Enhancing Students' Critical Thinking Skills in Madrasah Ibtidaiyah through Problem-Solving Learning

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Abstract
This study analyzes the impact of problem-solving learning on the critical thinking skills students. A quasi-experimental method with a pretest-posttest control group design was used. The sample consisted of 5th-grade students from Madrasah Ibtidaiyah Negeri 2 Serang, with 27 in the experimental class and 27 in the control class. Data collection involved observation and tests using a validated multiple-choice instrument. Normality and homogeneity tests preceded data analysis using the t-test. Results showed significant improvements in both classes, with the experimental class implementing the problem-solving model outperforming the control class using conventional methods. The t-test significance (2-tailed) was 0.007, indicating a significant difference in critical thinking skills between the groups. This finding supports the effectiveness of active learning approaches in fostering higher-order thinking skills where developing critical thinking is essential to fulfilling human responsibilities in living a meaningful life.

Keywords: critical thinking skills; problem-solving learning; *madrasah ibtidaiyah*

INTRODUCTION

Islamic education aims not only to impart religious knowledge but also to foster analytical, reflective, and creative thinking in understanding religious teachings and daily life (Syihabuddin & Abdussalam, 2015; Lahmar, 2020). This aligns with the Qur'anic teachings, as Allah states in Surah al-Baqarah (2:219):

كَذَٰلِكَ يُبَيِّنُ اللهُ لَكُمُ الْأٰيٰتِ لَعَلَّكُمْ تَتَفَكَّرُوْنَ

"Thus Allāh makes clear to you the verses [of revelation] that you might give thought" (QS. 2:219). [2] Al-Baqarah: 219).

Similarly, the Prophetic Hadith emphasizes the importance of deep understanding:

مَنْ يُرِدِ اللَّهُ بِهِ خَيْرًا يُفَقِّهْهُ فِي الدِّينِ

"Whoever Allah wills to be good, He will make him understand religion" (Narrated by Bukhari and Muslim).

Islamic education in madrasah ibtidaiyah (elementary schools) plays a crucial role in cultivating students' critical thinking skills. It encourages students to engage deeply with the Qur'an and Hadith, enabling them to understand, reason, and apply Islamic values in broader contexts (Dahari et al., 2019; Haqiqi & Albar, 2019; Ahmad et al., 2020; Widayanti & Juhji, 2023).

Students are taught to analyze life's challenges through Islamic principles (Syihabuddin & Abdussalam, 2015), moving beyond passive learning to critical evaluation of how religious teachings address complex social and moral issues. Research highlights that integrating cognitive and spiritual aspects in education enhances problem-solving, analytical skills, and informed decision-making (Hasan et al., 2019). Consequently,

madrasah ibtidaiyah contributes significantly to the intellectual and moral development of students by strengthening critical thinking skills, essential for both daily life and future challenges (Butler et al., 2017; Higgins, 2014; Juhji & Suardi, 2018; Juhji & Mansur, 2020; Vidal et al., 2023; Alhamuddin et al., 2023; Putri et al., 2024; Nandini et al., 2024).

The importance of dispositions in critical thinking is widely acknowledged both conceptually and practically (Davies & Barnett, 2015; Zohar & Cohen, 2016). In science learning at the elementary level, critical thinking is essential for understanding natural phenomena, solving problems, and making decisions based on evidence and scientific reasoning (Vieira & Tenreiro-Vieira, 2016; Krajcik & Czerniak, 2018). However, in practice, the development of critical thinking skills in some elementary schools is often constrained. Limited resources and insufficient teaching methods frequently hinder effective classroom integration (Meneses, 2020).

Grade 5 students, in particular, need to develop critical thinking skills as they enter a stage of cognitive development conducive to questioning, evaluating, and drawing conclusions (Sarwanto et al., 2021; Radiansyah et al., 2023). Challenges in fostering these skills include inadequate teacher training in integrating critical thinking into learning, which remains a significant barrier to their development at the elementary level (Khalid et al., 2021; Ma & Liu, 2023).

