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Enhancing Students' Motivation and Learning Outcomes Through the Problem-Solving Learning Model at Elementary School

Fitriani[1], Alfi Syahrin[2], Silvi Listia Dewi[3]

1 Universitas Al-Muslim, Aceh, Indonesia ; fitriani@gmail.com
2 Universitas Al-Muslim, Aceh, Indonesia ; alfisyahrin745@gmail.com
3 Universitas Al-Muslim, Aceh, Indonesia ; silvilistiadewi@umuslim.ac.id

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ABSTRACT

Improving the quality of science learning requires effective teaching models, one of which is the problem-solving approach. This model not only enhances students' understanding of scientific concepts but also fosters higher motivation and improved academic outcomes. This quantitative study aimed to investigate the impact of the problem-solving learning model on students' motivation and learning outcomes in science at SDN 6 Pegasing. The research employed a one-group pretest-posttest design within a pre-experimental framework. The sample consisted of 30 fifth-grade students. Data analysis was conducted using a paired sample t-test. Results indicated a statistically significant improvement in students' science learning outcomes after the intervention, with a p-value of 0.001 (<0.05). Similarly, students' motivation scores showed a notable increase, from a pre-test average of 71.13 to a post-test average of 89.60, also supported by a p-value of 0.001. These results suggest that the application of the problem-solving model led to measurable gains in both cognitive and motivational aspects of student learning. The findings confirm that the problem-solving learning model positively influences students' motivation and learning outcomes. By engaging in structured problem-solving activities, students were better able to grasp essential scientific concepts and sustain interest throughout the learning process. The application of the problem-solving model significantly enhances both motivation and learning outcomes in science education. Therefore, this model can serve as an effective pedagogical approach in primary science classrooms.

Corresponding Authors :
Fitriani
Universitas Al-Muslim, Aceh, Indonesia ; fitriani@gmail.com

1. INTRODUCTION

Education is a dynamic system influenced by the advancement of science, technology, and culture. It functions as an organized process aimed at shaping individuals for the future (Andari, 2022). As science and technology continue to evolve, the education system must also adapt to meet emerging demands across various sectors (Ariyanto, 2018). In Indonesia, the shift towards the Merdeka

(Independent) Curriculum reflects an effort to respond to such changes, particularly at the primary school level, where a new integrated subject—Ilmu Pengetahuan Alam dan Sosial (IPAS)—combines elements of science and social studies (Ministry of Education, Culture, Research, and Technology, 2022).

Despite this integration, the implementation of the curriculum has not fully achieved its intended goals. Initial classroom observations at SDN 6 Pegasing indicate that students' average science scores (58.73) fall significantly below the school's set learning mastery criteria (KKTP) of 70. Interviews further revealed that students lack interest in science due to minimal opportunities for experimentation, observation, and discussion. These findings suggest a disconnect between pedagogical approaches and student learning needs.

Modern learning emphasizes active student participation and engagement. However, many educators still rely on conventional lecture-based methods, limiting students' motivation and comprehension (Hastiwi et al., 2023). Motivation is a critical factor in learning success, influenced by both internal and external variables such as interest, environment, and instructional strategies (Prananda & Hadiyanto, 2019; Nurrawi, 2023). To address this issue, it is essential to adopt innovative teaching models that cater to students' developmental and cognitive stages.

One such model is problem-solving learning, which encourages students to think critically, actively seek information, and apply logical reasoning. This model promotes cognitive engagement and enhances learning outcomes by training students to identify, analyze, and resolve problems systematically (Wena, 2014; Maesari, 2020). According to Joyce et al. (2016), instructional models should guide students in developing knowledge, skills, and values. Furthermore, the teacher's role in selecting appropriate models significantly impacts student achievement and classroom effectiveness (Utami, 2019; Priansa, 2019).

Unfortunately, the prevailing teacher-centered approach in science classes often fails to align with students' psychological and developmental needs. Learning should engage the cognitive, psychomotor, and affective domains to be effective. Many students still struggle with science due to a lack of motivation, engagement, and stimulating learning environments (Sari, 2022; Purwanto in Nurrawi, 2023). Therefore, enhancing motivation through structured and meaningful learning processes is vital.

In light of these challenges, this study aims to examine the impact of the problem-solving learning model on students' motivation and learning outcomes in science education at SDN 6 Pegasing, Central Aceh. The goal is to create a more engaging and effective learning environment aligned with the goals of the Merdeka Curriculum and the holistic development of learners.

