

## The Role of Problem-Based Learning in Developing Critical Thinking and Improving Learning Outcomes of Fifth Grade Students

Tanti Wulandari\*, Nurmida Catherine Sitompul, Retno Danu Rusmawati

Magister of Educational Technology, Universitas PGRI Adi Buana Surabaya

\*E-mail Corresponding Author: [wulandaritanti328@gmail.com](mailto:wulandaritanti328@gmail.com)

**Abstract:** 21st-century learning requires students to develop critical, creative, and collaborative thinking skills, as well as the ability to solve contextual problems. However, learning practices in elementary schools are still dominated by expository strategies, which render student's passive and discourage the development of higher-order thinking skills. Research on the application of problem-based learning strategies to improve critical thinking skills and learning outcomes, particularly in natural disasters, is still limited. This study used a quasi-experimental method with a Nonequivalent Control Group Design on 104 fifth-grade students, divided into an experimental class using problem-based learning and a control class using an expository strategy. The instruments, a learning achievement test and a critical thinking test, were tested using Cronbach's Alpha in IBM SPSS Statistics 27, while pretest and posttest data were analyzed using an Independent Samples T-Test at a significance level of 0.05. The results showed a significant effect of problem-based learning strategies on improving learning outcomes and critical thinking skills, in line with constructivist theory, which emphasizes active student involvement. This strategy is more effective than expository learning and is recommended for wider implementation.

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### Introduction

The phenomenon of natural disasters in Indonesia continues to increase, particularly hydrometeorological disasters such as floods, extreme weather, and landslides. According to BNPB data, from early 2025 to mid-March, 641 disasters have occurred, affecting more than 2.2 million people and resulting in 110 deaths. In the case of the massive floods that hit Greater Jakarta (Jabodetabek), including Bekasi, Basarnas deployed personnel and technology such as *drones* for monitoring and evacuation of victims. This situation underscores the need for disaster education starting at the elementary school level so that students have the knowledge and skills to deal with emergencies.

In the context of basic education, the integration of natural disaster material needs to be implemented through a learning approach that fosters critical thinking skills. One such approach is the *Problem-Based Learning Strategy* (PSL), which encourages students to analyze, find solutions, and connect concepts to real-life situations (Gunawan et al., 2023).

Global educational trends also emphasize the importance of developing critical thinking skills, particularly in addressing issues such as climate change and disaster mitigation. Several studies have shown that PSL not only improves conceptual understanding but also relevant practical skills (Hernandez et al., 2023). In contrast, the widely used expository strategy is considered less effective in developing critical thinking skills due to its one-way nature and focus on conveying information.

Research by Alvarado & Diaz (2024) shows that SPBM is more effective than expository methods in improving critical thinking skills, primarily due to its demands on student engagement and the ability to connect theory to practice. A similar opinion is expressed by Baker (2023), who states that expository methods, while efficient in delivering material, provide less room for in-depth critical analysis.

Despite its many advantages, implementing SPBM in natural disaster learning in elementary schools faces several challenges. First, limited time and resources are the main obstacles. SPBM requires in-depth planning, access to supporting materials, and requires more time than traditional methods. A dense curriculum often makes SPBM less than optimal, especially for complex topics like natural disasters (Patel & Bhandari, 2023). Second, the effectiveness of SPBM is not uniform across all students. Jones et al. (2024) found that while many students experienced improvements in critical thinking skills, others struggled due to variations in initial abilities, motivation, and academic background. This suggests that SPBM requires support for learning differentiation to ensure its benefits are more evenly felt. Third, the application of SPBM to real-world situations such as natural disasters still face challenges. Natural disasters demand deeper contextual understanding and practical skills. Lee & Zhang (2025) found that SPBM does improve student understanding, but requires structured learning support and sufficient time for students to connect concepts to real-world situations. Fourth, measuring critical thinking skills in the context of SPBM is challenging. According to Carter & Green (2024), the abstract nature of critical thinking often makes evaluations subjective and not fully reflective of student development. More valid and objective instruments are needed to accurately assess the impact of SPBM. Fifth, the integration of SPBM into the elementary school curriculum remains unsystematic. Many curricula still focus on academic outcomes and do not fully support active approaches like SPBM. Gonzalez et al. (2023) noted that current curricula have not been designed to encourage innovative methods. Consequently, despite SPBM's great potential, its implementation remains limited.

