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The Effect of the Problem-Based Learning (PBL) Model Assisted by Vidumath Media on the Critical Thinking Skills of Fourth-Grade Elementary School Students

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Abstract

Problem-Based Learning (PBL) is widely employed to strengthen students' critical thinking; however, empirical research on its integration with Vidumath media in elementary mathematics education remains limited. This study aimed to examine the effect of Vidumath-assisted PBL on the critical thinking skills of fourth-grade elementary school students. A quantitative quasi-experimental approach with a nonequivalent control group design was employed, involving 51 fourth-grade students from SD Negeri Klepu 01 and SD Negeri Klepu 02 who were selected using a non-random sampling approach. The experimental group comprised 26 students, while the control group consisted of 25 students. Data were collected through critical thinking tests, observation sheets, and questionnaires and analyzed using descriptive statistics, the Shapiro–Wilk normality test, Levene's homogeneity test, and an independent-samples t test. The findings indicate that students taught through Vidumath-assisted PBL demonstrated significantly higher critical thinking skills than those who received conventional instruction. The experimental group achieved a mean post-test score of 81.38, compared with 68.60 in the control group, with the difference

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being statistically significant ($p < .001$). These findings confirm that integrating PBL with Vidumath media can facilitate active, meaningful, and student-centered mathematics learning while strengthening students' higher-order thinking skills. The study contributes to constructivist learning research by providing empirical evidence of the effectiveness of combining problem-based instruction with digital learning media in elementary mathematics education. Practically, the findings provide a reference for elementary school teachers seeking to implement innovative instructional strategies to enhance students' critical thinking skills. Further research should examine the implementation of Vidumath-assisted PBL across different educational levels, subject areas, and learning contexts.

Keywords: Critical Thinking Skills; Elementary Mathematics Education; Problem-Based Learning; Student-Centered Learning; Vidumath Media

INTRODUCTION

According to the *Kamus Besar Bahasa Indonesia* (KBBI), education is a process of changing a person's or group's attitudes and behavior in an effort to develop human maturity through teaching and training. Education does not only focus on the transfer of knowledge but also aims to develop students' potential so that they possess the ability to think, behave, and act appropriately in accordance with the demands of contemporary developments (Juliyantika & Batubara, 2022). Meanwhile, critical thinking is defined as the ability to use logical reasoning to consider and make appropriate decisions regarding a particular matter. Critical thinking skills include the ability to analyze information, evaluate evidence, draw rational conclusions, and make decisions based on logical reasoning (Zakaria et al., 2021). In the context of elementary education, critical thinking skills are considered one of the essential competencies that need to be developed from an early age because they play an important role in shaping students' abilities to analyze, evaluate, and solve problems systematically. This is in line with Law Number 20 of 2003 concerning the National Education System, Article 3, which states that national education functions to develop abilities and shape the character and civilization of a dignified nation in order to educate the life of the nation. Therefore, elementary education has a strategic role in creating students who not only master knowledge but also possess the ability to think critically, creatively, and adaptively in response to the development of science and technology in the 21st century (Daga et al., 2022; Isbadrianingtyas et al., 2024). Based on the explanation above, it can be concluded that

elementary education has an important role in developing students' critical thinking skills as a provision to face the development of science and the challenges of the 21st century. Critical thinking skills need to be instilled from an early age through a learning process that is able to train students to analyze, evaluate, and solve problems logically. Therefore, the implementation of education in elementary schools should not only focus on mastering learning materials but also support the development of higher-order thinking skills so that the goals of national education can be achieved optimally.

The implementation of innovative learning models is one of the efforts to develop students' higher-order thinking skills. One learning model that can encourage students to think actively, analyze problems, and find solutions is the Problem-Based Learning (PBL) model. PBL provides opportunities for students to engage directly in solving contextual problems through investigation and discussion activities. Research conducted by Setiawati and Rizqi (2025) showed that the implementation of the Problem-Based Learning model assisted by Spin Happy Media had a positive effect on students' conceptual understanding. The study indicates that the integration of PBL with learning media can create more meaningful learning experiences and support the improvement of students' cognitive abilities. Therefore, the use of PBL assisted by appropriate learning media has the potential to support the development of students' higher-order thinking skills, including critical thinking skills.

