

The Effect of Implementing the Problem-Based Learning Model Assisted by the Kemendikdasmen Virtual Web Lab on Elementary School Students' Problem-Solving Skills in Science Learning

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KEYWORDS	ABSTRACT
<p>Keywords: Problem-solving skills; Problem-Based Learning; Kemendikdasmen Virtual Web Lab; Science learning; Elementary school</p> <p>Conflict of Interest Statement: The author(s) declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.</p> <p>Copyright © 2026 EDU. All rights reserved.</p>	<p>This study aims to examine the effect of implementing the Problem-Based Learning model assisted by the Kemendikdasmen Virtual Web Lab on elementary school students' problem-solving skills in science learning. This research employed a quantitative approach using a quasi-experimental method with a nonequivalent control group design. The sample consisted of 24 students in the experimental class and 26 students in the control class. Data were collected through problem-solving ability tests administered as a pretest and posttest. The data were analyzed using normality tests, homogeneity tests, an Independent Samples t-test, and N-Gain analysis.</p> <p>The results showed a significant difference between the experimental and control classes, with a significance value of 0.039 (< 0.05). Furthermore, the N-Gain score of the experimental class was 0.3204, which falls into the moderate category, and was higher than that of the control class, which was 0.2090 and categorized as low. These findings indicate that the implementation of the Problem-Based Learning model assisted by the Kemendikdasmen Virtual Web Lab is more effective in improving students' problem-solving skills than conventional learning models. This is because the model provides students with opportunities to actively engage in inquiry and problem-solving processes. Therefore, the Problem-Based Learning model assisted by the Kemendikdasmen Virtual Web Lab can be considered an alternative science learning model in elementary schools to enhance students' problem-solving skills.</p>

Introduction

Elementary school is a highly important level of education because, at this stage, students learn fundamental concepts and develop essential skills needed to face real-life situations, which serve as a foundation for continuing to the next level of education. In everyday life, students are inevitably confronted with various problems. Therefore, to prepare them to deal with such challenges, they need to be trained from an early age to solve problems. The importance of students' problem-solving skills has also been emphasized by Riastini, who stated that problem-solving ability at the elementary school level is essential because it represents a potential that students must possess to solve problems and apply their knowledge in daily life (Harefa & La'ia, 2021; Putri, Suryani, & Jufri, 2019).

Unfortunately, the importance of problem-solving skills has not been fully reflected in actual classroom conditions, as this competence remains relatively low among elementary school students. This was revealed in a study by Ramadhani (2021) in class VB at SDN Dukuhan Kerten Surakarta, where interviews with teachers and students showed that students were not accustomed to learning through

everyday problem contexts, causing them to perceive the learning materials as difficult. This condition was supported by pre-test data showing that only 26.92% of students, or 7 out of 26, met the Minimum Mastery Criteria (KKM) of ≥ 75 , while the remaining 73.08%, or 19 students, had not achieved the KKM. Similarly, HS and Marianus (2022), through interviews with educators at SDS Perguruan Kristen Methodist Indonesia (PKMI) Efesus Aek Batu, South Labuhanbatu Regency, also found that students' achievement in science learning and their problem-solving skills remained inadequate.

The low level of students' problem-solving skills is closely related to science learning practices that do not sufficiently require students to solve problems independently. This condition is often caused by the lack of variation in teachers' presentation of learning materials, which makes students feel bored and less motivated to learn. According to Muyassaroh, Mukhlis, and Ramadhani (2022), the main contributing factor is that teachers have not consistently accustomed and trained students to engage in problem-solving activities through learning designs that integrate innovative models, media, and teaching materials. Instead, learning is often limited to simple question-and-answer activities. The limited application of various learning models and instructional tools that actively involve students has also been confirmed by HS and Marianus (2022). Therefore, to optimize students' potential, teachers need to create an innovative learning atmosphere supported by appropriate learning models and media that can stimulate higher-order thinking skills (Masruroh, Dafik, & Suprpti, 2020). In this context, the Problem-Based Learning model assisted by the Kemendikdasmen Virtual Web Lab emerges as an appropriate solution.

As a solution, the Problem-Based Learning model is a contextual and constructivist learning model that provides students with opportunities to actively construct their own knowledge based on real-life problems, which are then connected to the learning materials being studied (Rusman, Sumantri, & Zakiah, 2023; Kusumaningtias, as cited in Fauziah & Fitria, 2020; Siswantoro, 2018). The essential strength of Problem-Based Learning is confirmed by Agustin, as cited in Fauziah and Fitria (2020), who stated that presenting real-life problems in the classroom helps students become accustomed to solving problems in their daily lives. Based on this considerable potential, the present study focuses on examining the effect of implementing the Problem-Based Learning model, which encourages students to work collaboratively in finding solutions to concrete problems in order to develop their thinking skills. Specifically, this study aims to determine the effect of implementing the Problem-Based Learning model assisted by the Kemendikdasmen Virtual Web Lab on elementary school students' problem-solving skills in science learning.

