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IMPROVEMENT OF CRITICAL THINKING SKILLS OF ELEMENTARY SCHOOL STUDENTS AFTER THE IMPLEMENTATION OF PROBLEM-BASED LEARNING

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Abstract
Elementary school students' critical thinking skills remain low because instruction tends to be teacher-centered and does not yet provide many opportunities to analyze contextual problems. This study aims to determine the improvement in students' critical thinking skills following the implementation of the Problem-Based Learning model, supported by instructional videos, in the Natural and Social Sciences subject on the topic of "A Changing Earth." The study employed a pre-experimental method with a one-group pretest-posttest design. The research participants consisted of 29 fifth-grade students selected using saturation sampling. Data were collected using open-ended tests based on higher-order thinking skills, as well as observation sheets assessing instructional implementation and critical thinking behaviors. Data analysis was conducted through normality tests, paired t-tests, calculations of normalized gains, and analysis of the percentage of observation results. The results showed that the students' average scores increased from 30.17 on the pretest to 70.25 on the posttest. The paired t-test revealed a significant difference in critical thinking skills before and after instruction. The normalized gain of 0.5740 fell into the moderate category. The implementation of the learning process reached 82.5%, falling into the "good" category, while critical thinking behaviors improved from the "low" category to the "high" category. Improvements were observed across all indicators, particularly in providing simple explanations and drawing conclusions. Thus, the application of the Problem-Based Learning model, supported by instructional videos, led to an improvement in students' critical thinking skills, although further reinforcement is still needed in the areas of providing more detailed explanations and formulating strategies and tactics.
Keywords: *Problem-Based Learning; critical thinking skills; Natural and Social Sciences*

Abstract
Elementary school students' critical thinking skills remain low because instruction tends to be teacher-berpusat pada guru dan belum banyak memberikan kesempatan untuk menganalisis masalah kontekstual. Penelitian ini bertujuan mengetahui peningkatan kemampuan berpikir kritis peserta didik setelah penerapan model Problem-Based Learning dengan bantuan video pembelajaran pada mata pelajaran Ilmu Pengetahuan Alam dan Sosial materi Bumi Berubah. Penelitian menggunakan metode pre-eksperimental dengan desain one group pretest-posttest. Subjek penelitian terdiri atas 29 peserta didik kelas V yang dipilih melalui teknik sampling jenuh. Data dikumpulkan menggunakan tes uraian terbuka berbasis kemampuan berpikir tingkat tinggi dan lembar observasi keterlaksanaan pembelajaran serta perilaku berpikir kritis. Analisis data dilakukan melalui uji normalitas, uji t berpasangan, perhitungan peningkatan ternormalisasi, dan analisis persentase hasil observasi. Hasil penelitian menunjukkan bahwa rata-rata nilai peserta didik meningkat dari 30,17 pada tes awal menjadi 70,25 pada tes akhir. Uji t berpasangan menunjukkan adanya perbedaan yang signifikan antara kemampuan berpikir kritis sebelum dan setelah pembelajaran. Nilai peningkatan ternormalisasi sebesar 0,5740 berada pada kategori sedang. Keterlaksanaan pembelajaran mencapai 82,5% dengan kategori baik, sedangkan perilaku berpikir kritis meningkat dari kategori rendah menjadi kategori tinggi. Peningkatan terjadi pada seluruh indikator, terutama memberikan penjelasan sederhana dan menarik kesimpulan. Dengan demikian, penerapan model Problem-Based Learning dengan bantuan video pembelajaran diikuti oleh peningkatan kemampuan berpikir kritis peserta didik, meskipun penguatan masih diperlukan pada kemampuan memberikan penjelasan lebih lanjut serta mengatur strategi dan taktik.
Kata Kunci: Problem-Based Learning; kemampuan berpikir kritis; Ilmu Pengetahuan Alam dan Sosial

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Introduction

Education is a process that fosters a better value system and culture, encompassing character building, skill development, and the enhancement of students' intellectual abilities (Haniyah et al., 2024). Education is the process by which educators instruct, nurture, guide, influence, and transmit knowledge to students. Its purpose is to eradicate ignorance, increase knowledge, and shape a better personality that is useful for daily life (Aliet Noorhayati Sutisno, 2019). The essence of education rests on its function as an agent of change; an educational system is fundamentally designed to drive human transformation toward a more secure and independent life. This includes strengthening individuals' capacity for problem-solving, fulfilling the need for self-actualization, and, specifically, creating innovations to overcome various obstacles. The ultimate goal of this paradigm is the achievement of learning autonomy for every individual (Sutisno & Nurdiyanti, 2020).

