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The Influence Of AI Literacy On Teacher Performance Through Critical Thinking: A Case Study In Rural Schools, Indonesia

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Abstract— This study aims to examine the effect of artificial intelligence (AI) literacy on teacher performance, with critical thinking as a mediating factor, among private Vocational High School (SMK) teachers in rural Sukabumi Regency, Indonesia. AI literacy is regarded as an essential skill for navigating technological advances in education, yet its effectiveness in enhancing teacher performance requires reinforcement through cognitive competencies such as critical thinking. Employing a quantitative approach with a census of 82 teachers and analyzed using Structural Equation Modeling Partial Least Squares (SEM-PLS), the results indicate that AI literacy does not have a significant direct effect on teacher performance but does have a positive impact on critical thinking. These findings underscore that technological proficiency alone is insufficient without deep critical thinking skills in its application. This study offers practical implications for designing teacher training programs that integrate both technological and cognitive-reflective components to improve educational quality in rural areas.

Keywords— AI literacy, critical thinking, teacher performance, rural education, vocational high school (SMK)

I. INTRODUCTION

Teacher performance in Indonesia especially in rural areas such as Sukabumi Regency faces unique challenges and dynamics. Private schools in these regions often contend with limited facilities and infrastructure, lack of professional support, and low teacher welfare. Nevertheless, instructional quality remains the key factor in creating effective and meaningful learning for students. Teacher performance which encompasses classroom management, curriculum development, and pedagogical innovation directly influences student outcomes [1]. In rural private schools, constraints such as limited access to professional training and technological resources can significantly affect teacher performance, often making it difficult for educators to adopt more modern,

technology-based teaching methods [2]. Therefore, enhancing teacher performance through the development of educational technology skills and competencies such as AI literacy is critically important [3].

Advances in technology, particularly in artificial intelligence (AI), have opened new opportunities in education. AI can provide innovative solutions to support teachers' work, from automating administrative tasks and managing classrooms to developing more personalized learning materials. AI literacy the ability to understand and utilize AI technologies has thus become a highly relevant skill for teachers in the digital era [4].

In Sukabumi Regency, technology use in education remains relatively low, especially in private schools that often lack up-to-date facilities and training. Yet research shows that teachers with strong AI literacy are better able to integrate these technologies into their teaching processes, thereby improving both efficiency and instructional quality [2]. In this context, AI literacy can serve as an effective tool for enhancing teacher performance in rural private schools by providing solutions to improve teaching effectiveness and classroom management. Moreover, increasing teachers' technology literacy can reduce administrative burdens and help them focus more on direct student interaction, thereby raising overall teaching quality and performance [5].

Critical thinking is an essential skill for educators. The ability to analyze, evaluate, and construct logical arguments is crucial for managing classrooms and solving problems that arise during instruction [6]. In AI-enhanced teaching, critical thinking becomes even more important, as teachers must evaluate which AI applications and tools are most suitable for their pedagogy. Critical thinking not only involves cognitive skills but also a reflective approach to the teaching–learning process itself [7]. It acts as a mediating variable linking AI literacy with teacher performance [8]. Teachers who possess AI literacy without strong critical-thinking skills may struggle to select or apply the right technologies in their teaching. Conversely, teachers who can think critically will be more selective in using technology and ensure that it supports broader learning objectives [9], [10].

This study aims to explore how AI literacy influences teacher performance and critical thinking in vocational high school (SMK). By focusing on private schools in Sukabumi Regency, this research is expected to provide new insights into how technology especially AI can be effectively integrated into rural education, and how critical thinking can serve as a crucial factor in optimizing that integration. The findings are intended to inform the development of more inclusive, technology-based educational policies and contribute to improving the quality of rural education in Sukabumi Regency, Indonesia.

The theoretical framework underpinning this study involves three key variables: AI literacy, teacher performance, and critical thinking. These concepts are rooted in distinct but interconnected academic domains, drawing on educational psychology, cognitive science, and technology integration in education [11]. AI literacy refers to understanding AI technologies and their implications in various contexts. In education, AI literacy encompasses knowledge of AI concepts, applications, ethical considerations, and methods for integrating these technologies into teaching practice. According to [12], AI literacy is foundational for preparing educators to navigate an evolving technological landscape in which AI increasingly shapes learning environments. Furthermore, Sellami et al. (2024) argue that technology adoption in the classroom is heavily influenced by teachers' perceptions of their own technological competencies, making AI literacy a critical factor in modern education.

Teacher performance is defined as a teacher's effectiveness in carrying out instructional duties—from lesson planning and content delivery to student assessment and creating a conducive learning environment. [13] emphasize that teacher performance directly correlates with student learning outcomes, making continuous professional development essential for improving teaching quality. [14] add that teacher performance is enhanced through ongoing reflection and adaptation to new pedagogical approaches, including the use of AI technology.