In various situations, students must be able to make decisions and solve problems, skills essential for navigating life (Kozhevnikov, 2007). Developing these abilities requires critical thinking, which can be cultivated

through school learning processes (Ennis, 2011a; Halpern, 2013). Science education, particularly in Natural Sciences, plays a crucial role in fostering critical thinking (Kenedi et al., 2019; Prafitasari et al., 2021). It aims not only to convey scientific facts but also to train students in analysis, synthesis, evaluation, and application of concepts in real-life contexts. However, challenges persist in achieving this goal. Obstacles such as insufficient emphasis on critical thinking and limited opportunities for students to engage with thought-provoking questions hinder progress (Nuryanti et al., 2018)(Adinda et al., 2021).

Observations and interviews with teachers at Madrasah Ibtidaiyah Negeri 2 Serang regency reveal issues such as low student engagement, difficulty identifying key questions, challenges in analyzing information, limited ability to express logical opinions, struggles in finding solutions, and lack of curiosity or deeper interest in lessons.

Previous studies have highlighted the importance of developing students' critical thinking skills, but most have focused on high school and college levels (Gurcay & Ferah, 2018). Evidence on fostering critical thinking in young children remains limited, underscoring the importance of this research (Aizikovitsh-Udi & Cheng, 2015).

The novelty of this study lies in its focus on developing critical thinking skills in madrasah ibtidaiyah (elementary schools), a topic rarely explored in depth. While prior research has concentrated on higher education levels, this study contributes uniquely to primary education by examining how critical thinking can be integrated into madrasah ibtidaiyah.

This research aims to analyze the impact of science learning based on a problem-solving model on the critical thinking skills of grade 5 madrasah ibtidaiyah students.

METHOD

This study employed a quasi-experimental Pretest-Posttest-Only Control Group Design. Two groups were involved: an experimental group receiving problem-solving model treatment and a control group without treatment.

Research Design and Procedure

This study used a Pretest-posttest-only Control Group Design. The research design involved two groups: an experimental group that was given a specific treatment and a control group that did not get the treatment. The procedural steps included (1) a Pretest, Measuring the initial ability of students in both groups; (2) Treatment: The experimental group was given treatment based on the problem-solving model, while the control group was not; and (3) Posttest: Conducted to measure the effect of the treatment on the experimental group and compare with the control group.

Population and Sample

The population comprised 5th-grade students from Madrasah Ibtidaiyah Negeri 2 Serang Regency, Banten Province. A purposive sample of 54 students was selected, with 27 students each from classes 5B and 5C. The purposive sampling technique was used, where the sample selection was based on specific considerations in accordance with the research objectives (Sugiyono, 2014; Supardi, 2017; Khaeroni, 2021).

Data Collection Techniques and Instruments

Data were collected using a 30-question test assessing three critical thinking indicators: analysis, conclusion, and evaluation (Ennis, 2011). Instrument validity was verified with the Product Moment correlation, and reliability was tested using Cronbach's Alpha (Creswell & Creswell, 2017). Additionally, an observation sheet evaluated student skills during the problem-solving learning process.

Data Analysis Technique

After the data was collected, prerequisite tests were conducted to ensure its feasibility for further analysis. These included a normality test to verify that the data followed a normal distribution (Ghasemi & Zahediasl, 2012) and a homogeneity test to confirm balanced variances between the groups (Field, 2024). The data analysis was then carried out using a T-test to compare the posttest results between the experimental and control groups and an N-Gain test to measure the improvement in student learning outcomes from pretest to posttest (Randles, 2019).

DISCUSSION

Implementation of Problem-Solving Learning

Problem-solving learning is an approach that emphasizes students' active participation in a structured process to solve real-world problems. In this study, the problem-solving learning approach followed a sequence of steps: problem identification, information exploration, hypothesis formulation,

solution search, evaluating and validating solutions, implementing the solution, and reflection.

