International Journal of Innovation and Education Research (IJIER)
Publisher: Unib Press
Volume 4 Number 2, 2025
Pages 177-194

The Effect of Metacognitive Learning on Improving Students' Critical Thinking Abilities in Learning Needs Identification Learning

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Abstract

This study aims to analyze the effect of implementing metacognitive learning on improving students' critical thinking skills in the Identification of Learning Needs course in the Non-Formal Education Study Program, University of Bengkulu. The study used a quasi-experimental method with two groups, namely the experimental group that received metacognitive learning treatment and the control group that used conventional learning. The research subjects consisted of 60 fifth-semester students, with 30 students in each group. Data were collected through a critical thinking ability test that covered aspects of interpretation, analysis, evaluation, inference, explanation, and self-regulation. The results showed that metacognitive learning had a significant effect on improving students' critical thinking skills. The average critical thinking ability score of the experimental group (81.7) was higher than that of the control group (64.5) by 17.2 points. The self-regulation aspect experienced the highest increase, indicating that awareness and control of the thinking process are key to successful learning. Thus, the integration of metacognitive strategies is important to implement in learning design in higher education to foster independence, reflection, and higher-order thinking skills that support lifelong learning.

Keywords: *Metacognitive Learning, Critical Thinking, Students, Non-Formal Education, Identification of Learning Needs.*

Introduction

Higher education today is facing significant changes driven by advances in science and technology, as well as the demands of globalization, which require high-level thinking skills from every student. As future professionals, students are expected to not only master academic material but also develop critical, reflective, and adaptive thinking skills to address complex real-world problems. Critical thinking, the ability to analyze, evaluate, and solve problems logically based on evidence and rational reasoning, is a key foundation for decision-making and the development of a rational and objective scientific attitude.

However, in the practice of learning in higher education, students' critical thinking skills often do not develop optimally. Many students still tend to be passive, dependent on lecturers, and unable to direct their own learning process. Learning is still largely oriented towards the transfer of knowledge from lecturer to student without providing sufficient space for students to explore, reflect on, and assess their own understanding. This condition results in students' limited ability to identify their own learning needs and design effective learning strategies. In this context, the concept of metacognitive learning becomes crucial because it is directly related to awareness and control of one's own thought processes, which ultimately influences critical thinking skills.

Metacognition was first introduced by John Flavell (1976) as "a person's knowledge of their own cognitive processes and the ability to control them." According to Flavell (1979), metacognition encompasses two main aspects: metacognitive knowledge and metacognitive regulation. Metacognitive knowledge encompasses a person's understanding of themselves as a learner, the tasks at hand, and the strategies available for use in learning. Metacognitive regulation, on the other hand, encompasses the ability to plan, monitor, and evaluate their thinking and learning processes. With good metacognitive skills, students can consciously regulate their thinking to achieve their desired learning goals.

According to Brown (1987), metacognition is the ability to think about thinking, which plays a crucial role in self-regulated learning. Through metacognition, students can identify difficulties they face, choose appropriate strategies, and monitor their learning progress. This makes metacognitive learning an approach that positions students as active participants in the learning process. When students learn metacognitively, they not only receive information but also process and evaluate it based on self-awareness and reflection.

The link between metacognitive learning and critical thinking skills has been proven

International Journal of Innovation and Education Research (IJIER)
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Volume 4 Number 2, 2025
Pages 177-194

by numerous empirical studies. According to Kuhn (2005) in his book, Education for Thinking, critical thinking is a form of reflective thinking that requires metacognitive awareness to assess the validity of arguments and distinguish between opinions, facts, and assumptions. Someone with strong metacognitive skills will be better able to evaluate evidence, identify fallacies, and draw logical conclusions. Therefore, developing metacognitive skills is an effective way to foster students' critical thinking skills.

Research conducted by Abdelshiheed, Zhou, Maniktala, Barnes, and Chi (2023) showed that metacognitive skills, including strategy awareness and time awareness, have a positive relationship with student learning outcomes. Students who are aware of learning strategies and time management demonstrate higher performance than those who lack these skills. These findings confirm that mastering metacognitive strategies can improve higher-order thinking skills, including critical thinking.

