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The Effect of Problem-Based Learning (PBL) with Diorama Media on Understanding Science Concepts

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ABSTRACT

This study aims to test the Problem-Based Learning (PBL) model, supported by diorama media, in improving students' understanding of science concepts related to food chains. The study employed a quasi-experimental method with a One-Group Pretest–Posttest design. The study subjects consisted of 15 fifth-grade students from SDN Penapali, selected through saturation sampling. Data were collected via tests, observations, and documentation, then analyzed using the Shapiro–Wilk normality test and a paired-sample t-test with the assistance of Jamovi software. The analysis results indicated that the data were normally distributed ($p > 0.05$). Hypothesis testing revealed a significant difference between pretest and posttest scores ($p < 0.001$) with an effect size classified as very large. These findings confirm that implementing of the Problem-Based Learning (PBL) model aided by diorama media significantly and effectively improves students' understanding of science concepts. The integration of problem-based learning with concrete media has proven capable of strengthening student engagement and facilitating deeper knowledge construction. Therefore, this approach is recommended as an innovative strategy in science education at the elementary school level.

A. INTRODUCTION

Science education in elementary school plays a crucial role in developing students' scientific thinking skills through activities such as observing, classifying, and systematically understanding natural phenomena. Science learning at the elementary school level serves as the foundational basis for cultivating students who possess scientific knowledge, skills, and attitudes (Hakim (2024). However, the implementation of science education in elementary schools still faces various challenges, particularly in providing concrete and meaningful learning experiences for students. In practice, science instruction tends to be overly verbal and teacher-centered, resulting in students primarily receiving information rather than actively constructing their own knowledge. This situation leads to low student engagement in the learning process and contributes to poor conceptual understanding. In fact, effective science learning should provide students with the opportunity to directly experience the process of discovering concepts through meaningful activities Sufraini and Arwinda (2025). Furthermore, meaningful learning can be achieved when new information is connected to students' cognitive structures through contextual activities supported by appropriate learning media Baruno et al. (2025). Therefore, abstract science topics, such as ecosystems and food chains, require a learning approach that more concrete learning experiences. Based on this, the urgency of this

study lies in the need to develop science learning that is more active, contextual, and based on real-world experiences to optimally enhance students' conceptual understanding.

This issue was also observed in the field, particularly at SDN Penapali in Bima Regency. Based on observations and interviews with fifth-grade teachers, science instruction remains dominated by lecture-based methods using two-dimensional media from textbooks. Approximately 70% of class time is teacher-centered, resulting in suboptimal student engagement. Consequently, students struggle to grasp ecosystem concepts, particularly in identifying the roles of producers, consumers, and decomposers, as well as understanding the flow of energy within food chains. This is evidenced by low student achievement, with only about 42% of students meeting the Minimum Competency Criteria (KKM). This situation indicates that current teaching practices have not been able to accommodate students' learning needs at the concrete operational stage; therefore, educational innovations are needed that are better aligned with the characteristics of students' cognitive development.

To address these issues, a solution is needed in the form of a learning model that actively engages students while being supported by concrete media. One relevant alternative is the Problem-Based Learning (PBL) model supplemented by diorama media. The PBL model uses contextual problems as the starting point for learning, thereby encouraging students to think critically, discuss, and construct knowledge independently Najmiyatussofa and Fitriyani (2026). Meanwhile, dioramas, as three-dimensional media, can provide a tangible representation of an environment or phenomenon, thereby helping students understand abstract concepts more concretely. Zaenab et al. (2025) state that three-dimensional visual media can enhance students' attention and understanding, while Kurniasari and Maisaroh (2025) emphasize that concrete media provide a more effective learning experience because they allow direct interaction with learning objects. By integrating PBL and diorama media, learning is expected to become more contextual, interactive, and meaningful.

Although various studies have examined efforts to improve students' understanding of science concepts through the application of instructional models and the use of instructional media, these studies are generally still conducted in isolation. Research by Yulianci, Nurjumiati, and Asriyadin (2020) shows that the application of active learning models can improve students' understanding of science concepts by engaging them in the learning process. However, that study did not integrate the use of concrete media that could help students visualize abstract science concepts. On the other hand, research on diorama media indicates that three-dimensional media can enhance the appeal and visualization of learning materials; however, most studies still focus on the effectiveness of media as learning aids without linking them to problem-based learning models that encourage students to think critically and solve problems independently.