Table 1: Implementation of Problem-Solving Learning

Syntax	Activity	Observation	
		Yes	No
Problem Identification	The teacher introduced a relevant context containing a real problem and	√	
	guided students in identifying the main issue.	√	
Information Exploration	Students gathered necessary information to deepen their understanding of the problem.	√	
	The teacher either provided resources or directed students to find their own.		√
Formulating Hypotheses	Students made predictions based on the information gathered.	√	
	The teacher facilitated logical and scientific thinking during this process.	√	
Solution Search	Students developed alternative solutions by testing their hypotheses.	√	
	The teacher acted as a facilitator, guiding the students through discussions and experiments.	√	
Evaluating and Validating Solutions	Students assessed the strengths and weaknesses of the tested solutions.		√
	The teacher led a discussion to compare different solutions and helped students identify the most effective one	√	
Implementing the Solution	Students selected the best solution and applied it to the problem context.	√	
	The teacher provided feedback and led a reflection on the results	√	
Reflection	Students reflected on the entire process, identifying successful steps and challenges faced.	√	
	The teacher guided students in drawing conclusions and understanding lessons learned.	√	
	% Learning Implementation	86%	

Based on Table 1, the implementation of problem-solving learning in the experimental class had an implementation rate of 86%. The process

began with the problem identification stage, where the teacher provided a relevant real-life situation, and students were instructed to identify the main problem. This activity was fully observed. In the information exploration stage, students were engaged in gathering information; however, the teacher's guidance during this activity was not observed. At the hypothesis formulation stage, both students and the teacher actively participated in formulating predictive solutions based on the information collected. The solution-finding and solution evaluation stages were conducted well, although the teacher's evaluation of the solutions was not fully observed. The process concluded with reflection, where students reflected on their learning, and the teacher guided them through reflecting on the entire process.

Improving Critical Thinking Skills

Table 2 below shows the improvement of critical thinking skills of grade 5 students of *Madrasah Ibtidaiyah Negeri* 2 Serang Regency.

Table 2: Statistical Data for Students' Pre-Test and Post-Test Critical Thinking Skills

Statistics	Class			
	Control		Experimental	
	Pre-Test	Post-Test	Pre-Test	Post-Test
Average	50.84	60.61	56.23	71.04
Median	54.55	63.64	54.55	72.73
Mode	45.46	63.64	54.55	72.73
Maximum Score	72.73	81.82	81.82	90.91
Minimum Score	27.28	36.37	27.28	45.46
Standard Deviation	14.09	13.808	14.92	13.349
Variance	198.684	190.680	222.696	178.204

Table 2 presents statistical data on the pre-test and post-test scores of critical thinking skills among 5th-grade students at Madrasah Ibtidaiyah

Negeri 2 Serang Regency. The data indicates that the experimental class showed a significant improvement in critical thinking skills compared to the control class. Specifically, the experimental class's average pre-test score was 56.23, which increased to 71.04 in the post-test, demonstrating a notable enhancement in their critical thinking abilities. In contrast, the control class's average score rose from 50.84 in the pre-test to 60.61 in the post-test, reflecting a more modest improvement.

Further analysis reveals that the experimental class outperformed the control class in both pre-test and post-test assessments, as indicated by their higher average scores and median values. Additionally, the experimental class exhibited a broader range of scores, with a maximum post-test score of 90.91, compared to 81.82 in the control class. These findings suggest that the intervention applied in the experimental class was more effective in enhancing students' critical thinking skills, as evidenced by the more substantial increase in post-test scores and overall performance.

Assumption Test

Normality Test

A normality test was conducted to ensure that the data distribution in this study followed a normal distribution. The results of the normality test are presented in Table 3 below.

Table 3: Data Normality Results

Class	Significance		α
	Pre-test	Post-tes	
Experiment	0.115	0.167	0.05

Control	0.145	0.170	0.05

Based on the results shown in Table 3, the significance value for the normality test in the experimental class was 0.115 for the pre-test and 0.167 for the post-test, while for the control class, the significance values were 0.145 for the pre-test and 0.170 for the post-test. Since all significance values are greater than α = 0.05, it can be concluded that the data in both groups, for both the pre-test and post-test, are normally distributed.

Homogeneity Test

The homogeneity test was conducted to ensure that the variance between groups was balanced. This study used the Levene Statistic test for the homogeneity analysis. Data is considered homogeneous if the significance value of the test is greater than 0.05. If the significance value is less than 0.05, the data is deemed not homogeneous.

Table 4: Data Homogenity Results

	Levene Statistic	df1	df2	Sig.
Based on Mean	0.111	3	10 4	0,954

Based on Table 4, the Levene Statistic value obtained was 0.111 with degrees of freedom (df1) of 3 and (df2) of 10. The significance value (Sig.) was 0.954. Since the significance value is greater than 0.05, it can be concluded that the data has homogeneous variance, meaning the assumption of data homogeneity is satisfied in this study.