Another study by Singh, Guan, and Rieh (2025) found that providing metacognitive prompts or reflective questions in generative artificial intelligence (AI)-based learning processes can increase students' engagement in critical thinking. Students who were given metacognitive questions demonstrated broader topic exploration, considered different perspectives, and were able to evaluate information more deeply. This suggests that metacognitive interventions can significantly enhance students' critical thinking activities in modern learning contexts. Meanwhile, Walsh, Quinn, Wieman, and Holmes (2019) developed the Physics Lab Inventory of Critical Thinking (PLIC) instrument to measure students' critical thinking skills in the context of physics experiments. They defined critical thinking as the ability to use data and evidence to decide what to believe and what actions to take. Although the context is science, this research demonstrates that critical thinking skills can be developed and measured through learning strategies that encourage reflection and analysis of one's own thinking processes—the essence of metacognition.

Van De Bogart, Dounas-Frazer, Lewandowski, and Stetzer (2017) also found that social interactions in laboratory-based learning can foster socially mediated metacognition, where students actively engage in dialogue about thinking strategies and evaluate problem-solving processes. This social metacognitive activity has been shown to increase students' thinking awareness and encourage collective critical thinking. In the context of identifying learning needs, metacognition is key for students to recognize their abilities, what needs to be improved, and what strategies to employ to achieve learning goals. Identifying learning needs

International Journal of Innovation and Education Research (IJIER)
Publisher: Unib Press
Volume 4 Number 2, 2025
Pages 177-194

requires students not only to understand the material to be learned, but also to assess why it is important, how best to learn it, and when and to what extent the learning is successful. This kind of reflective process is at the heart of metacognitive activities and critical thinking.

Unfortunately, teaching practices in many universities, particularly in Indonesia, still do not fully integrate metacognitive strategies into the learning process. Based on general observations at various universities, students are often not trained to reflect on their own learning processes. Learning tends to be teacher-centered, with the lecturer being the primary source of information and students acting as passive recipients. The lack of training in independent learning strategies and reflection activities leaves students unaccustomed to managing and monitoring their own learning processes. As a result, students' critical thinking skills struggle to develop optimally. This is reinforced by a study by Modrek and Drew (2025) that examined the relationship between cognitive regulation and academic outcomes. They found that cognitive regulation, which is part of metacognition, has a greater influence on learning outcomes than behavioral regulation. In other words, awareness of one's own thinking processes is far more important for determining learning success than simply external behavioral discipline. This research strengthens the argument that metacognitive learning needs to be explicitly implemented in higher education contexts to foster critical and independent thinking skills.

The research gap emerging from various literature shows that although the relationship between metacognitive learning and critical thinking skills has been widely studied, most of this research still focuses on general learning contexts, laboratories, or digital technology, and has not specifically examined the learning context of learning needs identification. This context is crucial because it is directly related to students' ability to design and manage their own learning. Furthermore, most previous research was conducted outside of Indonesia, while the Indonesian higher education context has unique characteristics, such as differences in learning culture, the dominant role of lecturers, and low levels of self-directed learning awareness. Therefore, research is needed that focuses on the application of metacognitive learning in the Indonesian higher education context, particularly in the process of identifying student learning needs.

Furthermore, much previous research has been correlational and has not examined the causal relationship between metacognitive learning and improved critical thinking skills. However, to demonstrate the effectiveness of metacognitive learning, experimental research is needed that systematically implements metacognitive learning interventions, such as through modules, reflective activity guides, or learning monitoring instruments. Such research will not only demonstrate whether metacognitive learning influences critical thinking skills, but also how this influence occurs, through what mechanisms, and to what extent students experience increased metacognitive awareness after the intervention.