Based on this research map, it is evident that previous studies have been limited to testing the effectiveness of learning models or instructional media in isolation. In fact, improving students' understanding of science concepts requires not only their active engagement through appropriate learning models but also concrete representations that can help them understand the relationships between concepts more deeply. Therefore, there remains a research gap regarding how to integrate Problem-Based Learning (PBL) and diorama-based media can work synergistically to enhance elementary school students' understanding of science concepts, particularly regarding food chains. This study aims to address this gap by testing the effectiveness of integrating PBL and diorama-based media as a unified learning strategy that not only improves learning outcomes but

also strengthens students' knowledge-construction processes. In addition to introducing an innovative integration of the Problem-Based Learning (PBL) model and diorama media, this study is also based on a conceptual model that explains the mechanisms through which learning can enhance students' understanding of science concepts. In this conceptual model, the application of PBL supported by diorama media is viewed as a learning stimulus capable of increasing students' active engagement in the learning process. Through the presentation of contextual problems and the use of concrete three-dimensional media, students gain a more meaningful learning experience, enabling them to construct knowledge independently. It is this process of knowledge construction that subsequently contributes to an improved understanding of science concepts, particularly regarding food chains.

This conceptual model is based on constructivist theory, which states that knowledge is actively constructed through the interaction between learning experiences and students' cognitive structures. In the context of this study, dioramas serve as a concrete visualization tool that helps students understand the relationships among ecosystem components, while PBL facilitates critical thinking and problem-solving. Thus, improved conceptual understanding is viewed not only as a result of using the model and learning media but also as a consequence of increased student engagement and the process of knowledge construction.

Based on this gap, this study offers a novel approach by integrating the Problem-Based Learning (PBL) model with diorama media as a unified learning strategy that is not only oriented toward learning outcomes but also explains the mechanisms for enhancing conceptual understanding through students' active engagement and the process of knowledge construction. Thus, this study not only provides a practical contribution in the form of a more effective alternative for science learning but also offers a theoretical contribution by strengthening the understanding of the relationship between problem-based learning, the use of concrete media, and the development of science conceptual understanding among elementary school students. The findings of this study are expected to enrich the study of constructivism in science education, particularly regarding the role of concrete learning experiences in enhancing students' conceptual understanding at the concrete operational stage.

Conceptual understanding in science refers to students' ability to explain phenomena, classify objects, connect concepts to real-life situations, and understand the relationships among components within a system Lestari, Rustan, and Munir, (2024). Kusuma et al. (2025) emphasize that conceptual understanding is best developed when students are actively engaged in the learning process and supported by concrete visualizations. Therefore, integrating the PBL model with diorama media is a relevant strategy for improving the quality of science learning.

Based on the above discussion, the general objective of this study is to examine the effect of implementing the Problem-Based Learning (PBL) model assisted by diorama media on students' science concept understanding regarding the food chain topic in Grade 5 at SDN Penapali. This study is expected to contribute to the development of educational science, particularly in introducing innovations in science learning that integrate problem-based learning models with concrete media, thereby improving the quality of the learning process and outcomes for elementary school students.

B. METHODS

This study employed a quasi-experimental method using a one-group pretest–posttest design. The study was conducted at SDN Penapali, Woha Subdistrict, Bima Regency, during the even semester of the 2025/2026 academic year, with a sample of 15 fifth-grade students consisting of 10 boys and 5 girls. All students were included in the study using a saturation sampling technique. Data collection techniques included observation, testing, and documentation. The research instruments consisted of an observation sheet to measure the implementation of instruction and student activities, as well as pretest and posttest questions to measure students' understanding of science concepts related to food chains. Data analysis was conducted systematically through several stages. First, the pretest and posttest data were collected and tabulated. Second, descriptive statistical analysis was performed to determine the general characteristics of the data, including the mean, minimum, maximum, and standard deviation. Third, a normality test was conducted using the Shapiro–Wilk test to determine whether the data were normally distributed. Fourth, after the data were confirmed to be normally distributed, a hypothesis test was conducted using a paired-sample t-test with a significance level of 0.05 to determine the effect of implementing a media-assisted diorama-based Problem-Based Learning (PBL) model on students' understanding of science concepts. Fifth, to determine the magnitude of the treatment effect, an effect size calculation was performed. The entire data analysis process was conducted using the Jamovi software, version 2.6.