Amid these challenges, SPBM remains relevant because it develops essential skills for dealing with disasters. Learning that involves analyzing real-world problems can improve students' preparedness in responding to emergencies (Salam et al., 2023). Students who are able to think critically are better equipped to make quick, effective, and data-driven decisions. This approach also aligns with the demands of 21st-century education, which emphasizes *problem-solving* and adaptive skills. Green & Carter (2024) emphasized that SPBM can develop critical thinking skills, especially when applied to relevant contexts such as natural disasters. In addition to understanding scientific concepts, students also learn to respond appropriately to emergency situations. Lee & Zhang (2025) also demonstrated that SPBM enhances students' understanding and practical skills when the material is directly related to everyday experiences.

The social impact of implementing SPBM in natural disaster education is also significant. Students can become agents of change by disseminating disaster knowledge to their families and communities, thereby enhancing collective preparedness. Thus, the benefits

of SPBM are felt not only in the classroom but also in increasing community capacity to face disaster threats. Several related studies indicate a research gap that remains unfilled. Jones et al.'s (2024) study compared SPBM and expository methods, but did not specifically examine the context of natural disasters. Lee & Zhang (2025) examined the application of SPBM to natural disaster material, but did not compare it with expository methods. Meanwhile, Patel & Bhandari (2023) focused on the challenges of implementing SPBM in general, not on developing critical thinking or disaster topics. Gonzalez et al. (2023) pointed out the limitations of the expository method but did not examine its comparison in the context of natural disasters.

Therefore, the current study attempts to fill this gap by focusing on a direct comparison between the SPBM and expository methods in disaster management learning in fifth-grade elementary schools. This study not only analyses learning outcomes but also examines the influence of both methods on students' critical thinking skills in the context of Indonesian education. Given the dynamic nature of the Indonesian curriculum, this study is expected to provide new contributions to the development of a curriculum that is adaptive and responsive to the needs of disaster management learning. This research is also important because the topic of natural disasters requires a learning approach that encourages in-depth understanding, not just memorization of concepts. By comparing these two learning methods, it is hoped that the most effective strategies for preparing students for real-world challenges, particularly those related to the increasingly frequent occurrence of disasters, can be identified.

## Research Method

Research design using *quasi-experimental design* approach with a *non-equivalent control group design*, because the characteristics of the population did not allow for random group selection. The purpose of the study was to measure the effect of two learning strategies *problem-based learning strategies* and expository strategies on the critical thinking skills and learning outcomes of fifth-grade students on natural disaster material. The selection of these two strategies was based on the theory that *problem-based learning strategies* can improve critical thinking and active student engagement, while expository strategies remain dominant in traditional learning despite their tendency to be passive. The study involved two groups: an experimental group that received learning with *problem-based learning strategies* through solving contextual problems related to natural disasters, and a control group that learned using expository strategies through direct and systematic delivery of material. Both groups learned the same material but with different approaches, so this design allowed researchers to comprehensively analyze how the different strategies affect critical thinking skills and student learning outcomes, with the hope that *problem-based learning strategies* create more interactive learning compared to one-way learning in expository strategies.

Table 1 Research Design

Group	Pre-test	Treatment	Post-test
Problem-based learning strategy experiment	O1	problem-based learning strategies	O2
Control (Expository)	O3	Expository Strategy	O4

### Information:

O1, O3 = Pre-test to measure initial abilities

O2, O4 = Post-test to measure the results after treatment

This research design required all students to take a *pre-test* to measure their critical thinking skills and understanding of the material before the treatment was given. Then, each group received learning according to the specified strategy, and after that, students took a *post-test* to assess changes in their abilities. The use of *pre-tests* and *post-tests* allowed researchers to identify improvements in critical thinking skills and understanding of the concept of natural disasters. To maintain the validity of the comparison between *problem-based learning strategies* and expository strategies, all test instruments and learning treatments were tested for validity and reliability first. Measurement of learning outcomes was carried out through a written test that assessed students' understanding of the concept of natural disasters and their ability to apply the concept in real situations. After the entire learning series was completed, students took another *post-test* to measure changes in conceptual understanding, so this study could determine whether there was a significant influence of the two learning strategies on students' critical thinking skills and learning outcomes in the material on natural disasters.