Data Analysis
T-Test

The t-test was conducted to compare the post-test results between the experimental group and the control group. The results of the t-test on critical thinking skills of grade 5 students at Madrasah Ibtidaiyah Negeri 2 Serang Regency are presented in Table 5 below.

Table 5: Independent Sample T-Test Results

	Levene's Test for Equality of Variance		T-Test for Equality of Means			
	F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference
Equal Variances Assumed	0.115	0.736	2.823	52	0.007	10.43296

Table 5 presents the results of the independent sample t-test conducted to assess critical thinking skills among grade 5 students at Madrasah Ibtidaiyah Negeri 2 Serang Regency. Levene's Test for Equality of Variances yielded an F value of 0.115 with a significance level of 0.736, indicating that the assumption of equal variances between the two groups was met. This suggests that the variance in critical thinking skills between the experimental and control groups was similar.

The t-test results show a t-value of 2.82 with 52 degrees of freedom and a significance level of 0.007, which is below the conventional threshold of 0.05. This statistically significant p-value indicates a substantial difference between the means of the two groups. The mean difference of 10.43296 further confirms this difference, highlighting that the experimental group demonstrated significantly better critical thinking skills compared to the control group. These results underscore the effectiveness of the intervention

applied to the experimental class in enhancing students' critical thinking abilities.

The significant t-value and p-value demonstrate that the intervention had a notable impact on the experimental group's critical thinking skills. According to the theory of critical thinking Ennis (2018), effective interventions often involve strategies that promote higher-order thinking skills, such as analysis, evaluation, and synthesis, which are essential for developing critical thinking abilities. Additionally, the results align with findings from a recent study by King and Kitchener (2004), which emphasizes that targeted educational interventions can significantly enhance students' critical thinking skills by engaging them in reflective and evaluative processes. Furthermore, the mean difference of 10.43296 emphasizes the substantial improvement, validating the approach used in the experimental class.

N-Gain Test

After obtaining the pretest and post-test scores, we attempted to find out the extent to which students' critical thinking skills have improved from the pretest and post-test data using the normalized gain formula (N-Gain). N-Gain data are presented in Table 3 below. The table provides a detailed view of the N-Gain test results for critical thinking skills among grade 5 students at Madrasah Ibtidaiyah Negeri 2 Serang Regency. The data indicates a marked improvement in the experimental class, where four students achieved a high increase in critical thinking skills, 16 students demonstrated a medium increase, and seven students showed a low

increase. The average N-Gain score for the experimental group is 0.3968, suggesting a significant enhancement in critical thinking abilities. This result is consistent with educational theories that emphasize the effectiveness of targeted interventions in improving cognitive skills over time (Sternberg, 2020).

Table 3 N-Gain Test of Students' Critical Thinking Skill

Experimental		Control	
Category	Frequency	Category	Frequency
Tall	4	High	1
Currently	16	Medium	7
Low	7	Low	19
Amount	27		27
Average	0.3968		-0.0067

In contrast, the control class exhibited less favorable outcomes, with only one student showing a high increase, seven students in the medium category, and 19 students in the low category. The average N-Gain score for the control group is -0.0067, indicating a negligible or even negative change in critical thinking skills. This disparity highlights the efficacy of the intervention applied in the experimental class compared to the conventional approach used in the control class. The findings underscore the importance of implementing structured educational strategies to foster critical thinking, aligning with Paul and Elder (2013) who emphasizes the role of effective pedagogical practices in enhancing students' cognitive abilities.

The development of critical thinking skills in the context of Islamic education can be viewed from the perspective of theories and teachings

contained in the Qur'an and Hadith. For example, in Surah al-Mulk (67:10), For example, in Surah al-Mulk (67:10), Allah says:

وَقَالُوا لَوْ كُنَّا نَسْمَعُ اَوْ نَعْقِلُ مَا كُنَّا فِيْ اَصْحٰبِ السَّعِيْر (الملك: ١٠)

"And they will say, "If only we had been listening or reasoning, we would not be among the companions of the Blaze" (QS. [67] Al-Mulk: 10)

This verse emphasizes the importance of using reason to think critically as part of human responsibility in living a blessed life. In the context of this study, improving students' critical thinking skills aligns with Islamic teachings that encourage reasoning and reflection to understand and address life's challenges.