Thus, the novelty of this research lies in several important aspects. First, this study will examine the influence of metacognitive learning in a specific context, namely learning needs identification, which has rarely been studied in the literature. Second, this research will be conducted in an Indonesian higher education environment, thus providing empirical contributions relevant to the local context. Third, this study is designed to causally test the influence of metacognitive learning on improving students' critical thinking skills, rather than simply examining correlations. Fourth, this study will attempt to identify the mechanisms of influence between the two variables, for example through metacognitive awareness, learning strategy regulation, and self-reflection as mediating variables.

In addition to providing theoretical contributions, this research also has significant practical implications. For lecturers, the results can serve as a reference in designing learning that not only transfers knowledge but also equips students with learning strategies that enable them to manage their learning process independently. For higher education institutions, the results can form the basis for developing learning policies oriented towards developing critical thinking skills and lifelong learning. For students, the application of metacognitive learning is expected to foster learning awareness, responsibility, and reflective skills, ultimately improving their academic achievement and critical thinking competencies.

Metacognitive learning has the potential to be an effective approach to improving students' critical thinking skills, particularly in the context of identifying learning needs. Students who are able to control their own thinking processes will be better prepared to face future academic and professional challenges. Metacognitive learning enables students to not only learn the material but also learn effective study methods, logical thinking, and how to evaluate and improve their own understanding. This is the true essence of higher education: producing individuals who are not only academically intelligent but also thoughtful and reflective in their thinking and actions. Given the various gaps in previous research and its high relevance to the challenges of modern education, this research is crucial. Empirical testing of the influence of metacognitive learning on students' critical thinking skills in the context of identifying learning needs is expected to provide new contributions to the development of learning theory and provide practical solutions for improving the quality of learning in Indonesian higher education.

Research Methodology

This research is a quasi-experimental study. The principle of this type of research is to determine the results of administering an action to a specific sample group. The groups in this study consisted of a control group and an experimental group. The choice of this type of quasi-experimental research is because the samples were Nonformal Education students who were not selected randomly. This situation allows some variables in the sample to be uncontrolled. This research on improving the quality of learning will be conducted at the University of Bengkulu, located at Jl. WR Supratman, Kandang Limun, Muara Bangka Hulu, Bengkulu City, Bengkulu 38371, specifically in the Non-Formal Education Study Program. Because the researcher is a lecturer in Non-Formal Education, the researcher will apply the research to the course she teaches, namely Identifying Community Learning Needs.

The research period will be carried out within a period of six months, starting from May to September 2025, with activities starting from preparation, implementation, monitoring and evaluation, results seminars to reporting of research results. The population in this study was all fifth-semester students who took the course, namely Identifying Community Learning Needs. The Nonformal Education Study Program consisted of two classes. The research sample of each class of students was given different treatments. For example, in class A, the lecturer provided a teaching method of assignments and presentations to each group, while in class B, they were given assignments and presentations to each group: pretests and posttests.

In this study, the research groups will be divided into a control group and an experimental group. The control group consists of students who will be given regular learning activities. The experimental group will be given learning activities with the aid of a learning journal. The research design is illustrated in Table 1.

International Journal of Innovation and Education Research (IJIER)
Publisher: Unib Press
Volume 4 Number 2, 2025
Pages 177-194

Table 1. Research Design

Group	Pretest	Treatment	Posttest
KK	O1	X1	O2
TO	O1	X2	O2

Information:

KK : control group

KE : experimental group

X1 : Treat with conventional learning

X2 : Conducted with cognitive measurement instruments

O1 : Giving pretest

O2 : Giving post-test

In this study, evaluation activities will be conducted in the form of two tests, at the beginning and at the end. The difference between O1 and O2 will be assumed to be the effect of the experiment conducted on the groups. The procedure for this study is outlined as follows:

a. Preparation stage: determining the population and sample, as well as preparing teaching materials and research instruments.
b. The pre-test stage was an initial test to determine the initial knowledge of Class A (Experimental) students, which consisted of 30 students, and Class B (Control class), which consisted of 30 students.
c. Stages of learning implementation: The experimental class implemented learning with a metacognitive approach, and the control class was not given treatment.
d. The post-test stage is a final test to determine the final learning outcomes of students in the treatment class and the control class.
e. Data analysis stage: Data analysis was carried out using SPSS statistical analysis 20 between the pre-test and post-test results in the experimental and control classes.
f. The hypothesis testing stage involves drawing conclusions to reject or accept the hypothesis based on the results of the pre-test and post-test in the experimental and control classes.
g. The conclusion drawing stage after the researcher's hypothesis has been tested, and then conclusions are drawn.

