and language usage." (AYA)
"During the editing process, I review the paper's structure to ensure coherence and clarity in the flow of ideas." (SM)

"I pay attention to the use of appropriate words and ensure that readers easily understand my sentences." (MRL)

"While editing, I also focus on the use of quotations and references, ensuring that each source is cited correctly and consistently." (MC)

"I refine transitional sentences between paragraphs to ensure a smooth and cohesive flow of thought." (AN)

"In the editing process, I remove or rework sections that are less relevant or overly redundant in the paper." (NH)

The reflection journal explores the role of inquiry in enhancing students' critical thinking skills in academic writing. Through the reflection process, students gain profound insights into the importance of the inquiry approach in fostering in-depth analysis and strong arguments.

Table 5. Reflection Journal

Date	Experiences and Reflections
March 28, 2023	*The orientation stage in the inquiry process helps us better understand our research topic and contributes to the existing literature on the topic. These essential ideas help us write scientific papers, especially papers. The conclusion of my research results from the critical assessment I have conducted.*
April 04, 2023	*Creating straightforward questions or problems helps me critically assess various essential things in scientific work.*
April 11, 2023	*By making initial guesses, I become more interested in understanding what I am researching more deeply. This encourages me to think more complicatedly and conduct deeper analysis in my scientific writing.*
May 2, 2023	*When I analyze data, I understand more about the information I have. This allows me to explain my research findings clearly and objectively.*
May 9, 2023	*The conclusions of my research are the result of the critical assessment I carried out.*

The purpose of this study was to investigate whether the use of BAMKII teaching materials affects students' critical thinking skills. The results showed a difference between students' abilities before and after using the teaching materials. This difference was identified through analysis of scientific writing by utilizing all phases of inquiry at various stages of scientific writing and semi-structured interviews. This finding indicates that BAMKII teaching materials effectively improve critical thinking skills.

The main findings of this study significantly support the initial hypothesis of this research, which aimed to investigate the impact of using BAMKII teaching materials on students' critical thinking skills. Through careful data analysis, it has been found that using these teaching materials positively influences the development of critical thinking skills, in line with the research questions.

This study calculated a corrected average to compare the results of writing scientific papers before and after using inquiry-based scientific writing teaching materials. The calculations show that the average learning outcomes for writing paper-type works after using these teaching materials are higher. The average learning outcome before using teaching materials is 53.36, whereas after using teaching materials, the average learning outcome increases to 78.72.

The successful application of inquiry-based scientific writing teaching materials can be seen in the results of scientific papers. The results of the analysis show that the statistical test of different learning outcomes in writing papers before and after using inquiry-based paper writing teaching materials obtained t = -11.461 with a significance value of 0.0000 less than 0.05, so it can be concluded that there is a significant difference in the score of learning outcomes in inquiry-based scientific writing before and after treatment. The mean (mean) posttest is greater than the pretest, with a mean difference of -25,360. The average (mean) posttest is 78.72 with an SD of 4,886, while the mean pretest is 53.36 with an SD of 13,307. So, it can be concluded that there is an increase in student scores in Indonesian language courses after using teaching materials to write scientific inquiry-based works.

These results are in line with those carried out by Wale and Bishaw (2020) in their article on the Effects of using inquiry-based Learning on EFL students' critical thinking skills. Students involved in teaching through inquiry instruction experience a significant increase in aspects of academic writing. Students can develop better writing skills and produce higher-quality written work using this approach. Our research findings aligning with theirs further strengthen the conclusion that this instructional approach consistently enhances aspects of academic writing and students' critical thinking skills. This confirms that writing process skills are emphasized in the product approach and tasks given and following the context (Thulasi et al., 2014).

Writing scientific papers using an inquiry approach can significantly improve one's critical thinking ability. Inquiry-based Learning has improved students' critical thinking skills, including searching, collecting, analyzing, synthesizing, and evaluating data, creating ideas, solving problems, and interpreting, analyzing, evaluating, and self-regulating (Sutiani et al., 2021). Inquiry-based writing instructions can improve critical thinking skills that involve searching, collecting, analyzing, synthesizing, and evaluating data (Wale & Bogale, 2021). Inquiry learning enables active involvement and the use of critical thinking skills to solve problems in scientific writing (Sahoo & Mohammed, 2018) by looking at various points of view and scientific solutions (McDowell, 2023). Teaching inquiry-based writing improves the ability to write academically, critical thinking skills, engagement, problem-solving, and enthusiasm for lifelong Learning (Lin, V. et al., 2023)

In particular, Smith (2017) reveals that inquiry-based writing instruction positively influences students' English learning because the process of inquiry and self-discovery is an essential part of educational endeavors. Therefore, students need investigative strategies and experiences that help them write influential texts. Likewise, a study conducted to assess student feedback on the effectiveness of inquiry-based Learning in second-language pedagogy demonstrated that this method developed students' understanding of the material (Lee, 2014). Inquiry-based writing can improve students' writing skills and positively impact their academic writing skills (Ulfah, 2012). In the context of our research, our results strengthen the understanding that Learning that encourages students to ask questions, conduct analysis, and draw conclusions through inquiry processes can be a strong foundation for developing students' writing and critical thinking skills. Thus, our research contribution confirms previous findings and broadens the understanding of the importance of implementing inquiry-based approaches in a wider language learning context.