Research Design and Methodology

This study employed a quantitative approach using a quasi-experimental method. The research design used was a non-equivalent control group design involving an experimental group and a control group. Both groups were administered a pretest and posttest to determine changes in students' problem-solving skills after the treatment. The study was conducted at SDN Sindangsono during the even semester of the 2025/2026 academic year. The research sample was selected using a purposive sampling technique. The sample consisted of 26 students from class V A as the control class and 24 students from class V B as the experimental class. The experimental class received instruction using the Problem-Based Learning model assisted by the Kemendikdasmen Virtual Web Lab, while the control class was taught using the Student Teams Achievement Division learning model.

The research instrument was a problem-solving skills test in the form of essay questions developed based on Polya's problem-solving indicators, namely understanding the problem, devising a strategy, carrying out the plan, and reviewing the solution. The instrument consisted of five items that had been tested for validity and reliability before being used in the study. The validity test results showed that all items were categorized as significant to highly significant, indicating that they were appropriate for use as research instruments. The reliability test using Cronbach's Alpha produced reliability coefficients of 0.75 for the pretest and 0.73 for the posttest, indicating that the instrument had a good level of reliability.

Data collection techniques included tests, observation, and documentation. The data obtained were analyzed using descriptive and inferential statistics. Prior to hypothesis testing, prerequisite tests were conducted, including normality and homogeneity tests. Subsequently, hypothesis testing was

carried out to determine the effect of implementing the Problem-Based Learning model assisted by the Kemendikdasmen Virtual Web Lab on students' problem-solving skills in science learning.

Results

1. **Students' Problem-Solving Ability**
Students' problem-solving ability was measured by administering a pretest and a posttest to the experimental and control classes. The results of the descriptive analysis of students' problem-solving ability are presented in Table 1.

Table 1. Descriptive Statistics

Data	Class	Range	Minimum	Maximum	Mean
Pretest	Experiment	35	15	50	30.83
	Control	40	10	30	24.62
Posttest	Experiment	70	20	90	52.50
	Control	60	20	80	41.35

Based on Table 1, the average pretest score in the experimental class was 30.83, while in the control class it was 24.62. After the learning process was implemented, the average posttest score in the experimental class increased to 52.50 and in the control class to 41.35. These results indicate that both groups experienced improved problem-solving abilities after the learning process. However, the average posttest score in the experimental class was higher than in the control class.

2. **Analysis Prerequisite Tests**
Before conducting the hypothesis testing, analysis prerequisite tests were first conducted, including normality and homogeneity tests on the posttest data on students' problem-solving abilities. These tests aimed to determine whether the data met the basic assumptions in parametric statistical analysis.

The normality test was conducted to determine whether the posttest data in the experimental and control classes were normally distributed. The Shapiro-Wilk test used. The results of the normality test are presented in

Table 2.

Table 2. Posttest normality test

Class	Shapiro-Wilk			Information
	Statistics	df	Sig.	
Experiment	0.941	24	0.169	Normal
Control	0.952	26	0.060	Normal

Based on Table 2, it is known that the significance value in the experimental and control classes is greater than 0.05. This indicates that the posttest data in both classes are normally distributed. Thus, the assumption of normality in parametric statistical analysis has been met.

A homogeneity test was conducted to determine the similarity of posttest data variance between the experimental and control classes. The test used was Levene's Test. The results of the homogeneity test are presented in Table 3.

Table 3. Posttest Homogeneity Test

Mark	Levene Statistics	df1	df2	Sig.
Based on Mean	6,272	1	48	0.016

Based on Table 3, the significance value obtained is less than 0.05, so it can be concluded that the variances of the two groups are not homogeneous. Therefore, hypothesis testing using the Independent Sample t-Test was conducted with reference to the results of Equal Variances Not Assumed.

3. **Hypothesis Testing**
was conducted using the Independent Sample t-Test to determine the differences in students' problem-solving abilities between the experimental class that received learning using the *Problem Based Learning model* assisted by *the Virtual Web Lab*. The Ministry of Education and Culture and a control class that received learning using *the Student Teams Achievement Division (STAD)* model. The results of the hypothesis testing are presented in Table 4.

Table 4. Independent Sample t-Test

Data	t	df	Sig (2-tailed)
<i>Equal Variances Not Assumed</i>	-2,132	40,454	0.039

Based on Table 4, the significance value (Sig. 2-tailed) is 0.039. This value is smaller than the significance level of 0.05 ($0.039 < 0.05$), so H_0 is rejected and H_a is accepted. These results indicate that there is a significant difference in problem-solving abilities between students who learn using the *Problem Based Learning model* assisted by the Ministry of Education and Culture's *Virtual Web Lab* and students who learn using the *Student Teams Achievement Division model*.

4. Improving Students' Problem Solving Skills

To determine the level of improvement in students' problem-solving abilities after being given treatment, an analysis was conducted using *N-Gain*. The results of the *N-Gain analysis* in the experimental and control classes are presented in Table 5.