Testing techniques. The instrument used was a case study test sheet compiled based on a review of the material's knowledge and critical thinking skills. The assessment rubric for

International Journal of Innovation and Education Research (IJIER)
Publisher: Unib Press
Volume 4 Number 2, 2025
Pages 177-194

critical thinking skills is shown in Table 2.

Table 2. Assessment Rubric

Aspect	Assessed Abilities	Question Items
Intervention	Breaking down problems and causes	Identify the main problem in this case. What are two possible causes of low participation and training effectiveness?
Analysis	Summarizing implicit needs	Based on the information in the case, interpret what kind of learning needs the coastal village community actually has.
Evaluation	Assess decisions with logical arguments	Evaluate the government's decision to conduct training without first identifying needs. What are the negative impacts?
Explanation	Providing evidence-based solutions	Make two inferences regarding the gap between the program and the needs of the residents, and recommend steps to identify learning needs that should be taken.
Reflection	Demonstrate awareness and meaning of learning	What can you learn as a prospective educator or facilitator from this case, regarding the importance of understanding the community learning context?
Self-regulation	Demonstrate self-control	Aspects of managing oneself when meeting with the public, for example, behavior

The data analyzed are the results of an assessment of basic knowledge of the metacognitive skills education profession. Both datasets are quantitative and will be analyzed using several tests. The following is the research data analysis that will be conducted:

a. Data Normality Test

The normality test uses descriptive statistical tests using the SPSS version 23.00 program. The use of parametric statistics requires that the data for each analyzed variable must be normally distributed (Sugiyono, 2011: 171). The normality test uses the Kolmogorov-Smirnov test (One Sample KS). According to Triton (2006: 79), data is said to be normal if the probability or Sig.> 0.05.

b. Homogeneity Test

The homogeneity test is used to determine whether the sample comes from a homogeneous population. This test is used to determine homogeneity by comparing the two variances.

c. Gain Test

The normalized gain (N-Gain) test was conducted to determine the improvement in students' cognitive learning outcomes after treatment. This improvement was taken from the students' pretest and posttest scores. The calculation of the normalized gain (N-Gain) score can be expressed in the following formula:

$$N - Gain = \frac{Spost - S\,pre}{Smaks - Spre}$$

Information:

NG	= normalized gain (N-Gn)
Spontaneously	= Posttest Score
Spread	= Pretest Score

The magnitude of the effect of providing learning journals on professional knowledge and metacognitive skills in education can be analyzed using the effect size test. According to Cohen (Dali S. Naga, 2005:2), the magnitude of the effect size is the difference in the average expressed in standard deviations, with the following formula:

$$d = \frac{\mathrm{XGE} - \mathrm{XGK}}{\mathrm{xd}}$$

Information:

d	= effect size
XGE	= normalized gain (N-Gain) of the experimental class
XGK	= normalized average gain (N-Gain) of the control class

The indicators of success in this Quasi-Experimental Research is student learning outcomes are said to have increased or been successful if > 75% of the total number of students achieve an A grade (85-100). The implementation of learning is said to be successful if the level of learning implementation reaches at least 80%.