Critical thinking is the active cognitive process of analyzing, synthesizing, and evaluating information to make sound decisions or solve problems. [15] describe critical thinking as the ability to engage in purposeful, reflective thought. In education, critical thinking is recognized as a key competency for both students and teachers. [15] contend that critical thinking is essential for teachers to integrate new technologies effectively, as it enables them to assess the usefulness, ethics, and pedagogical relevance of educational tools [16].

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Although previous studies have examined the individual effects of AI literacy and critical thinking on teacher performance, the integration of these three variables in the context of rural private schools in Sukabumi remains underexplored. This study seeks to fill that gap by investigating how AI literacy affects teacher performance through the mediation of critical thinking, thereby offering valuable insights for policymakers, educators, and stakeholders aiming to enhance educational quality in rural Indonesia.

II. METHODS

The study population comprised all 82 teachers working at four private vocational high schools (SMKs) in Sukabumi Village. Because the population size was limited, a census sampling technique was employed, whereby every member of the population served as a research subject. This approach was chosen to ensure that each teacher could contribute representative data, so that the findings would accurately reflect the actual conditions in the local private-school context.

A quantitative survey design was adopted. Data were collected via a structured questionnaire developed to measure AI literacy, critical thinking skills, and teacher performance. The questionnaire included items assessing teachers' knowledge of and ability to use AI technologies, their critical-thinking capabilities, and their self-perceptions of instructional performance. All items were rated on a Likert scale to enable quantitative analysis.

Data analysis was conducted using Structural Equation Modeling–Partial Least Squares (SEM-PLS), which is well suited for examining complex relationships among latent variables such as AI literacy, critical thinking, and teacher performance. SEM-PLS is also effective with relatively small sample sizes, as in the present study, and can accommodate nonnormal data distributions. The analysis proceeded in two main stages: first, the measurement model was evaluated to ensure indicator reliability and validity; second, the structural model was tested to examine the direct and indirect relationships among variables—especially the mediating role of critical thinking between AI literacy and teacher performance. This research aimed to test four hypotheses concerning the influence of AI literacy on teacher performance mediated by critical thinking among private SMK teachers in Sukabumi Village.

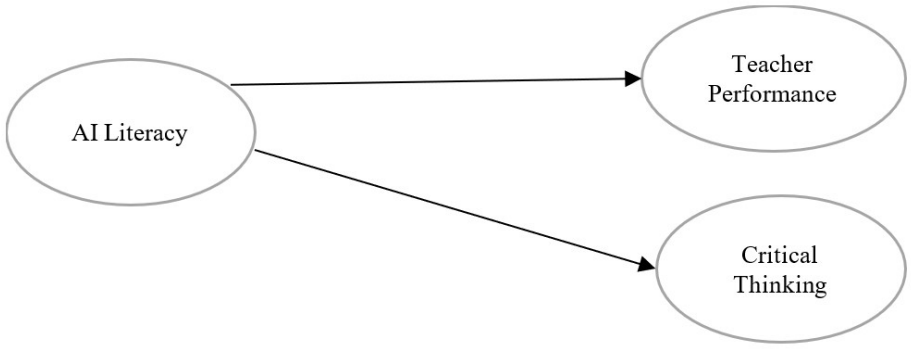

Figure 1. Research Framework

Research Hypotheses:

H_1: AI literacy has a positive effect on teacher performance.

H_2: AI literacy has a positive effect on critical thinking.

All four hypotheses will be tested using a quantitative approach via Structural Equation Modeling with the Partial Least Squares (SEM-PLS) technique, which allows examination of both direct and indirect relationships among the variables.

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III. RESULT AND DISCUSSION

A. Result

The study sample consisted of 82 teachers. Their demographic characteristics are summarized as follows:

Table 1. Demographics of main study sample.

Characteristic	Attribute	Frequency	Percentage
Gender	Female	25	30%
	Male	57	70%
Age (years)	21–30	20	24%
	31–40	36	44%
	41–50	17	21%
	> 50	9	11%
Education	Diploma	45	55%
	Bachelor's degree	33	40%
	Master's degree	3	4%
	Doctoral degree	1	1%
Internet usage	One hour or less per day	18	22%
	Few hours per day (2–3 hrs)	30	37%
	Multiple hours per day (> 3 hrs)	34	41%

Outer loading and AVE tests are essential to ensure that the indicators we use truly reflect their intended constructs and exhibit adequate internal consistency. Outer loading assesses the strength of each item's relationship with its construct; only items with loadings above 0.70 are considered valid because they contribute substantially to the construct's variance. Meanwhile, the Average Variance Extracted (AVE) measures the proportion of indicator variance that the construct itself explains; an AVE of at least 0.50 indicates that more than half of the item variance stems from the construct rather than from measurement error or noise.