Table 5. *N-Gain* Analysis

Class	<i>N-Gain</i>	Category
Experiment	0.3204	Currently
Control	0.2090	Low

Based on Table 5, the average *N-Gain value* in the experimental class was 0.3204, which is included in the medium category, while the average *N-Gain value* in the control class was 0.2090, which is included in the low category. These results indicate that the increase in students' problem-solving abilities in the experimental class was higher than in the control class after participating in the learning process.

Discussion

The results of this study indicate that students who received instruction using the Problem-Based Learning model assisted by the Kemendikdasmen Virtual Web Lab demonstrated better problem-solving skills than those who were taught using the Student Teams Achievement Division (STAD) model. This finding is reflected in the difference in posttest scores between the two groups, as well as in the results of the Independent Samples t-test, which showed a significant difference after the treatment was implemented. These results suggest that the implementation of the Problem-Based Learning model assisted by the Kemendikdasmen Virtual Web Lab can provide learning experiences that support the development of students' problem-solving skills in science learning.

The improvement in problem-solving skills in the experimental class occurred because the learning process was conducted through the five structured stages of Problem-Based Learning. In the problem-orientation stage, students were introduced to light-related phenomena that were closely connected to everyday life. This encouraged curiosity and motivated students to identify the problems to be solved. In the stage of organizing students for learning, learners worked in heterogeneous groups to discuss the problems and formulate solution strategies. Through this activity, students did not merely receive information from the teacher but were actively involved in the process of seeking solutions. This finding is consistent with Argaw, Haile, and Ayalew (2017), who stated that problem-based learning can improve problem-solving skills by actively engaging students in the learning process.

During the investigation stage, students utilized the Kemendikdasmen Virtual Web Lab to conduct virtual experiments related to the topic of light. The use of this medium helped students visualize concepts that were previously difficult to observe directly. Through the simulations, students were able to test their assumptions, observe cause-and-effect relationships, and gather the information needed to solve the problems. The Virtual Web Lab served as an exploratory tool that enabled students to gain more concrete and meaningful learning experiences. This finding is in line with Aprianti, Harjono, Verawati, and 'Ardhuha (2024), who stated that virtual laboratories can represent the main functions of real laboratories through web-based simulations. It is also supported by Verawati and Sukaisih (2021), who explained that virtual laboratories can help students develop a better understanding of scientific concepts.

Furthermore, in the stage of developing and presenting learning outcomes, students presented the results of their group discussions and explained the solutions they had obtained. This activity provided students with opportunities to express ideas, defend arguments, and receive feedback from other groups. In the analysis and evaluation stage, students and the teacher reflected on both the process and outcomes of the problem-solving activities. This reflection helped students become more careful in reviewing their answers. This finding is supported by Hindiyati, Wirahayu, Astina, and Soekamto (2022), who found that evaluation and reflection activities accompanied by

teacher guidance are effective in improving students' metacognitive abilities, particularly in drawing conclusions from the problems they encounter.

The N-Gain analysis showed that the experimental class achieved a higher improvement in problem-solving skills than the control class. However, this improvement remained in the moderate category. This condition may have been influenced by students' adaptation process to problem-based learning, which required them to think systematically according to Polya's problem-solving stages. Students needed time to become accustomed to understanding the problem, devising a plan, carrying out the plan, and reviewing the solution. This finding is consistent with Pujiyanti, Ellianawati, and Hardyanto (2021), who explained that the implementation of Polya's stages requires an adaptation process so that students become familiar with using systematic thinking patterns in solving problems. When viewed based on the indicators of problem-solving skills, the checking stage was found to be the most challenging indicator for students. This was reflected in the relatively lower score achieved in this indicator compared with the other indicators. This finding is in line with Yanni, Syaflita, and Yandri (2020), who stated that reviewing the solution is the stage least commonly mastered by students in the problem-solving process. Nevertheless, through repeated reflection and evaluation activities conducted at the end of each lesson, students began to show improvement in carefully checking their answers and formulating conclusions.

Overall, the findings of this study show that the implementation of Problem-Based Learning assisted by the Kemendikdasmen Virtual Web Lab has a positive impact on students' problem-solving skills. The integration of systematic Problem-Based Learning syntax with interactive virtual media enabled students to engage actively in investigation, discussion, presentation, and reflection. As a result, students' problem-solving skills could develop more optimally in science learning.

Conclusion

Based on the results of the study, it can be concluded that the implementation of the Problem-Based Learning model assisted by the Kemendikdasmen Virtual Web Lab has an effect on students' problem-solving skills in science learning, particularly on the topic of the properties of light at the elementary school level. The results of the Independent Samples t-test indicated a significant difference in problem-solving skills between students who learned through the Problem-Based Learning model assisted by the Kemendikdasmen Virtual Web Lab and those who learned through the Student Teams Achievement Division model.

Furthermore, the N-Gain analysis showed that the improvement in students' problem-solving skills in the experimental class was in the moderate category and was higher than that of the control class, which was in the low category. These findings indicate that the integration of the Problem-Based Learning model with the Kemendikdasmen Virtual Web Lab can create a more active, interactive, and problem-solving-oriented learning environment. Therefore, this model can serve as an effective alternative for improving elementary school students' problem-solving skills in science learning.

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