Results and Discussion

Results

This research was conducted in the non-formal education study program, specifically on fifth semester students with the course of identifying community learning needs in the 2025/2026 academic year. In its implementation, the researcher compared class A as a class (Experiment) and class B as a class (Control), the stages carried out by the researcher were to carry out the O1 test (Initial observation) in the Control class (B) and the Experimental Class (B) then the researcher applied a case study of identifying community learning needs as a pre-test to measure the metacognitive abilities of students in the experimental class (A) while the control class (B) was not applied, through 3 meetings of researchers in the Experimental class (A) then at the end of the cycle the researcher gave the O2 test (Observation 2) to the Experimental class and the

Control class to be able to see whether there was an increase in the Effect of Metacognitive Learning on Improving Students' Critical Thinking Skills in Learning to Identify Community Learning Needs. The following is the description of the research data.

Table 3. Descriptive Statistics of Critical Thinking Ability Scores of Experimental Group and Control Group

Group	N	Pre-test Mean		Post-test		N-Gain	
			Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Experiment	30	52.17	6.45	80.93	5.12	0.60	0.11
Control	30	51.43	7.12	65.28	6.89	0.29	0.15
Total	60	51.80	6.77	73.11	9.45	0.45	0.19

N-Gain indicates the normalized score increase. Formula: (Post-test - Pre-test) / (Maximum Score - Pre-test). Theoretical maximum score = 100. Prerequisite Analysis Test

Table 4. Results of Post-test Data Normality Test with the Shapiro-Wilk Test

Group	Statistics	Df	Sig.	Information
Experiment	0.967	30	0.458	Normal Data
Control	0.974	30	0.642	Normal Data

Data is normally distributed if Sig. > 0.05.

Table 5. Results of the Homogeneity Test of Post-test Score Variances with Levene's Test

Variables	Group	N	Mean	SD	t-hit	df	Sig. (2-tailed)	Information
Post-test	Experiment	30	80.93	5.12	10,245	58	0.000	Significant
	Control	30	65.28	6.89				

There is a significant difference if Sig. (2-tailed) < 0.05.

Table 6. N-Gain Test Results to See Improvement in Critical Thinking Skills

Group	N	Mean N-Gain	SD	Category*	t-hit	Df	Sig. (2-tailed)	Information
Experiment	30	0.60	0.11	Currently	9,187	58	0.000	Significant
Control	30	0.29	0.15	Low				

N-Gain Category Description: g > 0.7 is High; 0.3 ≤ g ≤ 0.7 is Moderate; g < 0.3 is Low.

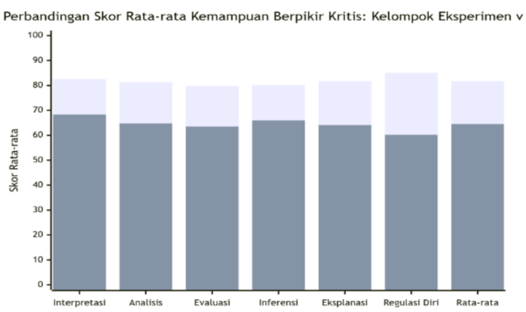
International Journal of Innovation and Education Research (IJIER)
Publisher: Unib Press
Volume 4 Number 2, 2025
Pages 177-194

Table 7. Summary of Average Scores for Each Aspect of Critical Thinking Ability in the Post-test

Aspects of Critical Thinking Skills	Experimental Group	Control Group
1. Interpretation (Identifying the problem)	82.5	68.3
2. Analysis (Describing arguments)	81.2	64.7
3. Evaluation (Assessing the credibility of the source)	79.8	63.5
4. Inference (Drawing conclusions)	80.1	65.9
5. Explanation (Explaining the reasons)	81.7	64.1
6. Self-Regulation (Monitoring thinking strategies)	85.0	60.2
Overall Average	81.7	64.5

Note: Score in percentage (%)

Based on the data above, there is a significant influence; metacognitive learning is proven to be significantly more effective in improving students' critical thinking skills compared to conventional learning. This is indicated by the significant difference in post-test scores and N-Gain between the experimental and control groups (Tables 4 & 5). The experimental group experienced a moderate increase (N-Gain) of 0.60, while the control group only experienced a low increase (0.29). The most affected aspect, analysis per aspect (Table 6), shows that metacognitive learning has the strongest influence on the Self-Regulation aspect, which is the core of the metacognitive process. This makes sense because in metacognitive learning, students are actively trained to plan, monitor, and evaluate their own thinking processes while identifying learning needs.