According to Law Number 20 of 2003 concerning the National Education System, Article 1 Paragraph (1), education is a conscious and planned effort to create a learning atmosphere and learning process so that students can actively develop their potential to possess spiritual religious strength, self-control, intelligence, noble character, and the skills needed in social, national, and state life (Rahmawati et al., 2023). In addition, Article 3 explains that national education functions to develop abilities and shape the character and civilization of a dignified nation in order to educate the life of the nation. Based on this provision, the learning process in elementary schools should not only emphasize the mastery of subject matter but also be able to develop students' critical thinking skills as one of the important skills of the 21st century (Achmad & Utami, 2023; Darmawati & Mustadi, 2023). Critical thinking skills are needed so that students are able to analyze information, solve problems, make logical decisions, and adapt to the increasingly complex development of science and technology. However, current learning conditions in elementary schools indicate that students' critical thinking skills have not yet developed optimally. The learning process

is generally still dominated by lecture and memorization methods, causing students to receive more information passively rather than being actively involved in learning activities.

Based on this description, it can be concluded that Law Number 20 of 2003 emphasizes the importance of an educational process that is able to actively develop students' potential, including critical thinking skills. However, the implementation of learning in elementary schools still faces various challenges because learning tends to be teacher-centered and involves students less actively. Learning that is still dominated by teachers causes students to receive more information passively, so opportunities to develop thinking skills, engage in discussions, solve problems, and build independent understanding become limited. In fact, the learning process in elementary schools should be able to create active student involvement so that various 21st-century skills, including critical thinking skills, can develop optimally (Rozali et al., 2022). Previous research conducted by Nabila and Rizqi (2026) showed that the implementation of the Problem-Based Learning model assisted by Piramid Pintar Matematika media had a positive effect on students' mathematical reasoning abilities. This finding indicates that the integration of the PBL model with learning media can encourage students to be more active in analyzing problems, constructing understanding, and developing higher-order thinking skills. Therefore, the implementation of the Problem-Based Learning model assisted by Vidumath media can be one of the innovative solutions to improve students' critical thinking skills through active, contextual, and meaningful learning so that the goals of national education can be achieved optimally.

The problem that becomes the focus of this research is the low level of critical thinking skills among fourth-grade elementary school students, particularly in mathematics learning. The low level of these skills can be seen from students' difficulties in understanding problems that require analysis, identifying important information, providing logical reasons, and drawing conclusions from the given problems. Most students are still accustomed to solving problems procedurally and memorizing formulas without deeply understanding the concepts. Learning conditions that still emphasize procedural mastery and concept memorization cause students to experience difficulties when facing problem-solving-based questions or contextual problems that require higher-order thinking skills. Students tend to have difficulties in analyzing information, evaluating solution strategies, and developing alternative solutions to a problem. In addition, learning that is still dominated by lecture methods and one-way delivery of material causes limited active student involvement in the learning process. Teacher-centered learning approaches can reduce students' opportunities

to explore ideas, construct conceptual understanding, and develop critical thinking and problem-solving skills (Aini et al., 2021; Arviani et al., 2023). Through such active involvement, students have opportunities to construct knowledge, exchange ideas, and develop their thinking abilities in solving the problems presented. In line with this, problem-based learning that provides opportunities for students to encounter contextual problems has been proven to improve higher-order thinking skills because students are involved in the processes of analysis, evaluation, and solution finding (Saputri & Rizqi, 2025; Tâm, 2021).

Critical thinking is defined as an individual's ability to analyze, evaluate, and interpret information logically in order to determine appropriate decisions or solutions to a problem. Critical thinking skills are the ability to think rationally and reflectively, which are used by individuals to understand information, analyze problems, evaluate arguments, and make decisions based on relevant evidence. Critical thinking involves the processes of identifying problems, assessing information, analyzing evidence, and formulating logical conclusions before making a decision (Braun et al., 2020; Sato, 2022).