Table 2. Measurement models

	Items	Outer Loading	AVE
	AI Literacy		0,768
AI1	I understand the basic concepts and terminology of artificial intelligence (AI).	0,855	
AI2	I can explain how AI algorithms process data to make predictions.	0,824	
AI3	I feel confident using AI-powered tools in teaching.	0,891	
AI4	I can critically evaluate the quality and reliability of AI-generated outputs.	0,850	
AI5	I know how to integrate AI applications into lesson planning and classroom activities.	0,755	
AI6	I am aware of ethical issues related to using AI in education.	0,955	
	Critical Thinking		0,895
CT1	I actively analyze the strengths and weaknesses of different teaching methods before choosing one.	0,930	
CT2	I question assumptions underlying educational recommendations or new technologies.	0,850	
CT3	I compare multiple sources of information when solving classroom-related problems.	0,979	
CT4	I draw logical conclusions based on evidence from student data or lesson outcomes.	0,970	
CT5	I evaluate the credibility of information before applying it in my teaching practice.	0,955	
CT6	I reflect on my own teaching decisions to identify potential improvements.	0,940	
CT7	I synthesize ideas from diverse perspectives to design innovative learning activities.	0,811	
	Teacher Performance		0,820
TP1	I prepare clear, well-structured lesson plans aligned with learning objectives.	0,950	
TP2	I use a variety of instructional strategies to engage all students.	0,862	
TP3	I manage classroom behavior effectively to maintain a positive learning environment.	0,855	

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	Items	Outer Loading	AVE
TP4	I provide timely, constructive feedback on student work.	0,761	
TP5	I adapt my teaching in response to students' individual needs and learning styles.	0,889	
TP6	I incorporate technology to enhance student learning.	0,771	
TP7	I participate in professional development activities to improve my teaching skills.	0,722	
TP8	I collaborate with colleagues to share best practices and solve instructional challenges.	0,832	

The outer loading results for the three constructs AI Literacy, Critical Thinking, and Teacher Performance, confirm that every indicator exceeds the critical threshold of 0.70. For AI Literacy, loadings range from 0.755 (AI5) to 0.955 (AI6), indicating each item strongly reflects teachers' AI literacy. Critical Thinking loadings are even higher, from 0.850 (CT2) to 0.979 (CT3), showing all seven items consistently measure critical-thinking ability. Likewise, every Teacher Performance item loads above 0.72, with TP1 at 0.950 and TP8 at 0.832 as highly representative examples. Thus, all indicators merit retention, as they contribute substantially to their respective constructs.

Regarding convergent validity, each construct's Average Variance Extracted (AVE) also meets the criterion of > 0.50: ALiteracy AVE = 0.768, Critical Thinking AVE = 0.895, and Teacher Performance AVE = 0.820. These values show that, on average, over half of each construct's item variance is captured by the construct itself rather than measurement error. In sum, both outer loading and AVE tests reinforce that our measurement model exhibits solid convergent validity and accurately captures the essence of each research variable.

Table 3. Hypotheses test

	T statistics	P values	Result
AI Literacy -> Critical Thinking	6.440	0.000	H2 Accepetd
AI Literacy -> Teacher Performance	1.426	0.154	H1 Rejected

Based on the hypothesis tests, AI Literacy has a positive and significant effect on Critical Thinking ($T = 6.440$; $p = 0.000 < 0.05$), so H_2 is supported. In contrast, the direct effect of AI Literacy on Teacher Performance is not significant ($T = 1.426$; $p = 0.154 > 0.05$), so H_1 is rejected.