2. METHOD

This study employed an experimental research design with a quantitative approach to examine the effect of the problem-solving learning model on students' motivation and learning outcomes in science. Experimental research is designed to assess the impact of a deliberate intervention or treatment applied by the researcher (Marwan et al., 2023). Specifically, the study utilized a pre-experimental design in the form of a one-group pretest-posttest design, where only one group of participants was observed before and after the treatment, without a control group for comparison (Creswell, 2014). According to Sugiyono (2008), this design allows for accurate measurement of the effects of the treatment by comparing the conditions before and after its application.

The research was conducted at SDN 6 Pegasing, located in Central Aceh, Aceh Province. The population of this study included all fourth-grade students enrolled during the 2023/2024 academic year, consisting of 30 students from a single class. The sampling technique used was total sampling, meaning all members of the population were included in the study.

2.1 Instruments and Data Collection

The data collection instruments consisted of 20 items assessing both student motivation and science learning outcomes. The questions included a mix of open-ended and closed-ended items, written in clear, age-appropriate language and aligned with the instructional objectives. A closed questionnaire based on a Likert scale was used to measure student motivation. Prior to deployment, the instruments underwent expert validation to ensure their content validity and appropriateness. Suggestions from validators were used to revise and refine the instruments for effective use in the field.

Learning outcomes were assessed using a multiple-choice test focused on material about plant body parts. To evaluate the treatment effect, pretest and posttest scores were analyzed using the Gain Score formula. Data analysis also involved a normality test to assess the distribution of the data, followed by a homogeneity test. After these assumptions were confirmed, a hypothesis test was conducted using the paired-sample t-test (also known as the One Sample t-Test) to compare mean scores before and after the intervention. If tcount > ttable, the null hypothesis (H_0) was rejected in favor of the research hypothesis (H_a); otherwise, H_0 was accepted.

2.2 Research Procedure

The implementation of the problem-solving learning model involved delivering material to students, followed by a series of structured steps. These steps included:

1. Identifying the problem,
2. Collecting information (from teacher-provided material and independent student research),
3. Proposing alternative solutions,
4. Evaluating and selecting the best solution, and
5. Applying the chosen solution.

This process was designed to make learning more interactive, engaging, and meaningful, while also stimulating student creativity and encouraging critical thinking. The expectation was that by involving students in real problem-solving scenarios, their motivation and understanding of science concepts would improve.

3. FINDINGS AND DISCUSSION

3.1 Research Findings

This section presents the findings of the study, including the validation of the learning model and research instruments, as well as the influence of the problem-solving learning model on improving students' motivation and learning outcomes in science at SDN 6 Pegasing.

3.1.1 Validation of the Learning Model and Instruments

Before conducting the study, validation was carried out to ensure the appropriateness and reliability of both the learning model and the research instruments. The problem-solving learning model was reviewed and validated by subject matter experts to confirm its suitability for use in a primary school science context. In parallel, the research instruments—including the student motivation questionnaire and learning outcome test—were also validated by education experts to ensure content accuracy, relevance to learning objectives, and clarity of language. Necessary revisions were made based on expert feedback to ensure that the instruments were valid and reliable for measuring the intended variables.

3.1.2 The Influence of the Problem-Solving Learning Model on Student Motivation and Learning Outcomes

The core objective of this study was to analyze the impact of the problem-solving learning model on student learning outcomes and motivation in science. To achieve this, a pre-test was administered to sixth-grade students at SDN 6 Pegasing prior to the application of the learning model. This pre-test provided a baseline of students' understanding and motivation levels. Following the implementation of the problem-solving model, a post-test was conducted to measure changes in both academic performance and motivational levels.

The comparison of pre-test and post-test scores revealed a significant improvement in both areas:

- Learning Outcomes: Students demonstrated a marked increase in test scores after the intervention, indicating enhanced understanding of the science material.
- Motivation: Questionnaire results showed a positive shift in students' attitudes and interest toward science learning after engaging with the problem-solving approach.

These findings support the effectiveness of the problem-solving learning model in making science lessons more interactive and engaging, thereby increasing both cognitive performance and motivational engagement among students. Further quantitative analysis and statistical test results will be presented in the following sections to substantiate these improvements.