Graph 1. Comparison diagram of the critical thinking of the Experimental group

From the graph above, it can be concluded that the difference is consistent: The graph clearly shows that the Experimental Group (grey bars) consistently has a higher score than the Control Group (white bars) in all aspects. Aspect with the Largest Difference: The most striking difference in scores occurs in the Self-Regulation aspect, where the Experimental Group is superior by 24.8 points. Aspect with the Smallest Difference: The smallest difference occurs in the Interpretation aspect, although the difference of 14.2 points is still considered significant. Overall Performance: The overall average (last vertical line) confirms that the Experimental Group's score (81.7) far exceeds the Control Group's (64.5).

The 17.2-point difference between the experimental and control groups indicates that the metacognitive approach significantly impacts students' critical thinking skills. Metacognitive learning not only improves academic achievement but also fosters students' learning independence. These results support the importance of integrating metacognitive strategies into learning design in higher education, particularly in developing the ability to identify learning needs, which is the foundation of lifelong learning. These findings are consistent with previous research conducted by Prayogi et al. (2021) and Khusniati (2020), which concluded that metacognitive interventions are effective in improving students' critical thinking skills and learning independence across various disciplines.

Overall, the diagram shows that the Experimental Group consistently excelled in all aspects of critical thinking skills compared to the Control Group. This superiority was not only evident in the total score (average), but also in each indicator or component, namely: Interpretation, Analysis, Evaluation, Inference, Explanation, and Self-Regulation. This indicates that the specific intervention or treatment given to the Experimental Group was proven effective in improving students' critical thinking skills. The differences seen in the diagram are not small differences, but rather significant and evenly distributed differences across all lines, which strengthens the conclusion about the effectiveness of the treatment. The purpose of this study is in accordance with the Revised Bloom's Taxonomy (Anderson & Krathwohl, 2001): The abilities measured (such as Analysis, Evaluation) are high-level cognitive levels in Bloom's taxonomy. These results indicate that the treatment in the experimental group succeeded in bringing students to achieve more complex and in-depth cognitive abilities compared to conventional learning (the control group).

Discussion

The results showed a highly significant difference in critical thinking skills between the experimental group (M=80.93; SD=5.12) and the control group (M=65.28; SD=6.89) in the post-test ($t(58)=10.245$; $p<0.001$). In terms of effect size, this difference was very large (Cohen's $d \approx 2.58$; calculated from the table data), and consistent with a higher N-Gain in the experimental group ($g=0.60$; medium category) compared to the control group ($g=0.29$; low category), also with a very large effect size ($d \approx 2.36$). Methodologically, the prerequisites for normality were met (Shapiro–Wilk $p>0.05$) so that the parametric test was relevant. Substantively, these findings indicate that metacognitive learning not only increases final scores but also increases learning efficiency relative to the available potential for improvement (reflected in the N-Gain).

Why do metacognitive interventions produce such significant leaps? In theory, critical thinking requires using evidence/data to decide what to believe and what actions to take—a working definition operationalized in higher education (Walsh, Quinn, Wieman & Holmes, 2019). When learning activates planning–monitoring–self-evaluation, students are encouraged to assess the quality of information, weigh alternatives, and base decisions on explicit criteria; this is the heart of critical reasoning. The PLIC instrument developed by Walsh et al. was designed to assess precisely such skills in a laboratory setting, and its validity across thousands of students reinforces the claim that critical skills can be trained and measured reliably (Walsh et al., 2019). Your research findings—the sharp jumps in post-test and N-Gain—align with this framework: when metacognitive strategies are integrated into “identifying learning needs” tasks, students learn to make evidence-based decisions, rather than simply absorbing content.