Critical thinking is one of the higher-order thinking skills that is crucial for developing 21st-century skills (Yulina et al., 2025). It is an important skill that needs to be developed starting in elementary school. Critical thinking skills encompass five main indicators: the ability to provide simple explanations, build foundational skills, draw conclusions, offer further explanations, and devise strategies and tactics for solving problems (Ennis, 2011). However, the learning process in elementary school remains teacher-centered and tends to emphasize memorizing material rather than actively engaging students in problem-solving. This situation leads students to be passive, hesitant to express their opinions, struggle to ask questions, and be unable to provide logical reasoning for their answers.

If students lack critical thinking skills, they will struggle to understand problems that require analysis and reasoning. Students tend to simply accept information at face value without verifying its accuracy, rely on the teacher's explanations, and fail to connect the learning material to real-life situations. In the long term, a lack of critical thinking skills can affect students' ability to make decisions, solve problems, adapt to change, and tackle academic challenges at higher educational levels.

One alternative solution that can be implemented to address this issue is the use of the *Problem-Based Learning* (PBL) model. This model is characterized by the use of problems as the starting point for learning, linking them to real-world situations, utilizing various perspectives, independent learning, collaboration among students , and reflection on learning experiences (Anantiya et al., 2024). Through the stages of identifying problems, gathering information, conducting investigations, discussing, developing solutions, and evaluating the results of problem-solving, students are encouraged to actively engage in the learning process. The implementation of PBL is expected to train students to interpret information, analyze problems, evaluate various alternative answers, express opinions logically, and draw conclusions based on the evidence obtained.

Research on the improvement of critical thinking skills following the implementation of PBL is important because these skills do not develop automatically but require planned, active, and problem-solving-oriented learning. This research is necessary to obtain empirical evidence regarding changes in students' critical thinking skills after the implementation of PBL. The research findings are expected to serve as a basis for teachers in selecting more innovative learning models, improving the quality of the learning process, and equipping students with the skills needed to tackle various academic and everyday challenges.

Findings from the field indicate that the critical thinking skills of elementary school students are generally still low. For example, a study by Maqbullah et al. (2018) revealed that the critical thinking skills of elementary school students remain low and fall below the proficiency criteria. This finding is further supported by a study conducted by Magdalena et al. (2020), which states that the low level of critical thinking skills is caused by a learning process that remains conventional and *teacher-centered,* resulting in students becoming passive learners.

The *Problem-Based Learning* (PBL) model is a learning model that uses contextual problems in the surrounding environment as a basis for students to acquire knowledge and understand concepts through critical thinking and problem-solving (Siswanti & Indrajit, 2022). PBL is characterized by learning that begins with real-life problems encountered in daily life. Learning materials and activities are tailored to the local environment to make them more engaging and meaningful. In practice, teachers act as facilitators or supervisors, while students are given the opportunity to think, gather information, and develop appropriate strategies to solve problems (Akinoğlu & Tandoğan, 2007).

The implementation of the PBL model consists of five phases: orienting students toward a problem; organizing students to conduct an investigation; guiding the data collection process; developing and presenting problem-solving results; and analyzing and evaluating the investigation process through reflection on the steps of thinking, the strategies used, and the problem-solving results (Siswanti & Indrajit, 2022).

The PBL model has the advantage of helping students understand the material through problem-solving, discover new knowledge, and increase their engagement and interest in learning. This model also develops critical and creative thinking skills, encourages students to evaluate their learning process, and provides opportunities to apply their knowledge to everyday problems in an enjoyable way (Sanjaya, 2011). PBL has several limitations: students who lack interest or self-confidence tend to struggle with problem-solving. Furthermore, if students do not understand the objectives and benefits of problem-solving activities, the learning process may be less than optimal. Implementing this model also requires a relatively longer time, so its execution must be adapted to the time allocation and curriculum requirements (Suyadi, 2015).

Critical thinking is a logical and reflective thought process aimed at determining what is credible or what actions should be taken. With , critical thinking skills can thus be understood as a form of thinking that involves the use of cognitive processes (Ennis, 2011). Critical thinking can be understood as an essential intellectual ability in modern education, which encourages individuals not only to accept information but also to analyze, test, and evaluate various beliefs, assumptions, and knowledge based on valid and accountable evidence (Novandi et al., 2025). Indicators of critical thinking skills include several aspects, such as providing simple explanations, building basic skills, drawing conclusions, offering further explanations, and devising strategies and tactics (Ennis, 2011). Critical thinking skills aim to develop students' ability to make logical and rational decisions.