This study was conducted on 5th grade elementary school students in the Bareng area in the 2025/2026 academic year, with a population consisting of 104 students from four classes, namely VA, VB, VC, and VD. This study aims to test the effect of *problem-based learning (PBL)* on critical thinking skills and student learning outcomes in natural disaster material compared to conventional methods in the form of lectures. To achieve this goal, the research subjects were divided into two groups, namely the experimental group that received treatment using *problem-based learning strategies* and the control group that followed learning with expository or lecture strategies, so that this division allows for evaluation of the effectiveness of each method in improving students' conceptual understanding of natural disaster material, as described in Table 2.

Table 2. Research Subjects

No.	Class	Subject	Lecture Method Learning	Problem-Based Learning Strategy
1	Class VA	26 students	26 students	-
2	VB Class	26 students	26 students	-
3	VC Class	25 students	-	25 students
4	Class VD	27 students	-	27 students
	Amount	104 students	52 students	52 students

Each class in this study was divided into two groups, namely the experimental group that implemented a *problem-based learning strategy* and the control group that used the lecture method, each consisting of 52 students; the study lasted for 6 meetings, each meeting lasting two lesson hours (70 minutes), with the experimental group receiving digital media-based assignments to understand the concept of natural disasters in an applicable manner to improve critical thinking skills, while the control group followed conventional learning through direct delivery of materials. This study aims to evaluate the effect of both methods on students' conceptual understanding of natural disasters, with the hope that *the problem-based learning strategy* is able to stimulate active student involvement, while the lecture method continues to provide systematic understanding, so that the results of the study can provide insight into the effectiveness of each approach in improving learning outcomes and supporting the development of innovative learning strategies in elementary schools.

The data collection technique in this study used two main instruments, namely tests and questionnaires, which were designed to measure variables related to the research objectives, namely the influence of *problem-based learning strategies* and *expository learning strategies* on critical thinking skills and student learning outcomes on natural disaster material. Tests were used to assess critical thinking skills and student understanding through two stages, namely *pre-test* and *post-test*. *The pre-test* was given before learning to measure students' initial understanding of natural disasters, including types of disasters, causes, impacts, mitigation, and handling, as well as to identify students' initial abilities in analyzing disaster-related information.

After the learning treatment, students were given a *post-test* to measure changes in their conceptual understanding and critical thinking skills, including the ability to analyze, evaluate, and connect information about natural disasters in a broader context. *The post-test* also assessed students' abilities in interpreting, applying knowledge, and developing creative and practical solutions related to disaster problems. Overall, the two tests were used to identify changes in learning outcomes and critical thinking skills after the implementation of two different learning strategies, so that the data obtained can show the extent to which *the problem-based learning strategy is effective* compared to *the expository learning strategy* in helping students understand and analyze natural disaster material.

The data analysis in this study used *Multivariate Analysis of Variance (MANOVA)* because this multivariate statistical technique is able to test the average difference between two groups on two dependent variables simultaneously, namely critical thinking skills and student learning outcomes, both of which are interrelated. The use of *MANOVA* allows researchers to see whether there are significant differences between the group that applies *the problem-based learning strategy* and the group that uses *the expository strategy*, while also understanding the extent to which the two dependent variables interact and are influenced by different learning methods. In addition, *MANOVA* reduces the risk of type I error that may arise if the dependent variables are analyzed separately as in ANOVA, so that the results of the analysis are more valid and provide a comprehensive picture of the influence of the two learning strategies on the development of critical thinking skills and student learning outcomes in the material of natural disasters.