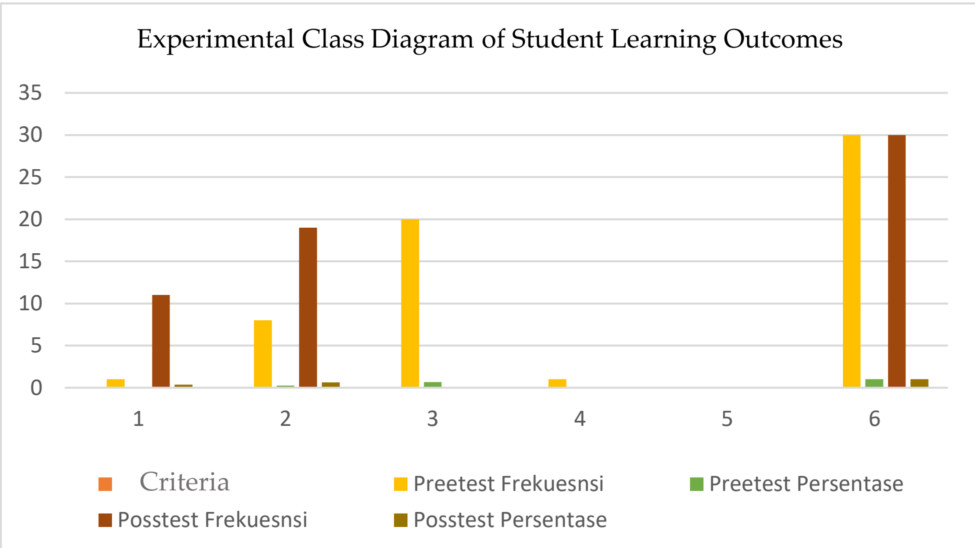

Figure 1. Students Learning Outcomes

Based on the pre-test frequency distribution diagram in the experimental class, learning outcomes include 1 student or 3.3% who have learning outcomes with very high criteria, 8 students or 26.6% have high concentration levels, 20 students or 66.6% have medium criteria, and 1 student or 3.3% who have concentration levels with low criteria. From the results of the frequency distribution of the post-test scale of learning outcomes with very high criteria as many as 11 students or 36.6%, students who have learning outcomes with high criteria as many as 19 students or 63.3%, students who have medium concentration levels, as many as 0.

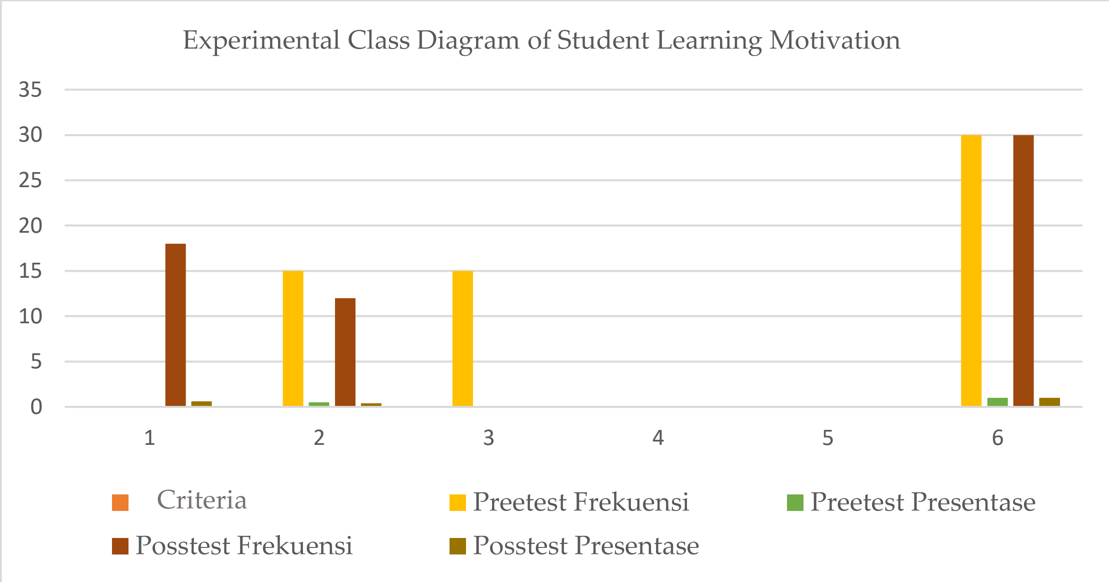

Figure 2. Students Learning Motivation

Based on the table above, the pre-test frequency distribution for learning motivation in the experimental class shows that 15 students (50%) were categorized under the high criteria, while the remaining 15 students (50%) fell into the medium criteria. Following the implementation of the problem-solving learning model, the post-test results indicated an improvement. Specifically, 18 students (60%) achieved learning outcomes in the very high category, and 12 students (40%) were categorized as having high learning outcomes.