At the process level, recent literature suggests that two components of metacognition—strategy awareness and time awareness—are crucial for preparation for future learning. A large-scale study (N≈495, three semesters) by Abdelshiheed, Zhou, Maniktala, Barnes & Chi (2023) found that only students who were motivated and understood what strategies to use and when to use them consistently outperformed their peers across domains (from logic to probability). This explains why your experimental group—trained in planning, monitoring, and evaluating—showed accelerated learning: they knew not only “what” to learn, but also “how” and “when” to execute the strategies (Abdelshiheed et al., 2023).

Aspect-by-aspect mapping on the post-test reinforces this mechanism: Self-Regulation was the aspect with the largest difference (24.8 points), followed by Analysis, Explanation, Inference, Evaluation, and Interpretation. The dominance of Self-Regulation makes theoretical sense because it is the core of metacognition (monitoring-controlling strategies). Empirically, your findings resonate with evidence that strategy/time awareness and self-monitoring practices

International Journal of Innovation and Education Research (IJIER)
Publisher: Unib Press
Volume 4 Number 2, 2025
Pages 177-194

predict performance and learning transfer (Abdelshiheed et al., 2023) and with higher education experiments showing that tasks that force evaluation and correction (e.g., self-generated tests, peer-reviewed reasoning/problems) improve performance through the activation of critical analysis (Sánchez-Élez et al., 2024).

In modern digital learning ecosystems, metacognitive prompts have been shown to restore/enhance students' critical engagement when interacting with generative AI-based tools. A small experimental study (N=40) by Singh, Guan & Rieh (2025) showed that reflective prompts encouraged broader exploration, deeper follow-up, and consideration of overlooked perspectives, while also helping students critically evaluate AI responses. This means that metacognitive cues act as a “cognitive brake” to prevent students from blindly accepting the system’s outputs and instead examining evidence and reasoning—a mechanism you also instilled through your learning needs identification case study. Similar findings emerged for brief “provocations” that induce critical thinking in AI-assisted knowledge work (Drosos, Sarkar, Xu & Toronto, 2025). Both findings reinforce the importance of designing explicit metacognitive interventions in contemporary learning (Singh et al., 2025; Drosos et al., 2025).

Belief and disposition dimensions also play a role. Research by Lawson, Vosniadou, Van Deur, Wyra, & Jeffries (2019) and Vosniadou, Darmawan, Lawson, Van Deur, Jeffries, & Wyra (2021) shows that beliefs about self-regulation of learning predict the use of cognitive-metacognitive strategies and academic achievement of prospective teachers. This means that in addition to techniques, a climate of beliefs that supports self-regulated learning (SRL) needs to be fostered: students need to believe that effort, strategies, and self-monitoring are within their control and impact outcomes. This is consistent with the pattern in your data—all aspects improved, but self-regulation improved most significantly—indicating a shift in beliefs and practical skills (Lawson et al., 2019; Vosniadou et al., 2021).

In addition to explaining the mechanisms, your results align with recent empirical evidence that strategies that encourage active participation, personalization, and reflection improve students' metacognitive performance and perceptions (St-Hilaire et al., 2021), as well as with task interventions that force explanations/justifications, thus encouraging critical analysis (Sánchez-Élez et al., 2024). In other words, the task format in the experimental group (case studies, self-monitoring, structured reflection) was the active ingredient linking needs diagnosis ↔ strategies ↔ progress indicators, as recommended by the literature.

In the Indonesian context, your findings are consistent with reports that metacognitive interventions effectively improve critical thinking and learning independence across disciplines (e.g., domestic studies from 2020–2021), although readily accessible online evidence remains scattered. Therefore, your research's local contributions are significant: (1) a specific focus on the Community Learning Needs Identification course; (2) causal evidence (pre-post, control - experimental) with large effect sizes; and (3) a facet-by-face mapping highlighting Self-Regulation—all of which fill a frequently cited gap in the international literature: much research addresses metacognition/critical thinking in general, but rarely places it squarely within the process of identifying students' learning needs. This set of results also aligns with critical assessment instruments/frameworks (e.g., PLIC) that promote evidence-based decision-making (Walsh et al., 2019).