Additionally, the Hadith of the Prophet Muhammad (sallallahu alaihi wasallam) also underscores the importance of reason. In a hadith narrated by Abu Hurairah, the Prophet Muhammad (sallallahu alaihi wasallam) said:

مَنْ لَا يَفْقَهُ فِي دِينِهِ فَكَأَنَّهُ لَمْ يَعْقِلْ أَصْلًا

"Whoever does not understand his religion, it is as if he has no reason at all.") (HR. Al-Bukhari)

This hadith highlights that understanding religion and using reason to do so is a crucial aspect of reasoning itself. Therefore, interventions that enhance students' critical thinking skills are consistent with Islamic teachings, which prioritize intellectual development as part of a holistic education.

The Islamic scholar Ibn Khaldun, in his Muqaddimah , also emphasized that knowledge and education must include critical and analytical thinking (Machouche and Bensaid (2015)). He argued that true

education fosters deep understanding and reflection on social and intellectual realities. This aligns with the results of this study, which show that innovative learning methods can enhance students' critical thinking skills (Raikou et al., 2017; Subramani & Iyappan, 2018; Afikah et al., 2022), reflecting the principles of Islamic education that encourage the development of reason and profound understanding.

From the data presented in Table 1, the experimental class showed a significant increase in students' critical thinking scores from the pre-test to the post-test compared to the control class. This finding is consistent with the results of Çalişkan et al., (2020)who observed a notable improvement in students' critical thinking skills following the learning process. However, this contrasts with the findings of Van Peppen et al. (2021), who reported improvements in students' critical thinking skills from pre-test to post-test, with further improvement after a delay, but no significant differences between contrasting examples (true, false, and practice problems) This suggests that while improvements in critical thinking skills are evident, the learning model can influence the extent of these improvements.

Although the assumption of equal variance was met, there were significant differences in the critical thinking scores between the two groups, with the experimental group showing a higher mean. This indicates that various learning methods can lead to different outcomes in the development of students' critical thinking skills. Several studies, such as those by Maharani et al. (2023)and Yaki (2022), highlight the effectiveness of inquiry-based learning and integrated STEM approaches in enhancing

critical thinking skills. However, other research, such as Agustin et al. (2023) presents mixed results depending on the instructional methods used. Specifically, Tommasi et al. (2023)found that the problem-based learning model did not significantly affect students' critical thinking skills. Therefore, it is evident that the choice of learning method plays a crucial role in shaping students' critical thinking abilities, with some methods proving to be more effective than others.

The learning method used in the experimental class was more effective in improving students' critical thinking skills than the method used in the control class. Significant improvements were observed in the distribution of students across improvement categories and in the average increase in critical thinking scores. This is consistent with research by Maharani et al. (2023), Sartika et al. (2023), and Bazarbayeva and Aitbayeva (2023), all of whom demonstrated substantial improvements in students' critical thinking abilities. Overall, these findings underscore the importance of innovative teaching approaches in fostering the development of critical thinking skills.

CONCLUSION

The findings of this study indicate that the application of the problem-solving-based learning model significantly contributes to the development of critical thinking skills among Madrasah Ibtidaiyah students, particularly in grade 5 students at Madrasah Ibtidaiyah Negeri 2 Serang Regency. The results suggest that active learning models, such as problem-solving, not only

lead to significant improvements in critical thinking scores compared to conventional methods, but also support the theory that active learning approaches are more effective in fostering higher-order thinking skills. For future research, it is recommended to explore the application of problem-solving-based learning models in different educational contexts, assessing their impact on critical thinking skills and other learning outcomes across various grade levels. Additionally, future studies should investigate the factors that influence the effectiveness of this model in diverse educational settings. The development of critical thinking skills in the context of Islamic education can be framed through the theories and teachings found in the Qur'an and Hadith. For example, Q.S. Al-Mulk verse 10 emphasizes the importance of using reason to think critically as part of human responsibility in leading a blessed life.

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