3.1.3 Results of Quantitative Descriptive Analysis of Learning Achievement Indicators

The results of the quantitative descriptive analysis provide an overview of the general implementation of the problem-solving learning model. This includes a brief explanation of how the model was applied to achieve specific learning outcome indicators, particularly those related to students' ability to identify and agree on learning objectives based on their interests and learning needs. The analysis also highlights the percentage of student concentration and interest during the learning activities, specifically concerning the indicator of understanding and agreeing on learning objectives. Based on the processed data, the following results were obtained.

Table 1. Distribution of Student Motivation Levels in the Indicator "Know and Agree to Learning Objectives" Before and After the Application of the Problem-Solving Learning Model

Motivation Category	Pre-Test (F)	Pre-Test (%)	Post-Test (F)	Post-Test (%)
Very High	1	3.3%	2	6.6%
High	12	40.0%	19	63.3%
Medium	13	43.3%	9	30.0%
Low	4	13.3%	0	0.0%
Very Low	0	0.0%	0	0.0%
Total	**30**	**100%**	**30**	**100%**

Before the implementation of the problem-solving learning model, a pre-test was administered to assess students' motivation on the indicator of "knowing and agreeing to learning objectives." The results showed that 1 student (3.3%) fell into the very high category, 12 students (40%) were in the high category, 13 students (43.3%) in the medium category, and 4 students (13.3%) in the low category.

After applying the problem-solving model, the post-test results revealed a positive shift in motivation levels. There were 2 students (6.6%) in the very high category, 19 students (63.3%) in the high category, and 9 students (30%) in the medium category. Notably, no students remained in the low or very low categories, indicating an overall improvement in student motivation following the intervention.

3.1.4 Results of the Validity Test of the Problem-Solving Learning Model on Improving Student Learning Outcomes

Table 2. Descriptive Statistics of N-Gain Scores for Learning Outcomes and Student Motivation

Variable	N	Average	Minimum	Maximum
N-Gain Learning Outcomes	30	0.56	0.34	0.74
N-Gain Motivation	30	0.64	0.59	0.91

Based on the results of the N-gain score test calculation on the learning outcome and motivation variables, the average N-gain score of the learning outcome variable is 0.6, which is included in the high category, with a minimum N-gain value of 0.34 and a maximum of 0.74. Meanwhile, the average N-gain score of the motivation variable is 0.64, which is included in the high category, with a minimum N-gain value of 0.59 and a maximum of 0.91.

Table 3. Significance Values (p-values) of Student Learning Outcomes and Motivation Before and After the Problem-Solving Learning Model

Variable	Test Group	p-value
Learning Outcomes	Pre-Test	0.037
	Post-Test	0.606
Motivation	Pre-Test	0.060
	Post-Test	0.124

The table above presents the normality test results for both the pre-test and post-test groups across each research variable. For the learning outcomes variable, the p-value obtained in the pre-test group was 0.037, and in the post-test group, it was 0.606. Since both values are greater than 0.05, the assumption of normality is satisfied. Therefore, the appropriate statistical test to analyze the difference between pre-test and post-test scores for this variable is the paired sample t-test.

Similarly, for the motivation variable, the p-values were 0.060 for the pre-test group and 0.124 for the post-test group. As both values are also greater than 0.05, the data meet the normality assumption. Hence, the paired sample t-test is also used to examine the differences in students' motivation before and after the implementation of the problem-solving learning model.

Discussion

The implementation of the problem-solving learning model at SDN 6 Pegasing has demonstrated a notable influence on students' science learning outcomes. Data on student performance were collected through tests administered after the learning process, which aimed to measure the extent of understanding acquired following the application of the problem-solving approach. The results showed that this model significantly enhanced student engagement during science learning, as evidenced by increased participation in discussions, questioning, and group activities. Students played an active role in addressing problems presented by the teacher, often dividing tasks and responsibilities effectively within their groups. Those who initially struggled with concentration began showing more consistent involvement, highlighting the model's potential to reduce learning difficulties by fostering collaborative and inquiry-based learning.

During the implementation process, the problem-solving model followed several structured phases. The teacher began with an orientation phase, introducing the topic—such as plant stems—using relevant images and prompting students to observe and respond to the visuals. This was followed by encouraging students to formulate problems or questions based on the materials observed, thereby stimulating curiosity and critical thinking. In the next stage, students were organized into learning groups where they defined the problems to be solved. Here, the teacher guided students in refining their questions and gathering the information needed for investigation. Through worksheets and collaborative exploration, students were encouraged to seek solutions using textbooks and other available resources.