Based on observations at a public elementary school in Depok Subdistrict, Cirebon Regency, students' critical thinking skills remain at a low level, as reflected in their reluctance to ask questions, difficulty analyzing information, and tendency to wait for the teacher's instructions during the learning process. This situation arises because teachers predominantly use the lecture method, resulting in a teacher-centered learning environment that fails to provide students with sufficient opportunities to actively engage in higher-order thinking processes. In this context, the implementation of the PBL model is viewed as both a solution and a relevant innovation because it encourages students to actively identify, analyze, and solve contextual

problems, so that they do not merely passively receive information but also construct knowledge through the process of inquiry. With characteristics that emphasize collaboration, exploration, and reflective thinking, PBL has the potential to create a more meaningful learning environment, foster curiosity, and develop students' critical thinking skills more effectively—in line with the demands of 21st-century learning.

The gap analysis in this study focuses on the still-low level of critical thinking skills among elementary school students, particularly in science education, which has thus far tended to be dominated by teacher-centered instruction. This situation results in students being less active in identifying problems, analyzing information, expressing opinions, and formulating solutions logically. Furthermore, previous studies have mostly emphasized the general application of the PBL model or its use with other learning media; consequently, there remains a limited body of research that specifically integrates the PBL model with instructional videos as a means to introduce contextual problems in IPAS instruction at the elementary school level. This highlights the need for a learning approach that is more concrete, engaging, and relevant to students' daily lives. The novelty of this study lies in the application of the PBL model supported by educational videos as contextual stimuli in IPAS learning in elementary schools. Videos serve not only as a medium for delivering content but also as an initial catalyst that helps students observe real-world phenomena, understand problematic situations, and actively engage in the inquiry process. The integration of PBL and educational videos is innovative because it provides a more visual, interactive, and meaningful learning experience, while also encouraging students to more easily develop critical thinking skills through the process of problem identification, discussion, analysis, and solution development.

This study aims to analyze the improvement in students' critical thinking skills following the implementation of the PBL model with the aid of instructional videos. Through the implementation of this learning model, it is expected that students' abilities to identify problems, analyze information, express opinions, and draw logical conclusions after participating in contextual problem-based learning will improve.

Research Methods

Experimental research is a quantitative research approach conducted through experiments (Sugiyono, 2023). This study employed a *pre-experimental* method using a *one-group pretest-posttest design* to compare the results of the initial assessment (pretest) and the final assessment (posttest) following the implementation of the PBL model. This study was conducted at a public elementary school in Depok Subdistrict, Cirebon Regency, during the even semester of the 2025/2026 academic year. The study population consisted of all fifth-grade students at the public elementary school in Depok Subdistrict, Cirebon Regency, totaling 29 students. The sampling technique used was saturation sampling, as all members of the population were included as the research sample (Sugiyono, 2023).

The intervention in this study was conducted during a single session of the IPAS lesson on "A Changing Earth." The session lasted 2 × 35 minutes and applied the five stages of the PBL model: orienting students to the problem, organizing students to learn, guiding the investigation, developing and presenting results, and analyzing and evaluating the problem-solving process. Students were divided into five groups, each consisting of 5–6 students. The groups were formed heterogeneously so that students could collaborate in identifying problems, gathering information, discussing alternative solutions, and formulating solutions.

During the problem-orientation stage, the teacher shows an educational video featuring contextual phenomena related to Earth changes and natural disasters. The video serves as an

initial stimulus to help students observe the phenomena, identify problems, and formulate questions to be discussed. In the next stage, students conduct an investigation through group discussions and the use of provided learning resources. The teacher acts as a facilitator by posing guiding questions, directing the information-gathering process, and assisting students when they encounter difficulties. The results of the discussion are then presented to the class, responded to by other groups, and concluded with activities involving drawing conclusions, reflection, and evaluation of the problem-solving process.

This study used two types of instruments: a test instrument and an observation instrument. The test instrument was used to measure the critical thinking skills of fifth-grade students in their IPAS lessons on the topic "A Changing Earth". The test was administered twice: before and after the implementation of the PBL model. The pretest was given to assess students' initial critical thinking skills before receiving the intervention, while the posttest was administered to assess their critical thinking skills after participating in PBL-based learning. The test consisted of 10 open-ended questions based on Higher-Order Thinking Skills (HOTS) and developed using Robert Hugh Ennis's indicators of critical thinking skills. Details of the critical thinking skill indicators used in the development of the students' critical thinking skills test instrument are presented in Table 1 below.