In this study, we found that using BAMKII-based teaching materials significantly enhances students' critical thinking skills, consistent with findings previously elucidated in a study by Escalante. Escalante (2014) also found that inquiry-based Learning positively impacts language skills in general and the writing skills of EFL students in particular. Inquiry-based writing instruction has a positive impact on students' academic writing skills. Therefore, our research findings provide an additional contribution to support the conclusion that inquiry-based learning approaches consistently positively impact the development of students' critical thinking skills, particularly in scientific writing. The implications of these findings become increasingly relevant in addressing the demands of Learning that are more oriented towards developing critical thinking skills across various subjects.

Related to the mentioned findings, particularly regarding how students engaging in inquiry-based instruction may perceive themselves as academic writers learning the process of posing and answering questions and connecting academic writing with everyday issues (Godbee, 2016). Moreover, the importance of cultivating critical, evaluative, and creative thinking habits in problem-solving learning (Gholami et al., 2016). this aligns with the findings of our study. Using BAMKII-based teaching materials, this approach not only assists students in enhancing critical thinking skills but also enables them to develop an identity as academic writers capable of linking scientific writing with real-life issues. Thus, emphasizing inquiry-based Learning in scientific writing enriches students' understanding of the writing process while also aiding them in developing critical and evaluative thinking skills crucial to the learning process.

The interviews conducted in March-April 2023 with Mathematics Education students who used BAMKII in their mandatory Indonesian Language curriculum revealed that BAMKII appeared to have significantly improved students' critical thinking skills, as evidenced by the responses provided. Students emphasized that scholarly work involves a systematic and thorough investigation, prioritizes data validity and research ethics, and serves to share knowledge and stimulate discussions within the scientific community. Developing ideas, organizing paragraph clusters, processing quotations, and editing papers were also highlighted as essential aspects of scholarly writing. Overall, the interviews suggest that BAMKII has enhanced students' critical thinking skills in academic writing. Critical thinking skills are essential in scholarly work and systematic investigation. Data validity is crucial in research ethics and knowledge sharing within the scientific community. Developing ideas and organization of paragraph clusters require high critical thinking and systematic investigation. Processing quotations and editing papers are integral parts of academic writing that uphold research ethics (Ali & Ulker, 2020). Scientific writing contributes to knowledge sharing and the advancement of ideas within the scientific community (Yuliarti et al., 2023). BAMKII has been found to enhance students' critical thinking skills, as evidenced by their reflections. During the orientation stage of the inquiry process, students gain a deeper understanding of their research topic and contribute to the existing literature. Formulating straightforward questions or problems helps them critically evaluate essential aspects of scientific work. By making initial predictions, their interest in understanding the research topic increases, leading to more complex thinking and deeper analysis in scientific writing. When analyzing data, they gain a better understanding of the information they have, enabling them to explain their research findings clearly and objectively. The conclusions of their research are the result of their critical assessment.

Although inquiry-based scientific writing instructional materials have significant benefits in making students active and capable of problem-solving, fostering learning autonomy, and even lifelong Learning, several limitations must be considered. In theory, instruction on inquiry-based scientific writing materials maximizes engagement and allows students to find meaning and purpose in their Learning. However, this does not always hold in practice, as readiness is required to maximize learner engagement and save time (Demircioglu & Ucar, 2015; Awada et al., 2020). In inquiry-based Learning, students are required to become active participants; however, learners who are not fast thinkers when processing problems will be left behind. Additionally, unprepared instructors cannot adequately

prepare themselves, interfering with their ability to engage learners meaningfully. Therefore, instructors need to pay attention to these challenges and develop appropriate strategies to ensure the effectiveness of implementing inquiry-based Learning in the classroom. Instructors can develop collaboration strategies. Collaborative work allows students to solve problems with their peers while constructing knowledge and improving their performance during activities, leading to positive attitudes (Rohaeti, 2020). Compared to individual Learning, Collaborative Learning supports students' comprehension skills, fosters participation in the learning process, creative problem-solving skills, socialization, and language development ((Tomcho & Foels, 2020).

4. CONCLUSION

Teaching materials for writing inquiry-based scientific papers (BAMKII) enhance critical thinking and scientific writing skills more effectively than direct instruction methods such as existing teaching materials. Utilizing this instructional material can address issues in learning related to students' low proficiency in critical thinking and scientific writing. Through the stages of BAMKII, students are provided with a fundamental understanding of the close relationship between critical thinking skills and academic writing, distinguishing between papers and non-papers, designing academic writing, structuring paper frameworks, developing ideas, managing citations and editing, all of which are traversed through the processes of orientation, problem formulation, hypothesis generation, data collection, analysis, and conclusion. This facilitates students to synthesize knowledge, arguments, ideas, and developments and express them in academic work. Students must diligently undergo the preceding stages to utilize BAMKII effectively. The implications of this research include BAMKII 's ability to facilitate adult learning and prepare 21st-century students in critical thinking, problem-solving, collaboration, and communication skills. BAMKII trains students to conduct research, critically develop their thoughts and ideas, and communicate them through scholarly writing. BAMKII can enhance critical thinking and scientific writing, thus recommending its adoption. The challenge for further research is to integrate technology to enhance interactivity, accessibility, and effectiveness of Learning and investigate cultural values influencing how students understand and apply critical thinking concepts in scientific writing.

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