The implementation of the Problem-Based Learning (PBL) model in this study was chosen because it is able to encourage students to think actively, analyze problems, and find solutions independently. The PBL model uses real-world problems as the basis of learning so that students are directly involved in the processes of discussion, investigation, and problem-solving (Sari & Rizqi, 2025). Through the implementation of this model, students' critical thinking skills can be developed because students are trained to understand problems, seek information, and draw logical conclusions.

The implementation of the Problem-Based Learning (PBL) model aims to change students' mindsets so that they are able to solve problems related to critical thinking. In its implementation, this model will apply learning media in the form of "Vidumath", which is designed to assist students in understanding the learning materials being taught. A study conducted by Sari and Desnita (2023) showed that the use of context-based learning video media can improve students' critical thinking skills. Video media provides opportunities for students to understand concepts through engaging visual presentations, allowing students to be more active in observing, analyzing information, and connecting concepts with the problems provided. In addition, the use of video-based learning media can increase students' engagement and learning motivation because the learning process becomes more interactive.

Thus, the utilization of video media in learning has the potential to support the development of students' critical thinking skills through more active and meaningful learning activities.

***1. Research Questions**

1. Is there a difference in students' critical thinking skills between students who are taught using the Problem-Based Learning (PBL) model assisted by Vidumath media and students who are taught using conventional learning methods among fourth-grade students at SD Negeri Klepu 01 and SD Negeri Klepu 02?

2. Does the implementation of the Problem-Based Learning (PBL) model assisted by Vidumath media have an effect on the critical thinking skills of fourth-grade elementary school students?

3.

METHODS

1. Research Design

The research design employed in this study was an experimental research design, which is intended to determine whether a treatment administered to the research subjects produces an effect. However, the researcher did not have full control over external variables that could influence the research outcomes. Therefore, a quasi-experimental design can be understood as a research design that aims to examine the effect of a treatment on research subjects without full randomization. This design is appropriate for educational research because the classes used in the study had already been established prior to the implementation of the research.

This study employed a Quasi-Experimental Design using the Nonequivalent Control Group Design. According to Sugiyono (2016), the Nonequivalent Control Group Design is a research design involving two groups, namely the experimental group and the control group, which are not selected through random assignment. Both groups were given a pretest to determine the students' initial abilities. Subsequently, the experimental group received a treatment, while the control group did not receive any specific treatment. After the learning process was completed, both groups were administered a posttest to determine the changes or improvements in students' abilities after the treatment was implemented..

In this study, the experimental group received learning using the Problem Based Learning (PBL) model assisted by ViduMath, while the control group received learning using

the conventional learning model commonly applied by teachers. Furthermore, the pretest and posttest results of both groups were compared to determine the effect of the PBL model assisted by ViduMath on the critical thinking skills of fourth-grade elementary school students.

Based on the methodology of experimental research, the variables in an experimental study are classified into independent variables and dependent variables. The independent variable refers to the variable that is given treatment or manipulated by the researcher to determine its effect on a particular variable, whereas the dependent variable is the variable observed as the outcome or consequence of the given treatment (Creswell & Creswell, 2022). The independent variable functions as the factor that influences changes, whereas the dependent variable refers to the outcome or effect observed as a result of the treatment applied.

2. Research Variables

Independent Variable: This variable refers to the treatment given to students in the learning process. Problem Based Learning (PBL) is a learning model that places real-world problems as the main focus of learning. Through the problem-solving process, students are encouraged to conduct investigations, analyze information, construct knowledge, and develop higher-order thinking skills (Dolmans et al., 2016; Savery, 2019).

Dependent Variable: The dependent variable in this study is students' critical thinking skills, which are higher-order cognitive abilities involving the processes of analysis, evaluation, and logical conclusion drawing.

3. Population and Sample

In this study, the population used was all fourth-grade students of SD Negeri Klepu 01 in the 2025/2026 academic year, consisting of a total of 26 students. The population was selected because it is in accordance with the objective of the study, namely to determine the effectiveness of the Problem Based Learning (PBL) model assisted by ViduMath media on students' critical thinking skills in mathematics learning.

Based on several expert opinions, it can be concluded that a sample is a part of the population selected using a certain technique to represent the entire population in a study.