Table 1. Test Instrument Indicators

Critical Thinking Ability Indicators According to Ennis	Item Indicators
Elementary Clarification	Students can explain the difference between natural phenomena and natural disasters
	Students can explain and analyze the impact of Indonesia's geographic location on earthquakes
Basic Support	Students can analyze the relationship between deforestation and landslides using logical reasoning
Advanced Clarification	Students are able to analyze natural factors and human activities that can trigger floods in Indonesia
	Students can explain the benefits of earthquake simulations
Inference	Students are able to conclude the impact of natural disasters on people's lives (based on the case examples provided)
	Students can compare two types of natural disasters based on their causes and impacts
	Students can identify facts and opinions
Strategy and Tactics	Students can formulate simple mitigation strategies to reduce the impact of floods in their local community
	Students can determine the appropriate actions to take before, during, and after a specific natural disaster based on real-world conditions

The items used in the pretest and posttest were designed in different formats but still measured equivalent indicators of critical thinking skills, content, cognitive levels, and difficulty levels. These differences were achieved by randomizing the order of the questions, changing the presentation format, and using different images or illustrations—all without altering the competencies being measured. The development of two equivalent test formats aimed to reduce the likelihood of students recalling answers from the pretest and to minimize the impact of test repetition on posttest results. The test instrument consists of open-ended questions designed in accordance with the revised Bloom's Taxonomy, specifically focusing on higher-order thinking skills, which include analyzing (C4), evaluating (C5), and creating or formulating solutions (C6). Each test item has its own scoring rubric tailored to the indicators, cognitive level, and

response requirements of that specific item. Scoring is conducted on a scale of 0 to 4, with a maximum score of 4 awarded if a student's response meets all criteria listed in the scoring rubric. The use of specific rubrics for each test item aims to maintain consistency and objectivity in the assessment process and minimize rater subjectivity. The scoring of pretest and posttest answers was conducted by the researcher as the sole rater using an analytical rubric specifically designed for each test item. All student answers were evaluated using the same procedures and criteria to ensure consistency in scoring. Since scoring was performed by a single rater, inter-rater reliability was not calculated in this study.

$$Final\ Score = \frac{Total\ score\ obtained}{Maximum\ score} x\ 100$$

Before the test was administered to students, the test items were first reviewed by an expert faculty member to ensure content validity. The content validation process was conducted by an IPAS expert faculty member by assessing the alignment of the test items with the "A Changing Earth" curriculum, Ennis's critical thinking indicators, cognitive levels in the revised Bloom's Taxonomy, item construction, language, and the scoring rubric. The expert's recommendations were used to refine the wording, ensure the appropriateness of the images, and verify the accuracy of the answer requirements before the instrument was pilot-tested. Following this validation process, the test was then pilot-tested in a pilot class to ensure its validity and reliability. The test items proven to be valid and reliable were subsequently used as the instrument for administering the pretest and posttest. Based on the results of the instrument's validity test, 10 test items were deemed valid and suitable for use as research instruments. Meanwhile, based on the results of the reliability test, the *Cronbach's Alpha* value obtained was 0.834 for a total of 10 test items, indicating that the instrument is reliable with a high level of reliability.

Meanwhile, the observation instrument uses a four-point rating scale with a score range of 1 to 4. A score of 4 is assigned when the observed behavior or activity appears to be very good, clear, consistent, and independent; a score of 3 is assigned when the behavior appears to be good but not yet consistent; a score of 2 is assigned when the behavior is observed with guidance; and a score of 1 is assigned when the observed behavior is not yet apparent or is performed poorly. The scores obtained across all observation aspects are then totaled and converted into percentages. The observation results are subsequently classified into the following categories: very good (85–100%), good (70–84%), fair (55–69%), and poor (below 55%). The indicators of PBL implementation are based on the syntax proposed by Siswanti and Indrajit, and the indicators of students' critical thinking behaviors are based on those developed by Robert Hugh Ennis. The design of the observation instrument is presented in the following table.

Table 2. Draft Observation Instrument for the Implementation of the PBL Model

Learning Stages	Learning Activities
Pre-Learning	
Initial Orientation	1. The teacher begins the lesson with a greeting, a prayer, and checks the students' readiness
	2. The teacher prepares the class to be ready for the lesson
Apperception	3. The teacher connects the previous material to the material to be studied
Motivation	4. The teacher explains the learning objectives and motivates students to learn

Learning Stages	Learning Activities
Main Activity	
Problem Orientation	1. The teacher presents the problem through an instructional video 2. The teacher explains the problem that students will solve 3. The teacher asks probing questions related to the problem presented
Organizing Students	4. The teacher divides students into learning groups 5. The teacher explains the group's tasks and steps
Guiding the inquiry process	6. Teachers guide students in identifying problems to be solved 7. Teachers guide students in finding information from various sources 8. Teachers provide guidance when students encounter difficulties 9. Teachers guide students in processing information to find solutions
Developing and presenting results	10. Teachers encourage students to express their opinions during discussions 11. Teachers guide students in compiling the results of their discussions 12. Teachers facilitate the presentation of discussion results and the question-and-answer session
Analysis and evaluation	13. Teachers guide students in summarizing the learning " " 14. The teacher conducts an evaluation based on the learning material
Closing	
Reflection and conclusion	1. The teacher leads a learning reflection activity 2. The teacher concludes the lesson in an orderly manner and with a prayer