## Results

Before data analysis was conducted using the t-test (*Independent Samples t-test*) to determine the effect of *problem-based learning strategies* on critical thinking skills and student learning outcomes on natural disaster material for grade V of SD Negeri Karanganyar 1 and SD Negeri Banjarnegara 2, the study first conducted analysis prerequisite tests in the form of normality tests and homogeneity tests to ensure the data met the basic assumptions of parametric tests. The normality test was used to see whether the distribution of data from the experimental and control groups followed a normal distribution pattern, while the homogeneity test aimed to ensure that the variances of the two groups were comparable so that differences in learning outcomes were truly caused by the learning treatment, not by differences in data characteristics. The implementation of these two tests ensured that the statistical analysis carried out was valid and reliable, so that the use of the t-test could be scientifically justified. Thus, the prerequisite test is not only a technical procedure, but also a methodological foundation that ensures that conclusions regarding the effect of *problem-*

based learning strategies on critical thinking skills and student learning outcomes are truly based on valid, measurable, and reliable data.

The homogeneity of variance test is an important prerequisite step before analyzing the effect of *problem-based learning strategies* on critical thinking skills and learning outcomes of students at Karangany 1 Elementary School and Banjaragung 2 Elementary School, because this test ensures that the experimental group and the control group have comparable levels of data diversity so that differences in learning outcomes are not caused by differences in group characteristics. For this reason, *Levene's Test of Homogeneity of Variances* was conducted on both research variables, namely critical thinking skills and learning outcomes, where a significance value greater than 0.05 indicates that the data is homogeneous and meets the requirements for analysis using parametric tests such as *the Independent Samples t-test*. Thus, the homogeneity test ensures that the research results truly reflect the effectiveness of the application of *problem-based learning strategies*, not due to the irregularity of variance between groups.

Table 1 Homogeneity Test of Variance of Critical Thinking Skills and Student Learning Outcomes

		Levene Statistic	df1	df2	Sig.
KETERAMPILAN BERPIKIR KRITIS	Based on Mean	3.540	1	102	.063
	Based on Median	3.450	1	102	.066
	Based on Median and with adjusted df	3.450	1	97.406	.066
	Based on trimmed mean	3.584	1	102	.061
HASIL BELAJAR	Based on Mean	1.798	1	102	.183
	Based on Median	1.930	1	102	.168
	Based on Median and with adjusted df	1.930	1	101.987	.168
	Based on trimmed mean	1.852	1	102	.177

Source: Data Processing in the SPSS 27 Application (2025)

Based on the results of *Levene's Test of Homogeneity of Variances*, the critical thinking skills variable obtained a significance value of 0.063 and the learning outcomes variable obtained a significance value of 0.183, both of which are greater than 0.05 so that the variance of the experimental group and the control group is declared homogeneous. This homogeneity indicates that the distribution of data on critical thinking skills and learning outcomes of students of Karangany 1 Elementary School and Banjaragung 2 Elementary School is at a comparable level of diversity, so that differences in results that will emerge can be attributed to the application of *problem-based learning strategies* and not due to differences in group characteristics. By fulfilling the homogeneity requirements for both variables, the research data is declared suitable for analysis using parametric tests, especially the t-test (*Independent Samples t-test*), so that conclusions regarding the influence of learning strategies on critical thinking skills and learning outcomes can be drawn with a strong statistical basis and a high level of confidence.

The normality test was conducted before the inferential analysis to ensure that the data on critical thinking skills and learning outcomes of students of Karangany 1 Elementary School and Banjaragung 2 Elementary School, both in the experimental group using

*problem-based learning strategies* and the control group using *expository strategies*, were normally distributed so that they met the requirements for using parametric statistical techniques such as *the Independent Samples t-test*. The normality test used Kolmogorov-Smirnov and Shapiro-Wilk, with a significance value greater than 0.05 as an indicator that the data were normally distributed. Through this test, the researcher ensured that both groups had data characteristics that did not deviate from the normal distribution, so that the differences in results found later truly reflected the influence of *problem-based learning strategies*, not due to the unfairness of data distribution, as shown in the normality test results table.