4. Data Collection Techniques and Instruments

In addition, the data collection techniques used in this study consisted of:

1. Test technique, and

2. Non-test technique, which complement each other to obtain valid and reliable data.

Data Collection Instruments

1. Questionnaire Sheet Instrument: This observation sheet was prepared based on the indicators of critical thinking skills. The assessment of critical thinking skills was conducted by placing a checklist mark in the score column obtained by each student.

RESULTS

This research was conducted at SD Klepu 01 and SD Klepu 02 in the even semester of the 2025/2026 academic year. The experimental group consisted of fourth-grade students from SD Klepu 01 who were given treatment in the form of the Problem Based Learning (PBL) model assisted by Vidumath media, while the control group consisted of fourth-grade students from SD Klepu 02 who were given treatment using the conventional learning model. This study aimed to determine the effect of the PBL learning model assisted by Vidumath media in improving the critical thinking skills of fourth-grade elementary school students. The data collected in this study were in the form of pretest and posttest results of critical thinking skills from both groups. The following is a description of the research results that have been conducted.

1. Pretest Data of Critical Thinking Skills

The following is the pretest data of students' critical thinking skills in both research groups.

Table 1. Pretest Data of Critical Thinking Skills

Group Statistics					
Pretest	Kelas	N	Mean	Std. Deviation	Std. Error Mean
	Eksperimen	26	60.65	3.382	0.663
	Kontrol	25	61.84	2.794	0.559

Based on the table above, it is known that the number of students in the experimental group (SD Klepu 01) was 26 students, while the control group (SD Klepu 02) consisted of 25 students. The experimental group obtained a pretest mean score of critical thinking skills

of 60.65 with a standard deviation of 3.382 and a standard error of 0.663. Meanwhile, the control group obtained a mean score of 61.84 with a standard deviation of 2.794 and a standard error of 0.559. Based on these mean scores, the control group had a slightly higher pretest average compared to the experimental group, with a difference of 1.19.

2. Posttest Data of Critical Thinking Skills

The following is the posttest data of students' critical thinking skills in both research groups.

Table 2. Results of Students' Critical Thinking Skills Questionnaire

Group Statistics					
Posttest	Kelas	N	Mean	Std. Deviation	Std. Error Mean
	Eksperimen	26	81.38	3.163	0.620
	Kontrol	25	68.60	2.517	0.503

Based on the table above, it is known that the number of students in the experimental group (SD Klepu 01) was 26 students, while the control group (SD Klepu 02) consisted of 25 students. The experimental group obtained a posttest mean score of critical thinking skills of 81.38 with a standard deviation of 3.163 and a standard error of 0.620. Meanwhile, the control group obtained a posttest mean score of 68.60 with a standard deviation of 2.517 and a standard error of 0.503. Based on these mean scores, the experimental group had a higher posttest average compared to the control group, with a difference of 12.78.

Table 3. Results of Students' Mathematical Critical Thinking Skills Questionnaire

Class	Meeting	Total	Criteria
Experimental Class	1	88%	Very Good
	2	90%	Very Good
	3	91%	Very Good
Average of Experimental Class		89.67%	Very Good
Control Class	Meeting	Total	Criteria
	1	89%	Very Good
	2	89%	Very Good
	3	89%	Very Good
Average of Control Class		89.00%	Very Good

Based on the table of students' critical thinking skills questionnaire results, the researcher also distributed questionnaires aimed at determining students' critical thinking skills during the learning process. The analysis results showed that the average questionnaire result in the experimental class was 89.67% with a Very Good category, while the average questionnaire result in the control class was 89.00% with a Very Good category. The

difference in the average scores between the two classes was 0.67%, so it can be concluded that students' critical thinking skills in both classes were in the Very Good category, with the average score of the experimental class being slightly higher than the control class.