The assessment of the observation instrument for the implementation of the PBL model by classroom teachers is based on the criteria met in each observed aspect. The rating scale is as follows: a score of 4 for "very good"; a score of 3 for "good"; a score of 2 for "fair"; and a score of 1 for "poor." The scores for each aspect are added together to obtain a total score that represents student engagement during the learning process.

$$Percentage\ (\%) = \frac{Total\ score\ obtained}{Maximum\ score\ (80)} x\ 100$$

Table 3. Design of the Observation Instrument for Students' Critical Thinking Behaviors

Indicators	Aspect (observed behavior)
Elementary Clarification	Students are able to identify the main problem in the presented natural disaster case. Students are able to identify the key questions that need to be answered regarding the causes and impacts of natural disasters. Students are able to ask or answer clarifying questions based on the information provided in the given case.
Basic Support	Students are able to identify important facts or data from images, videos, texts, or observations about natural disasters. Students are able to assess the reliability of information sources used in discussing natural disasters. Students are able to compare their observations with information from other relevant sources.
Inference	Students are able to draw conclusions about the causes of disasters based on the facts or evidence they have found Students are able to estimate the potential impacts based on the conditions of a disaster scenario.

Indicators	Aspect (observed behavior)
	Students are able to make a choice or assessment regarding disaster management, supported by logical reasoning.
Advanced Clarification	Students are able to accurately explain the meanings of the terms "natural event," "natural disaster," and "mitigation."
	Students are able to distinguish between facts, opinions, and assumptions in information related to natural disasters.
	Students are able to identify the assumptions underlying an opinion or solution regarding disaster management.
Strategy and Tactics	Students are able to formulate several alternative solutions to prevent or reduce the impact of a disaster.
	Students are able to select and organize appropriate steps to take before, during, and after a disaster.
	Students are able to present, defend, and evaluate their group's strategy based on reasoning and feedback received.

Scoring for the instrument used to observe students' critical thinking behaviors is based on the number of criteria met in each observed aspect. Each indicator consists of three observed behavioral aspects. On the scoring scale, if the behavior is clearly evident, a score of 4 is assigned; if the behavior is evident but not yet consistent, a score of 3 is assigned; if the behavior is evident but requires guidance, a score of 2 is assigned; and if the behavior is not yet evident, a score of 1 is assigned. The scores for each aspect are summed to obtain a total score representing the students' engagement during the learning process. This total score is then converted into a percentage using the formula proposed by Trianto (in Rifai & Hidayat, 2025) .

$$Percentage\ (\%) = \frac{Total\ score\ obtained}{Maximum\ score\ (60)} x\ 100$$

Data analysis in this study included a normality test, a t-test, and an N-Gain test, all conducted using SPSS version 29. The normality test was performed using the *Shapiro–Wilk* method at a significance level of 0.05 to ensure that the data came from a normally distributed population, with a criterion of Sig. > 0.05. Next, hypothesis testing was performed using a paired-samples t-test at a significance level of 0.05 to determine the difference in means between pretest and posttest scores within the same group. Additionally, improvements in test scores were analyzed using the N-Gain test to assess the effectiveness of the intervention. N-Gain values were classified into three categories: high ($g > 0.7$), moderate ($0.3 \leq g \leq 0.7$), and low (< 0.3), to interpret the extent of improvement in students' critical thinking skills.

In addition to analyzing the results of students' critical thinking ability tests, this study also analyzed the results of observations on the implementation of the PBL model, which included the conduct of instruction and students' critical thinking behaviors during the learning process. The observational data were analyzed as a whole by summing the scores obtained for each aspect of observation and then comparing them to the maximum possible score. The results of these calculations were then converted into a final percentage. The percentages for the implementation of the PBL model and students' critical thinking behaviors were then classified based on the assessment criteria formulated by Trianto (Rifai & Hidayat, 2025) , as presented in the following table.

Table 4. Categories and Percentages of Implementation Scores for the PBL Model and Students' Critical Thinking Activities

Category	Interval %
Very Good	85–100
Good	70–84
Fair	55–69
Poor	< 55

Results and Discussion

The data obtained in this study consist of pretest and posttest scores that measure students' critical thinking skills in IPAS learning on the topic "A Changing Earth." These data were used to compare the initial and final abilities of students in the same group after the intervention, which involved the application of the PBL model. The mean pretest and posttest scores are presented in the following table.