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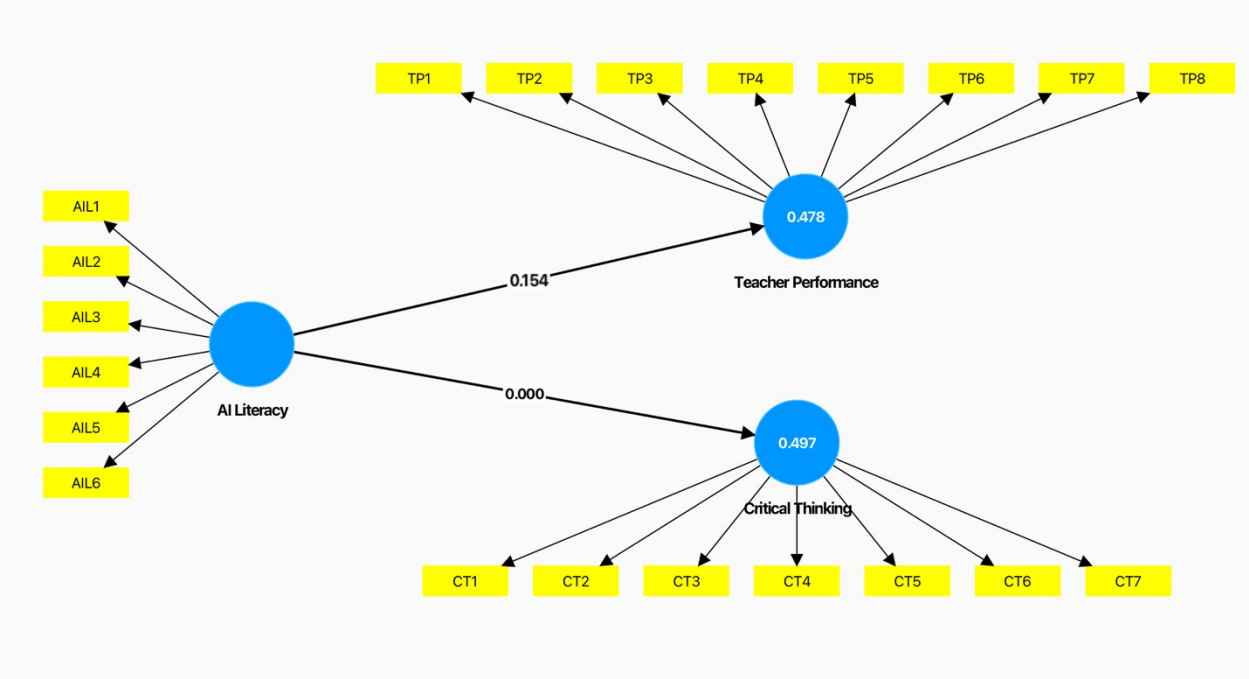

Figure 2. Research Result Model

B. Discussion

The findings indicate that AI literacy alone does not directly enhance teaching performance among vocational high school teachers in rural Sukabumi. This is likely due to infrastructural constraints such as unstable internet access and limited technical support that keep AI knowledge at the theoretical level without translating into everyday classroom practice [5]. Without hands-on training, curriculum-integration guidance, and school policies that encourage AI use, teachers struggle to convert AI literacy into performance gains [17].

By contrast, AI literacy significantly strengthens teachers' critical thinking skills. Educators who understand AI concepts, can evaluate system outputs, and are sensitive to ethical issues tend to scrutinize assumptions, analyze student data, and synthesize diverse perspectives when designing instruction [18]. In resource-constrained rural SMKs, where creativity is essential, these skills are invaluable for developing more targeted teaching strategies. Teachers who routinely assess information credibility, draw evidence-based conclusions, and reflect on their pedagogical decisions are better able to plan lessons, manage classrooms effectively, and provide constructive feedback [7]. In the rural SMK context where teachers face a wide range of student challenges this cognitive acuity directly contributes to the effectiveness of the learning process.

IV. CONCLUSION

This study reveals that AI literacy does not directly enhance teaching performance among vocational high school (SMK) teachers in rural Sukabumi. Instead, its effect materializes through the strengthening of critical thinking skills. Teachers who understand AI concepts and applications tend to sharpen their abilities to analyze, evaluate, and reflect when designing and delivering instruction. Those enhanced critical thinking skills then translate into more effective lesson planning, classroom management, and student feedback. Thus, critical thinking serves as a full mediator in the relationship between AI literacy and teacher performance.

For practice, schools and education authorities should offer integrated training programs that emphasize not only mastery of AI technologies but also the development of teachers' critical thinking strategies for example, through case-study workshops, reflective discussion sessions, and data-driven coaching. School policies must support adequate infrastructure such as stable

internet access, educational AI platforms, and technical assistance so that teachers can apply their AI literacy in real classroom contexts. Future researchers are encouraged to employ experimental or longitudinal designs to examine how AI literacy, critical thinking, and teacher performance evolve over time, and to broaden the sample to other school levels or regions to enhance the generalizability of findings.

LIMITATIONS

This research has several limitations. First, the sample was limited to private SMK teachers in a single rural village in Sukabumi, so the results may not represent other rural or urban school contexts. Second, data were collected via cross-sectional, self-report surveys, leaving open the possibility of response bias and limiting causal inference. Third, school-environment variables such as administrative support and collaborative culture were not included in the model, yet these factors may influence the relationships among AI literacy, critical thinking, and teacher performance. Future studies should incorporate these contextual variables and consider mixed-methods approaches to achieve a more holistic understanding.

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