C. RESULT AND DISCUSSION

1. Result

This study aims to examine the effect of implementing a media-assisted Problem-Based Learning (PBL) model on students' understanding of science concepts related to food chains. Research data were obtained from pretest and posttest results, which were analyzed using descriptive and inferential statistics. Descriptive statistical analysis aimed to describe the data distribution and the level of students' conceptual understanding before and after the intervention, including the mean, minimum, maximum, and standard deviation. The results of this analysis are presented in Table 1.

Table 1. Descriptive Statistics of Students' Pretest and Posttest Scores

	Mean	SD	Minimum	Maximum
pretest	41.9	14.09	12	68
posstest	72.4	8.22	60	90

Based on Table 1, it can be seen that the mean score on the posttest is higher than that on the pretest. This indicates an improvement in students' understanding of science concepts after being taught using the Problem-Based Learning (PBL) model supplemented with diorama media. The minimum and maximum scores on the posttest also increased compared to the pretest, indicating that nearly all students showed improvement in their learning outcomes.

Additionally, the standard deviation of the posttest scores is smaller than that of the pretest, indicating that the variation in student scores has decreased. This suggests that students' level of understanding has become more consistent following the instruction. Thus, descriptively, it can be concluded that the implementation of the PBL

model supported by diorama media has a positive impact on improving students' understanding of science concepts.

A normality test was conducted to ensure that the pretest and posttest data were normally distributed before hypothesis testing. The Shapiro–Wilk test, with a significance level criterion greater than 0.05, indicated that the data were normally distributed. The results of this test are presented in Table 2.

Table 2. Normality Test Results of Pretest and Posttest Data (Shapiro–Wilk)

		Shapiro-Wilk	
	SD	**W**	**p**
pretest	14.09	0.942	0.407
posstest	8.22	0.946	0.470

Based on Table 2, the results of the normality test using the Shapiro–Wilk test show that the significance value for the pretest is 0.407 and for the posttest is 0.470. Both values are greater than 0.05, so it can be concluded that the pretest and posttest data are normally distributed.

These results indicate that the data meet the normality assumption, allowing statistical analysis to proceed using a parametric test, specifically the paired-sample t-test. Meeting this assumption is crucial to ensure that the results of the hypothesis testing have a high level of accuracy.

A hypothesis test was conducted to examine the effect of implementing a media-assisted Problem-Based Learning (PBL) model using dioramas on students' understanding of science concepts. The test used a paired-sample t-test with a significance level criterion of less than 0.05, indicating a significant difference. The results of this analysis are presented in Table 3.

Table 3. Results of the Hypothesis Test Using a Paired Sample t-Test

						95% Cofidence Interval		
		Statistic	**d**	**P**		**Effect Size**	**Lower**	**Upper**
Pretest	posstet Student's t	-8.43	14.0	<.001	Cohen's d	-2.18	-3.11	1.22

Note. H_a $\mu_{Measure\ 1 - Measure\ 2} \neq 0$

Based on Table 3, the results of the paired-sample t-test show that the calculated t-value is -8.43 with degrees of freedom (df) = 14 and a significance level of $p < 0.001$. A significance level less than 0.05 indicates that there is a significant difference between the pretest and posttest scores. Thus, the null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted. This means that the implementation of the Problem-Based Learning (PBL) model aided by dioramas has a significant effect on students' understanding of science concepts.

Furthermore, the effect size (Cohen's d) of 2.18 indicates that the effect falls into the very large category. This value was derived from the absolute effect size value in the table, which is -2.18; the negative sign merely indicates the direction of the difference between the pretest and posttest, while the interpretation of the effect size category is based on the magnitude of the value. Based on the criteria for interpreting

Cohen's d, a value of 0.2 is categorized as small, 0.5 as moderate, and 0.8 as large. Thus, the value of 2.18, which is well above 0.8, falls into the very large category. This indicates that the improvement observed is not only statistically significant but also has a strong impact on enhancing students' conceptual understanding.

Furthermore, the effect size (Cohen's d) of 2.18 indicates that the effect falls into the very large category. This suggests that the observed improvement is not only statistically significant but also has a strong impact on enhancing students' conceptual understanding Nevertheless, such a high effect size must be interpreted with caution. An effect size of 2.18 indicates that the difference between pretest and posttest scores was very large in the study group. This large effect size may be influenced by several factors, such as the students' low initial ability before the intervention, the use of dioramas—a medium suitable for elementary school students at the concrete operational stage—and the students' active engagement in problem-solving through the PBL model. In addition, the relatively small sample size (n = 15) and the use of a one-group pretest–posttest design without a control group may also have influenced the magnitude of the effect size obtained. Therefore, although the research results indicate a very strong effect, generalizing the findings must be done cautiously and requires further testing on a larger sample as well as a research design that includes a control group.