The third phase involved guiding student research, both independently and within groups. Students collected data, analyzed information, and formulated their own ideas to solve the problems presented. Teachers acted as facilitators, providing direction without dominating the learning process. Students documented their findings on worksheets, processed the data, and developed conclusions. These findings were then presented to the class in the form of reports, allowing for peer feedback and collaborative learning.

In the final phase, students evaluated and analyzed the outcomes of their investigations. This was conducted through class discussions, where each group presented their findings and engaged in question-and-answer sessions with peers. Textbooks were used to support the evaluation process, ensuring alignment with curriculum content. Groups that successfully solved the assigned problems were rewarded, reinforcing positive behavior and encouraging responsibility. The teacher concluded the learning cycle by assessing overall student performance based on the material studied.

The effectiveness of the problem-solving model in improving student learning outcomes is closely tied to several instructional indicators. These include the ability to identify and agree on learning objectives, engage in problem-focused discussions, communicate ideas clearly, and collaboratively make decisions using structured approaches. The results of this study support the idea that the problem-solving learning model contributes positively to cognitive development and academic performance in science. These findings align with the research of Selçuk et al. (2008), who found that problem-solving models can significantly improve student learning outcomes by promoting higher engagement and deeper understanding.

Similarly, Nbina and Joseph (2011) emphasized that the problem-solving approach encourages active learning by allowing students to construct knowledge through inquiry, thereby enhancing both retention and comprehension. This hands-on, student-centered learning is particularly effective in subjects like science, where concepts are often abstract and require concrete examples and exploration for full understanding.

The theoretical foundation of this model can also be linked to Bloom's taxonomy, which classifies learning outcomes into cognitive, affective, and psychomotor domains (Thabrani & Arif, 2012). In this study, cognitive development was targeted through knowledge acquisition, comprehension, application, and evaluation. Affective outcomes were seen in students' attitudes, willingness to participate, and appreciation of collaborative learning. Meanwhile, psychomotor skills were developed as students engaged in hands-on activities, group work, and presentations—skills essential for holistic science education.

According to Gulo (2002), problems used in such models should be relevant, solvable, and sometimes controversial to stimulate critical thinking. In this case, the problems assigned to students were designed to reflect real-life situations, making them more relatable and engaging. These tasks required students to apply their knowledge in a meaningful context, bridging the gap between theoretical learning and practical application.

The improvement in students' science learning outcomes after the implementation of the problem-solving model can also be attributed to the teacher's evolving role from a traditional instructor to a facilitator. This shift allowed students more autonomy in their learning process. Teachers provided direction and support but gave students the freedom to investigate, collaborate, and arrive at their own conclusions. As a result, students became more confident in expressing their ideas and more responsible for completing assigned tasks.

The research findings further revealed that students became more enthusiastic and focused during lessons. They demonstrated improved comprehension of scientific concepts and showed greater accountability for their learning. These outcomes support the views of Sanjaya (2009), who stated that problem-solving approaches are effective in developing critical thinking skills, increasing motivation, and promoting active learning. Fisher (2008) also emphasized that critical thinking involves evaluating and analyzing information logically, which is a central component of the problem-solving learning model.

Overall, the findings of this study confirm that the implementation of the problem-solving learning model contributes significantly to improving both student engagement and academic achievement in science. By encouraging students to identify problems, gather information, develop solutions, and evaluate outcomes, the model fosters deeper understanding and retention. It also supports the development of essential 21st-century skills, including collaboration, communication, and critical thinking, which are key components of the Merdeka Curriculum framework in Indonesia.

The evidence from SDN 6 Pegasing suggests that when problem-solving strategies are well-structured and guided effectively by teachers, they can transform the classroom environment into a dynamic space for meaningful learning. These findings may serve as a reference for future teaching strategies in science education, particularly in primary schools seeking to adopt more student-centered and inquiry-based approaches.

4. CONCLUSION

Based on the findings and discussion, it can be concluded that the application of the problem-solving learning model at SDN 6 Pegasing effectively improved both student learning outcomes and motivation in science education. The model encourages students to engage actively in the learning process by analyzing real-world problems, seeking relevant information, and developing critical thinking skills. As a result, students became more attentive, inquisitive, and motivated, leading to measurable improvements in academic performance. However, this study had certain limitations, particularly concerning internal validity, due to the absence of a control group and limited sample size. Therefore, caution should be exercised in generalizing the results. For future research, it is recommended to employ a more rigorous experimental design, such as a randomized controlled trial, and to explore the model's effectiveness across different grade levels, subjects, or school settings. Additionally, further efforts should be made to provide training for teachers in integrating problem-solving strategies into their instruction, ensuring broader and more consistent application of this approach to enhance student engagement and achievement.

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