Table 4. Results of the Normality Test of Critical Thinking Skills and Student Learning Outcomes

		Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
METODE		Statistic	df	Sig.	Statistic	df	Sig.
KETERAMPILAN BERPIKIR KRITIS	MODEL PBL	.115	52	.084	.966	52	.138
	STRATEGI EKSPOSITORI	.095	52	.200*	.963	52	.106
HASIL BELAJAR	MODEL PBL	.103	52	.200*	.960	52	.080
	STRATEGI EKSPOSITORI	.110	52	.168	.961	52	.091

\*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Source: Data Processing in the SPSS 27 Application (2025)

In this study, the normality test was conducted using Kolmogorov-Smirnov and Shapiro-Wilk with the criteria that the data is normally distributed if the significance value is greater than 0.05, and the results show that the critical thinking skills variable in the group using *problem-based learning strategies* has a significance value of 0.084 and 0.138, while the group with *expository strategies* obtained values of 0.200 and 0.106; all of these values are above 0.05 so that the data is declared normally distributed, as well as the learning outcomes variable of students of Karangany 1 Elementary School and Banjaragung 2 Elementary School, where the *problem-based learning strategy group* obtained values of 0.200 and 0.080, while *the expository strategy group* obtained values of 0.168 and 0.091, which are also greater than 0.05, so that the entire data meets the normality assumption and can be further analyzed using *the Independent Samples t-test* without violating the parametric statistical assumptions.

After the data meets the prerequisite tests for normality and homogeneity of variance, the next stage is to conduct a hypothesis test using *the Independent Samples t-test* to determine the significant differences between the groups learning with *problem-based learning strategies* and the groups using *expository strategies*, so that it can be known whether problem-based strategies really have an effect on improving critical thinking skills and student learning outcomes on natural disaster material in grade V of Karangany 1 State Elementary School and Banjaragung 2 State Elementary School; this test not only compares the average of the two groups, but also assesses the effectiveness of the learning approach that emphasizes real problem solving and active student involvement, with the basis for decision making in the form of a significance value (*Sig. 2-tailed*) which must be smaller than 0.05 to state a significant effect, as shown in the *Independent Samples t-test results table* which illustrates the effectiveness of problem-based learning strategies on critical thinking skills and student learning outcomes.

Table 2 Results of the Independent Samples t-test on Critical Thinking Skills and Student Learning Outcomes

Independent Samples Test										
		Levene's Test for Equality of Variances				t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
HASIL BELAJAR SISWA	Equal variances assumed	1.620	.206	4.338	102	<.001	5.23077	1.20586	2.83895	7.62259
	Equal variances not assumed			4.338	101.794	<.001	5.23077	1.20586	2.83889	7.62264
KETERAMPILAN BERPIKIR KRITIS	Equal variances assumed	.137	.712	5.141	102	<.001	6.03846	1.17466	3.70853	8.36840
	Equal variances not assumed			5.141	100.240	<.001	6.03846	1.17466	3.70804	8.36889

Source: Data Processing in the SPSS 27 Application (2025) (Appendix 7)

The *Independent Samples t-test* was used after the data met the assumptions of normality and homogeneity of variance to determine significant differences between the groups using *problem-based learning strategies* and the groups using *expository strategies* on learning outcomes and critical thinking skills of students at Karangany 1 Elementary School and Banjaragung 2 Elementary School. Based on the analysis results, the Sig. (2-tailed) value of 0.000 for both variables indicates that there are significant differences between the two groups, so the alternative hypothesis ( $H_1$ ) is accepted and the null hypothesis ( $H_0$ ) is rejected. For the learning outcome variable, the t-value is 4.338 with df 102 and Sig. (2-tailed) 0.000, and the Mean Difference is 5.23077 which indicates that the average learning outcomes of students who learn through *problem-based learning strategies* are 5.23 points higher than the expository method, with a Confidence Interval of 2.83895 to 7.62259 which does not include zero. This proves that problem-based learning strategies provide significant improvements to learning outcomes because they emphasize real-world problem solving and deeper conceptual understanding.

In the critical thinking skills variable, the test results show a t-value of 5.141 with df 102 and Sig. (2-tailed) = 0.000, and a Mean Difference of 6.03846, which means that the critical thinking skills of students who learn using *problem-based learning strategies* are 6.04 points higher than those using expository strategies. The Confidence Interval range between 3.70853 to 8.36840 which does not include zero further strengthens that the difference is statistically significant. These results indicate that problem-based learning strategies have a strong influence on the development of critical thinking skills because they encourage students to identify problems, analyze information, propose hypotheses, and evaluate various alternative solutions, so that their higher-order thinking skills develop optimally.