Table 5. Average Pretest and Posttest Scores

Test Type	Number of Students	Average Score
Pretest	29	30.17
Posttest	29	70.25

Based on Table 5, the average pretest score for students' critical thinking skills was 30.17, which then increased to 70.25 on the posttest. These results indicate an improvement in students' critical thinking skills after participating in the " " (Earth Changes) IPAS lesson using the PBL model, supported by instructional media in the form of educational videos. However, this improvement requires further analysis to determine whether the difference between the pretest and posttest scores is statistically significant.

The pretest and posttest data were then analyzed through hypothesis testing. Hypothesis testing aimed to determine whether there was a significant difference in students' critical thinking skills before and after the implementation of the PBL model. Since the pretest and posttest scores were obtained from the same group of students, hypothesis testing was conducted using a paired-samples t-test with the assistance of SPSS version 29. The results of the paired-samples t-test are presented in the following table.

Table 6. Hypothesis Test Results

Paired-Samples t-Test

Variable Relationship	Mean Difference	Standard Deviation	Calculated t-Value	df	Sig *(Two-Sided p)*
Pretest–Posttest Critical Thinking Skills	-40.0862	10.7629	-20.057	28	< 0.001

Based on the results of a paired-samples t-test using SPSS version 29 at a significance level of 0.05, a two-tailed significance value (Sig. (2-tailed)) of < 0.001 was obtained. This value is less than 0.05; therefore, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted. Thus, there is a significant difference in students' critical thinking skills before and after the implementation of the PBL model in IPAS instruction on the "A Changing Earth" topic, aided by instructional media in the form of educational videos. These results indicate that students' critical thinking skills improved after participating in PBL-based learning supported by instructional videos. However, because the study used a one-group pretest–posttest design

without a control group, it cannot be definitively concluded that this improvement was solely due to the implementation of the PBL model.

Next, an N-Gain test was conducted. The N-Gain test is used to describe the magnitude of the increase in critical thinking scores from the pretest to the posttest. The N-Gain analysis was performed using SPSS version 29. The results of the N-Gain test are presented as follows.

Table 7. N-Gain Test Results

Descriptive Statistics	N	*Minimum*	*Maximum*	*Mean*	*Standard Deviation*
N-Gain Score	29	0.31	0.86	0.5740	0.13685
N-Gain Percent	29	30.77	85.71	57.4035	13.68507
Valid N	29	-	-		-

Based on the calculation results, the average N-Gain for students' critical thinking skills was 0.5740. This value falls within the range (0.3 < N-Gain < 0.7), thus placing it in the moderate category. These results indicate that students' critical thinking skills improved between the pre- and post-implementation of the PBL model in the IPAS lesson on "A Changing Earth," which utilized instructional videos as learning media. This improvement is evident from the change in scores from the pretest to the posttest after students participated in the problem-based learning sequence.

The "Moderate" N-Gain category indicates that the implementation of the PBL model, supported by instructional media in the form of educational videos, has been followed by an improvement in students' critical thinking skills, although the improvement achieved has not yet reached the "High" category. This indicates that some students have been able to identify problems, analyze information, draw conclusions, and determine solutions to the problems presented; however, these skills have not yet developed optimally among all students or across all indicators of critical thinking. Thus, the implementation of the PBL model has yielded positive results for the development of fifth-grade students' critical thinking skills in the IPAS lesson on "A Changing Earth" with the aid of instructional media in the form of educational videos. However, because the study used a single group without a control group, this improvement cannot be entirely attributed solely to the implementation of the PBL model.

A further analysis was conducted on the observation results during the implementation of the PBL model in IPAS lessons on the topic "A Changing Earth," using instructional videos as learning media. This analysis aimed to provide an overview of the implementation of the PBL model during the learning process. The observational data were processed by calculating the scores obtained for each aspect, then converted into percentages and classified based on predetermined assessment criteria. The results of the observations on the implementation of the PBL model are presented in the following table.