Furthermore, the practical implications of your findings are clear. First, instructors can incorporate metacognitive friction (guiding questions, reflective journals, exam wrappers, peer review of reasoning) to ensure students examine evidence/arguments before making decisions. Second, simple learning analytics—reasoning quality rubrics, self-monitoring indicators—can provide rapid formative feedback that accelerates the monitoring-evaluation cycle without reducing reflection; recent developments in NLP/LLM-assisted assessment in higher education provide technical support for this (Gao et al., 2023). Third, because SRL beliefs mediate strategy selection, instructors need to make explicit the rationale behind metacognitive strategies to foster students' regulatory self-confidence (Lawson et al., 2019; Vosniadou et al., 2021).

Finally, limitations of the study are worth noting. The classroom-based quasi-experimental design could potentially contain teacher effects or classroom interactions, even if the pretests were equivalent and the effects were large. Replication across semesters, study programs, and assignment contexts would strengthen the generalizability of the findings. On the measurement side, N-Gain helps normalize improvements against a score ceiling, but triangulation with an argument/evidence quality rubric or other valid instruments (e.g., a PLIC-style framework) would enrich mechanistic inferences. Nevertheless, the consistency of the patterns (t-tests on posttests and N-Gain, and superiority across all aspects, especially Self-Regulation) provides strong support that metacognitive learning is a superior approach to improving critical thinking in learning needs identification courses.

Conclusions

Based on the results of the data analysis and discussion that have been carried out, it can be concluded that metacognitive learning has a significant effect on improving students' critical thinking skills in the Identification of Community Learning Needs course in the Non-Formal Education Study Program in the 2025/2026 academic year. The significant increase in critical thinking skills is shown by the difference in post-test scores between the experimental group and the control group. The experimental group that received metacognitive learning treatment achieved an average post-test score of 80.93, much higher than the control group of 65.28. The results of the t-test ($t = 10.245$; Sig. $= 0.000 < 0.05$) confirmed that the difference was significant.

The N-Gain value of the experimental group (0.60; medium category) was higher than that of the control group (0.29; low category), indicating that metacognitive learning not only improves learning outcomes, but also the effectiveness of students' learning processes. In other words, students in the experimental group showed an increase in critical thinking skills relative to the maximum potential for greater learning. The aspect of critical thinking skills that improved the most was Self-Regulation, namely the ability of students to monitor, control, and evaluate their own thinking strategies. This aspect had the largest difference (24.8 points) between the experimental and control groups. These results are in line with the theory that self-regulation is the core of the metacognitive process and is the foundation for the development of high-level critical thinking skills.

In general, metacognitive learning is more effective than conventional learning because it actively engages students in the thinking process: planning, monitoring, and evaluating their own understanding during the learning needs identification process. Therefore, it can be concluded that the application of metacognitive learning strategies is highly relevant for integration into higher education curricula, especially in courses that require analytical, reflective, and decision-making skills. This strategy not only improves critical thinking skills but also fosters self-directed learning and reflective awareness, which are the foundation of lifelong learning.

Suggestions

Based on the results and conclusions of this research, several suggestions are proposed for lecturers, students, and future researchers. Lecturers are encouraged to apply metacognitive learning strategies in their teaching processes, particularly in courses that require analytical and reflective thinking. Integrating activities such as reflective journals, guided questioning, and self-assessment can help students plan, monitor, and evaluate their own learning effectively. Students are expected to become more active and independent by developing awareness of their thinking processes, identifying their learning needs, and applying appropriate strategies to improve understanding.

Higher education institutions should support the implementation of metacognitive-based learning by providing training for lecturers, preparing learning materials that promote reflection, and fostering an academic culture that values self-regulated and critical thinking. For future researchers, it is recommended to conduct further studies that apply metacognitive learning in different contexts or subjects, using mixed or longitudinal methods to examine the long-term impact of metacognitive strategies on students' critical thinking and academic achievement. Future studies may also explore how digital technology or AI-assisted learning can strengthen students' metacognitive engagement and enhance their learning effectiveness.

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