## Discussion

The results of the hypothesis testing showed that in this study the group of students taught with problem-based learning strategies had an average learning outcome of 5.23 points higher than the group taught with expository strategies, with a value of  $t = 4.338$ ;  $df = 102$ ;  $p = 0.000$ ; confidence interval (CI) range of 2.83895 to 7.62259, which confirms a significant difference. These results indicate that the application of problem-based learning strategies to natural disaster material in grade V of elementary school provides advantages compared to expository strategies in the context of student learning outcomes at SD Negeri Karangany 1 and SD Negeri Banjaragung 2. Thus, the hypothesis that "problem-based learning strategies have a significant effect on student learning outcomes" can be accepted in this study.

Theoretically, the advantages of this problem-based learning strategy can be explained by referring to the constructivist approach that students construct their own knowledge through experience, problem-solving, and social interaction, as explained in the 21st-century

learning literature that highlights the importance of critical thinking skills, collaboration, and reflection in the learning process. For example, research shows that problem-based learning strategies consistently improve students' critical thinking and collaboration skills because students engage in the process of exploration and reflection rather than simply receiving material passively. In the context of natural disaster material, which is contextual to students' lives in Indonesia, a learning model that emphasizes real-world contexts such as this allows students to relate scientific concepts to their own experiences, resulting in more meaningful learning and ultimately improved learning outcomes (Jelodari et al., 2025).

The results of this study are also supported by various previous studies. For example, research by (Darmawati & Mustadi, 2023) showed that fifth-grade elementary school students taught with problem-based learning strategies had higher critical thinking skills than students taught expository ( $p = 0.004$ ) in science lessons. Another study by (Abdullah & Ningrum, 2024) on natural disaster mitigation found that problem-based learning strategies significantly improved students' critical thinking skills compared to conventional learning. International studies such as those reported by (Zhang, 2023) found that meta-analyses of project-based learning models (which have very similar characteristics to problem-based learning strategies) significantly improved learning outcomes and thinking skills compared to traditional methods. Thus, your research, which found the superiority of problem-based learning strategies in student learning outcomes, aligns with current research trends showing that active learning models are superior to traditional expository models.

However, it should also be noted that not all studies show absolute superiority for problem-based learning strategies or active learning models over expository strategies. Some studies also show insignificant results or conditions that moderate the effectiveness of the model. For example, a meta-analysis by (Zhang, 2023) stated that although overall problem-based (or project-based) learning strategies showed a positive effect ( $SMD = 0.441$ ;  $p < 0.001$ ), the results were influenced by moderating variables such as subject area, group size, and duration of the experiment. A literature review by (Oktaria, 2025) stated that of ten journals in elementary schools, 70% showed improvement with problem-based learning strategies, but 30% did not explicitly demonstrate strong efficacy. Furthermore, research on the relevance of expository strategies shows that this method remains effective in certain contexts; for example, research by (Hasan, 2025) highlighted that expository strategies are relevant in teaching certain materials, especially if teachers are competent and interactive processes are implemented.

The difference in results between this study and several studies that are less supportive or that show variability can be explained by several contextual factors in implementation. First, teachers' readiness to implement problem-based learning strategies. If teachers are not accustomed to designing real-world problems, managing groups, and facilitating reflection, the effectiveness of problem-based learning strategies can be reduced. For example, a study by Nurwidodo et al. (2025) revealed that many teachers had not properly implemented the problem-orientation and group work organization stages, resulting in suboptimal student critical thinking achievement. Second, the time allocation and learning duration meta-analysis by Zhang (2023) showed that experimental durations of 9-18 weeks produced the clearest effects; if the time was shorter or the groups were larger, the benefits were reduced. Third, the contextual characteristics of the material and students—the natural disaster material in this study—are suitable for problem-based learning strategies because they are relevant to students' experiences; this can strengthen the effectiveness of problem-based learning strategies compared to material that is highly abstract or far removed from students' daily

lives. Fourth, the measurement instrument, if the instrument only assesses memorization or -lower-order thinking aspects, may not capture the benefits of active models such as problem-based learning strategies. This study does show that significant learning outcomes are possible using instruments that are sufficiently sensitive to conceptual understanding and application.