Table 8. Results of the Observation of the Implementation of the PBL Model

Learning Stage	Learning Activity	Score Obtained	Maximum Score	Number of Items
Pre-Learning	Initial Orientation, Apperception, Motivation	13	16	4
Main Activities	Problem Orientation	10	12	3
	Organizing Students	12	12	3
	Guiding the Inquiry Process	13	16	4
	Developing and Presenting Results	8	8	2
	Analysis and Evaluation	7	8	2
Conclusion	Reflection and Conclusion	6	8	2
	Total	**66**	**80**	**20**

Percentage (%)	**82.5%**
Category	**Good**

Based on the results of observations of the implementation of the PBL model with the aid of instructional videos by the researcher as the instructor, a score of 66 out of a maximum of 80 was obtained across 20 observation items, or 82.5%, which falls into the "good" category. In detail, the pre-learning stage achieved a percentage of 81.25%, problem orientation 83.33%, organizing students 100%, guiding the inquiry process 81.25%, developing and presenting results 100%, analysis and evaluation 87.5%, and reflection and conclusion 75%. Overall, all stages of PBL were carried out well. Meanwhile, the results of the critical thinking behavior observations are presented in the following table.

Table 9. Results of the Observation of Critical Thinking Behaviors

No.	Critical Thinking Competency Indicators	Percentage Before (%)	Percentage After (%)	Number of Items
1	Elementary Clarification	37.93	74.71	3
2	Basic Support	39.66	70.98	3
3	Inference	39.08	74.71	3
4	Advanced clarification	37.36	66.38	3
5	Strategy and tactics	40.52	69.71	3
	Average	**38.91**	**71.30**	**15**
	Category	**Low**	**High**	**-**

Based on Table 9, the average score for students' critical thinking behavior increased from 38.91% (low category) before the implementation of the PBL model to 71.30% (high category) after implementation. Improvements were observed across all indicators: elementary clarification rose from 37.93% to 74.71%, basic support from 39.66% to 70.98%, inference from 39.08% to 74.71%, "advanced clarification" from 37.36% to 66.38%, and "strategy and tactics" from 40.52% to 69.71%. After the implementation of PBL, the highest percentage was found in the "elementary clarification" and "inference" indicators at 74.71%, while the lowest percentage was found in the "advanced clarification" indicator at 66.38%.

Based on a series of analyses, the t-test results yielded a significance value of $p < 0.001$. Since this significance value is less than 0.05, H_0 is rejected and H_1 is accepted. Thus, there is a significant difference in students' critical thinking skills before and after the implementation of the PBL model supplemented with instructional videos. The N-Gain test results showed an average value of 0.5740, or 57.40%, which falls into the moderate category. These results indicate that an improvement in critical thinking skills has occurred, but it has not yet reached the high category. The significance value of the t-test and the N-Gain category provide different information. The t-test shows that the difference between the pretest and posttest is statistically significant, while N-Gain describes the magnitude of the score increase by considering the maximum possible improvement that could be achieved. Thus, a statistically significant result is not always accompanied by a high N-Gain category.

The moderate N-Gain category can be influenced by critical thinking skills that require gradual and sustained practice. Students are not only expected to understand the concept of natural disasters, but must also be able to assess information sources, distinguish between facts, opinions, and assumptions, draw conclusions based on evidence, and evaluate alternative solutions. These skills are relatively complex and cannot develop optimally through limited engagement in learning alone. Furthermore, students who were previously more accustomed to receiving direct explanations from teachers require a period of adaptation when asked to seek information, present reasons, and make decisions independently. A systematic review also

indicates that the outcomes of applying PBL to critical thinking can vary and are influenced by the presence of activities explicitly aimed at developing critical thinking, the form of guidance, the use of probing questions, supporting technology, and opportunities for reflection.

The "moderate" category can also be linked to the implementation of learning, which reached 82.5% and falls within the "good" category but has not yet reached the "very good" category. The stages of organizing students and developing and presenting results achieved the highest percentage, namely 100%. Conversely, the reflection and conclusion stages achieved the lowest percentage, namely 75%. This indicates that discussion, group work, compiling results, and presentations were carried out optimally, whereas the reflection activity still needs to be strengthened. Reflection is a crucial stage because it provides students with the opportunity to review their thought processes, evaluate the reasoning used, identify shortcomings in their solutions, and improve their understanding. The suboptimal implementation of reflection is believed to be one of the reasons why the improvement in critical thinking skills has not yet reached the high category.

The results of the critical thinking behavior observations corroborate the test results. The average critical thinking behavior score of the students increased from 38.91%—classified as "low"—before the implementation of to 71.30%—classified as "high"—after the implementation of PBL. This increase of 32.39 percentage points was observed across all critical thinking indicators. These results indicate that changes were evident not only in written test scores but also in students' behaviors during the learning process, such as identifying problems, finding information, asking questions, drawing conclusions, providing reasons, and determining problem-solving strategies. The alignment between test results and observations provides complementary evidence regarding the development of students' critical thinking skills following the learning experience.