Table 4. Results of Students' Critical Thinking Skills Observation

Class	Meeting	Total	Criteria
Experimental Class	1	93%	Very Good
	2	92%	Very Good
	3	93%	Very Good
Average of Experimental Class		92.67%	Very Good
Control Class	1	92%	Very Good
	2	90%	Very Good
	3	91%	Very Good
Average of Control Class		91.00%	Very Good

Based on the table above, the results of the observation of students' critical thinking skills showed that in the experimental class, the percentage of students' critical thinking skills in the first meeting was 93%, the second meeting was 92%, and the third meeting was 93%.

Analysis Requirements Description

1. Normality Test

Based on the results of the normality test using the Shapiro-Wilk method, the significance value (Sig.) obtained for the posttest data of the control class was 0.501 and for the experimental class was 0.542. Both significance values were greater than the significance level of 0.05 (Sig. > 0.05), so it can be concluded that the posttest data in both the control class and the experimental class were normally distributed. Thus, the posttest data results have fulfilled the normality assumption as one of the requirements for using parametric statistical tests. Therefore, the analysis can be continued to the homogeneity test and hypothesis testing using the Independent Samples t-test to determine the effect of implementing the Problem Based Learning (PBL) model assisted by ViduMath media on the critical thinking skills of fourth-grade elementary school students.

2. Homogeneity Test

Based on the results of the homogeneity test using Levene's Test of Equality of Variances, the significance value (Sig.) obtained was 0.302. This value was greater than the significance level of 0.05 (0.302 > 0.05), so it can be concluded that the variance of the pretest

data in the control class and experimental class was homogeneous. These results indicate that both groups had relatively similar data variability before the treatment was given. Thus, the data have fulfilled one of the assumptions for the use of parametric statistical tests, so the analysis can be continued to the hypothesis testing stage.

3. Descriptive Analysis

Based on the results of the descriptive analysis, it was found that the total research sample consisted of 51 students. The pretest data obtained a minimum value of 55, a maximum value of 67, a mean value of 61.24, and a standard deviation of 3.134. Meanwhile, the posttest data obtained a minimum value of 64, a maximum value of 87, a mean value of 75.12, and a standard deviation of 7.050. These results indicate that the students' average scores after participating in the learning process (posttest) were higher than before the learning process (pretest), with an increase of 13.88 points (75.12 − 61.24). In addition, the standard deviation of the posttest data was greater than the pretest data, indicating that the variation in students' scores after learning was more diverse. Descriptively, these results indicate an improvement in students' critical thinking skills after the implementation of the Problem Based Learning (PBL) model assisted by ViduMath media. However, to determine whether the improvement was statistically significant, hypothesis testing using the Independent Samples t-test was required.

DISCUSSION

The results of the study showed that there was a difference in students' critical thinking skills between the experimental class that used the Problem Based Learning (PBL) model assisted by ViduMath media and the control class that used conventional learning. Based on the results of the Independent Samples t-Test, the experimental class obtained a posttest mean score of 81.38, while the control class obtained a mean score of 68.60. The difference in the mean scores between the two classes was 12.78 points with a significance value of Sig. (2-tailed) < 0.001, so H_0 was rejected and H_1 was accepted. This indicates that the implementation of the Problem Based Learning (PBL) model assisted by ViduMath media had a significant effect on the critical thinking skills of fourth-grade elementary school students.

The results of this study were also supported by supporting data in the form of questionnaires, observations of learning implementation, and Student Worksheets (LKPD). Based on the results of the critical thinking skills questionnaire, the experimental class obtained an average of 89.67% with a Very Good category, while the control class obtained an average of 89.00% with a Very Good category. The results of the learning implementation observation showed an average of 89.33% for the experimental class, while the control class obtained an average of 90.00%, with an overall average of 89.67% which was included in the Very Good category. In addition, the LKPD results showed an average of 89.44% for the experimental class and 90.56% for the control class, both of which were also included in the Very Good category. Although the average results of learning implementation observations and LKPD in the control class were slightly higher than those in the experimental class, the difference obtained was relatively small. These instruments more accurately describe the implementation of the learning process and students' activities during learning, whereas the success of implementing the Problem Based Learning (PBL) model assisted by ViduMath media in improving critical thinking skills was more appropriately measured through the posttest results analyzed using the Independent Samples t-Test.