In terms of the implications of the findings, theoretically, this study strengthens the theoretical foundation that student *-centered*, contextualized learning that fosters collaboration and reflection (such as problem-based learning strategies) will improve learning outcomes better than teacher-centered and direct (expository) learning. This reaffirms that student mastery of material is not simply about receiving information, but through an active process of constructing meaning, solving problems, and reflecting on what has been learned, as supported by international research. Practically, these findings suggest that elementary school teachers, especially those teaching fifth-grade natural disasters, should consider implementing problem-based learning strategies as their primary learning strategy, ensuring that the problem scenarios used are relevant to the students' environment, facilitating group discussions and reflection, and providing adequate learning time. Schools and school policymakers need to provide teacher training in problem-based learning strategies, supporting worksheets and media, and classroom conditions that enable collaboration and exploration. While expository strategies should not be discounted—especially when implemented well and accompanied by interactive modifications—problem-based learning strategies are superior in the context of material that demands in-depth understanding and application. From a methodological perspective, this study suggests that further research should employ more robust experimental designs (e.g., pretest-posttest control groups), consider moderating variables (such as student motivation, prior skills, teacher preparedness, time allocation, and facilities), and utilize instruments that measure application domains and HOTS beyond memorization. Future research could also explore the application of problem-based learning strategies to other materials and grade levels to allow for broader generalization of the effects.

Overall, this discussion demonstrates that this study, which found the superiority of problem-based learning strategies in improving elementary school students' learning outcomes in natural disasters, falls within the current research framework that supports the effectiveness of active learning, but also recognizes that its effectiveness is contextual and dependent on implementation conditions. Therefore, while these results are very promising, implementation in the field must consider supporting factors for optimal functioning of problem-based learning strategies.

The results of the hypothesis testing showed that the group of students taught with problem-based learning strategies obtained an average score of 6.04 points higher in critical thinking skills than the group taught through expository strategies, with a very significant difference ( $p < 0.001$ ) and a confidence interval that does not encompass zero. This finding indicates that problem-based learning strategies have a strong influence on improving the critical thinking skills of students at Karangan 1 Elementary School and Banjaragung 2 Elementary School. In the context of this study, learning activities of problem-based learning strategies that include identifying real problems, analyzing information, proposing hypotheses, evaluating alternative solutions are the main mechanisms that encourage increased critical thinking.

Theoretically, this effect can be explained through constructivist and cognitive theory. When students are involved in activities that require them to formulate questions, evaluate

evidence, choose solutions, and reflect on the process, they practice higher-order thinking skills (analysis, evaluation, synthesis) as described in Bloom's revised taxonomy (Anderson & Krathwohl, 2001). In addition, Lev Vygotsky's zone of proximal development theory states that with teacher scaffolding and social interaction in groups, students can move from their actual abilities to higher cognitive potential. Problem-based learning strategies provide a framework for collaboration and discussion that allows teacher facilitation not as a passive transmitter, but as a guide so that the critical thinking achievements found become theoretically understandable.

In a review of previous supporting research, several studies showed results consistent with the findings of this study. For example, research by (Darmawati & Mustadi, 2023) found that elementary school students taught with problem-based learning strategies had higher critical thinking skills than those taught with expository strategies ( $p = 0.004$ ). Research by (Setiawan, 2023) on the problem-based learning strategy model in elementary schools also reported the effectiveness of problem-based learning strategies in improving critical thinking. Similarly, a meta-analysis of literature reviewing the effectiveness of problem-based learning strategies in elementary education contexts stated that problem-based learning strategies are generally effective in developing students' critical thinking skills (Fitriadi et al., 2025). Thus, this study aligns with the majority of empirical evidence showing that problem-based learning strategies are superior to expository learning in the context of developing critical thinking skills.