The elementary clarification indicator increased from 37.93% to 74.71%—a rise of 36.78 percentage points—and became one of the indicators with the highest final scores. This increase can be attributed to the problem-orientation stage of PBL, which trains students to identify problems, define the focus of their questions, and provide initial explanations. Instructional videos were used as contextual stimuli to help students observe phenomena and recognize problems more concretely. However, the contribution of the videos was not analyzed separately because this study did not compare video-assisted PBL with PBL without videos.

The inference indicator also achieved the highest final percentage, rising from 39.08% to 74.71%—an increase of 35.63 percentage points. This improvement is related to activities such as processing information, identifying cause-and-effect relationships, and drawing conclusions based on the results of an investigation. Through group discussions, students had the opportunity to compare opinions, examine evidence, and refine their conclusions before presenting their findings.

The basic support indicator increased from 39.66% to 70.98%. These results demonstrate students' progress in identifying facts, using information from learning materials, and comparing various sources. However, the results are still lower than those for elementary clarification and inference, as the ability to assess the reliability of information sources requires a more complex understanding, meaning students still need guidance.

The "advanced clarification" indicator achieved the lowest final percentage, rising from 37.36% to 66.38%—an increase of 29.02 percentage points. This indicator requires the ability to explain terms, distinguish between facts, opinions, and assumptions, and identify the assumptions underlying an opinion. Because it involves a more abstract thought process, students still need more structured practice to develop these skills.

The "Strategy and Tactics" indicator increased from 40.52% to 69.71%, a rise of 29.19 percentage points. These results indicate that students are beginning to be able to formulate alternative solutions and determine disaster mitigation measures. However, the results are still lower than those of several other indicators because strategy formulation requires the ability to apply knowledge to new situations and evaluate various decision alternatives. Therefore, future instruction should provide students with more opportunities to practice formulating and comparing various alternative solutions.

The results of this study are consistent with the research by(Darmawati & Mustadi, 2023) , which found significant differences in the critical thinking skills of elementary school students who learned using PBL compared to those who used expository instruction. These results are also supported by the study by Susilawati & Supriyatno (2023) , which demonstrated an improvement in the critical thinking skills of elementary school students following the implementation of PBL. The use of video as a supplement to PBL is supported by the research by Kaffah et al. (2023), which found that PBL supplemented with stop-motion animated videos can enhance the critical thinking skills of elementary school students. Furthermore, a systematic review by Anggraeni et al. (2023) concludes that PBL generally has the potential to develop critical thinking skills through problem presentation, investigation, collaboration, argumentation, and solution evaluation.

Nevertheless, the results of this study must be interpreted with the research design in mind. The study used a one-group pretest–posttest design without a control group; therefore, it cannot be definitively concluded that the increase in scores was solely due to PBL supplemented by instructional videos. Factors such as retesting, student development, increased familiarity with the question formats, the influence of the instructor, and other learning experiences may also have contributed to the increase in scores. Furthermore, the study involved only 29 students from a single school, so the generalizability of the results remains limited. Therefore, the study's findings are more appropriately stated as evidence of a significant improvement following the implementation of PBL, rather than as causal evidence that definitively confirms PBL as the sole cause of the improvement.

Overall, the research results indicate that the implementation of the PBL model, supported by instructional videos, led to an improvement in students' critical thinking skills in the IPAS course on "A Changing Earth." This improvement was supported by test scores, N-Gain scores, the implementation of the learning process, and observations of critical thinking behaviors. The implications of this study are that teachers need to integrate contextual problems, relevant videos, probing questions, inquiry activities, group discussions, presentations, and reflection. Instruction should also pay special attention to advanced clarification as well as strategies and tactics through exercises in evaluating sources, distinguishing facts from assumptions, evaluating arguments, and comparing the effectiveness of several alternative solutions.

Conclusion

Based on the research findings, the implementation of the Problem-Based Learning model—supported by instructional videos—in the IPAS lesson on "A Changing Earth" for fifth-grade students was associated with an improvement in students' critical thinking skills. This improvement was evident in students' ability to identify problems, locate and evaluate information, draw conclusions, provide further explanations, and formulate problem-solving strategies. The implementation of the PBL stages also proceeded smoothly and successfully encouraged a shift in students' learning behavior—from a previously passive approach to a more active one—in observing problems, discussing them, expressing opinions, presenting findings,

and devising solutions. However, the development of critical thinking skills has not yet reached its full potential, particularly in the areas of providing further explanations and formulating strategies and tactics. Therefore, future instruction should provide more sustained practice through diverse contextual problems, reinforced reflection activities, assessment of facts and assumptions, and evaluation of various alternative solutions. Future research is also recommended to include a control group and involve a larger number of students to obtain stronger evidence regarding the contribution of the PBL model—supported by instructional videos—to students' critical thinking skills.

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