Based on all the research results, it can be concluded that the Problem Based Learning (PBL) model assisted by ViduMath media has a positive effect on the critical thinking skills of fourth-grade elementary school students. This is evidenced by the higher average posttest score of the experimental class compared to the control class, namely 81.38 and 68.60, respectively, as well as the results of the Independent Samples t-Test which showed a significant difference between the two classes after the treatment was given (Sig. (2-tailed) < 0.001). Thus, the Problem Based Learning (PBL) model assisted by ViduMath media is feasible to be implemented as one of the alternative learning models in elementary schools to improve students' critical thinking skills.

This study aimed to determine the effect of implementing the Problem Based Learning (PBL) model assisted by ViduMath media on the critical thinking skills of fourth-grade students at SD Negeri Klepu 01. Based on the research results, the implementation of the model had a positive effect on students' critical thinking skills. This indicates that student-centered learning through problem-solving can create a more active learning process compared to conventional learning.

The improvement of critical thinking skills in the experimental class was inseparable from the characteristics of the Problem Based Learning model, which places students as the main subjects in the learning process. At each stage of learning, students were presented with a problem related to the material being studied. These problems encouraged students to identify the required information, express opinions, discuss with group members, find alternative solutions, and draw conclusions based on the results of the analysis. These activities directly trained critical thinking skills because students did not merely receive information from the teacher but also constructed understanding through the processes of investigation and problem-solving.

The use of ViduMath media also contributed to improving students' critical thinking skills. The presentation of material through video media helped students understand concepts more concretely because the material was delivered through visual and audio representations. This made it easier for students to connect mathematical concepts with the problems provided during learning. In addition, ViduMath media was able to increase students' attention and learning motivation so that they became more active in participating in the learning process. When students understood the context of the problem well, they were better able to provide logical reasons, evaluate information, and determine appropriate solutions. The results of this study showed that the improvement of critical thinking skills in the experimental class was better than in the control class. This difference indicates that the learning process involving students actively in finding solutions provides a more meaningful learning experience compared to learning dominated by teacher explanations. During the learning process, students in the experimental class had the opportunity to ask questions, discuss, express opinions, and defend the reasons they used in solving problems. These activities are important components in developing critical thinking skills.

The results of this study are also supported by the research of Astikawati et al. (2020) which explains that the implementation of the Problem Based Learning (PBL) model can improve students' higher-order thinking skills and learning independence. Through problem-based learning, students are actively involved in seeking information, analyzing problems, developing solution strategies, and conducting discussions to obtain solutions. Thus, students not only gain conceptual understanding but also develop critical thinking skills, problem-solving abilities, and learning independence that can be applied in everyday life.

The results showed that the Problem Based Learning (PBL) model assisted by ViduMath media can be an effective learning alternative to improve elementary school students' critical thinking skills. This model not only helps students understand learning materials but also trains them to think logically, analyze problems, collaborate in groups, and express opinions based on justifiable reasons. Thus, the implementation of the Problem Based Learning model assisted by ViduMath media has the potential to support the achievement of learning objectives oriented toward the development of higher-order thinking skills.

CONCLUSION

Based on the results of the study, it can be concluded that the implementation of the Problem Based Learning (PBL) model assisted by Vidumath media has a positive and significant effect on the critical thinking skills of fourth-grade elementary school students. This is indicated by the higher average posttest score of the experimental class compared to the control class, namely 81.38 and 68.60, respectively, as well as the results of the Independent Samples t-test which showed a significance value of < 0.001. These results prove that learning using the PBL model assisted by Vidumath media is more effective than conventional learning in improving students' critical thinking skills.

The implementation of the Problem Based Learning model assisted by Vidumath media is able to create more active, student-centered learning and encourage students to analyze problems, discuss, collaborate, and find solutions independently. Therefore, this learning model can be used as one of the alternative mathematics learning models in elementary schools to develop students' critical thinking skills.

This study contributes to the development of problem-based learning by utilizing innovative learning media. Further research is recommended to examine the implementation of the Problem Based Learning model assisted by Vidumath media at different educational levels, subjects, or with a broader sample scope in order to obtain more comprehensive results that can be generalized.

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