However, there are also studies that show that the superiority of problem-based learning strategies is not always absolute or that their significance varies depending on the conditions. For example, a meta-analysis by Setiawan et al. (2024) stated that although problem-based learning strategies have positive effects, their effectiveness is influenced by moderating variables such as learning duration, teacher and group readiness, and the type of material (Setiawan, 2023). Research on expository strategies by (Hasan, 2025) shows that expository strategies remain relevant in certain contexts and can provide adequate understanding if implemented interactively. Furthermore, a study by (Nurwidodo & al., 2025) found that in certain materials and contexts, students taught with problem-based learning strategies did not show significant improvement compared to controls, especially if the teacher was not yet proficient or facilities were limited. Therefore, despite the abundance of research supporting this, it is important to recognize that the effectiveness of problem-based learning strategies on critical thinking is contextual.

Several factors explain why some studies have not found significant differences between problem-based learning strategies and expository strategies. First, teacher readiness is crucial. If teachers are not accustomed to facilitating problem-based learning strategies (designing real-life problems, facilitating discussions, and working groups), then problem-based learning strategies can be similar to expository models, and the advantages of critical thinking are diminished. Second, limited time allocation and a dense material load can lead to less-than-optimal exploration and reflection activities in problem-based learning strategies, preventing students from experiencing in-depth critical thinking processes. Third, the characteristics of the material and students also influence this. If the material is too abstract or students are not accustomed to active learning, the advantages of problem-based learning strategies can be difficult to discern. Fourth, less sensitive critical thinking measurement instruments (e.g., those that only measure memorization or lower-level cognitive aspects) can make differences invisible, whereas this study used instruments capable of capturing critical thinking activities, which explains why the significant results were obtained.

Reviewing the implications of the findings of this study, from a theoretical perspective, the findings strengthen the framework that active problem-based learning is an effective pathway in developing critical thinking skills in elementary school students at Karanganyar 1 and Banjarsari 2. This enriches the literature that not only material and content mastery are important, but students' active cognitive processes (analysis, evaluation, synthesis) triggered by learning models such as problem-based learning strategies are key in developing critical thinking. From a practical perspective, these results suggest that fifth-grade elementary school teachers who teach natural disasters should consider the systematic use of problem-based learning strategies by selecting contextual problem scenarios, facilitating group discussions, providing space for evaluating alternative solutions, and reflecting on learning outcomes. Schools and policymakers need to support this by providing teacher training, relevant learning media, facilities that enable group work, and sufficient time for critical thinking processes to be prominent.

From a methodological perspective, this study demonstrates the importance of designing experiments with instruments sensitive to critical thinking skills, ensuring a relevant control group, adequate time allocation, and pre- and post-measurement. Future researchers are advised to consider moderating variables such as student motivation, initial critical thinking skills, and teacher preparedness for a more comprehensive analysis of the results. It is also recommended to use triangulation or mixed-methods approaches to understand how critical thinking processes develop during problem-based learning strategies compared to expository strategies.

Overall, this discussion indicates that this study, which found a significant difference and a 6.04-point increase in critical thinking skills when using a problem-based learning strategy compared to an expository strategy, is consistent with the current body of literature. However, its effectiveness is contextual and does not automatically guarantee successful implementation; student characteristics, materials, and instruments are crucial. Thus, the application of a problem-based learning strategy in the context of natural disaster learning for fifth grade elementary school students has proven effective and has important implications for both learning practice and future research.

## **Conclusion**

Based on the results of the study entitled "The Effect of Problem-Based Learning Strategy on Critical Thinking Skills and Student Learning Outcomes on Natural Disaster Material in Grade 5 of Karanganyar 1 Public Elementary School and Banjarsari 2 Public Elementary School," it can be concluded that the application of problem-based learning strategies (*Problem Based Learning*) has a significant influence on improving students' learning outcomes and critical thinking skills compared to expository strategies, which is evidenced by a t-value of 4.338 with a significance of 0.000 ( $<0.05$ ) on the learning outcome variable and a Mean Difference of 5.23 points which indicates an increase in students' conceptual understanding through active involvement in problem identification and contextual analysis; while on the critical thinking skills variable, a t-value of 5.141 with a significance of 0.000 ( $<0.05$ ) and a Mean Difference of 6.04 points is obtained, which confirms that problem-based learning strategies are more effective in stimulating *higher-order thinking skills* such as analyzing, evaluating, and synthesizing information in the context of real problem solving.

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