2. Disscusion

The results of this study indicate that the implementation of a media-assisted Problem-Based Learning (PBL) model has a significant impact on improving students' understanding of science concepts. This improvement aligns with the results of statistical analysis, which revealed a significant difference between pretest and posttest scores. These findings suggest that learning that involves direct problem-solving activities can help students understand concepts more deeply. Thus, these research results support the hypothesis that the use of the PBL model combined with concrete media is effective in improving students' conceptual understanding.

Theoretically, these findings align with constructivist theory, which emphasizes that knowledge is actively constructed through learning experiences. Students do not merely receive information but are engaged in the process of discovering and constructing concepts independently Martir, Sayangan, and Beku (2024). This active engagement allows students to connect new knowledge with prior experiences, thereby fostering a more meaningful understanding Daud (2024). Additionally, the constructivist approach emphasizes the importance of social interaction in the learning process, which contributes to the strengthening of students' cognitive structures Sayfullooh and Latifah (2023).

The Problem-Based Learning model shares characteristics aligned with this approach, as learning begins with contextual problems. Students are encouraged to identify problems, discuss them, and collaboratively seek solutions Ardhana and Dewi (2025). This process not only enhances student engagement but also cultivates critical and analytical thinking skills Laili, Ni'mah, and Amalia (2025). In the long term, problem-based learning also fosters higher-order thinking skills such as analysis and evaluation Givarin and Ellianawati (2025).

On the other hand, the use of dioramas significantly contributes to supporting students' conceptual understanding. This medium allows students to directly observe representations of the concepts being studied, particularly in abstract topics like food chains. Three-dimensional visualizations help students understand the relationships

among living organisms more concretely Alawiyah and Siregar (2025). Additionally, concrete media play a role in enhancing conceptual clarity and facilitating the internalization of knowledge Purbarani (2024).

The use of concrete materials in science education is crucial, particularly at the elementary school level. This is because students are still in the concrete operational stage and therefore require visual aids to understand abstract concepts Islamiah, Supriatin, and Mahmudah (2025). Direct and contextual learning experiences have also been shown to enhance students' memory and understanding of the learning material Suhermi, Barokah, and Kamal (2025). Thus, the use of dioramas in this study serves as a bridge between theoretical concepts and the reality that students can observe.

The findings of this study are also supported by various previous studies showing that the implementation of the PBL model can significantly improve students' learning outcomes and conceptual understanding Ramadani et al. (2026). Additionally, problem-based learning has been shown to enhance students' motivation and engagement in the learning process Husna, Ilmi, and Gusmaneli (2025). Other studies have also shown that the use of dioramas can increase interest in learning and help students understand concepts more effectively Azizah, Maruti, and Zahro (2024).

Empirically, the improvement in students' conceptual understanding in this study can be explained by several factors. First, students' active engagement in discussions and problem-solving facilitates interactions that support the learning process Depita (2024). Second, the use of dioramas provides a more contextual learning experience, enabling students to connect concepts to their daily lives Sitorus et al. (2025). Third, problem-based learning encourages students to think systematically in understanding the relationships between concepts Nugraha, Syihabuddin, and Damaianti (2022).

When compared to previous studies, the results of this study show strong alignment, and no significant contradictions were found. Instead, these findings reinforce various studies stating that active learning and the use of concrete media are an effective combination for enhancing students' understanding of science concepts Taroreh (2024). This indicates that the approach used in this study has a strong theoretical and empirical foundation.

In terms of novelty, this study contributes to the integration of the Problem-Based Learning model with diorama media into a single learning unit. Previous studies tended to examine learning models or media separately, whereas this study directly combines both. This integration has been shown to have a greater impact on students' conceptual understanding

Furthermore, the findings of this study have important implications for science education. Theoretically, these findings reinforce the importance of implementing constructivist learning in elementary education Jauhari, Kurniawan, and Rokhmat (2025). Practically, this study offers an alternative for teachers to implement more innovative, interactive, and meaningful learning. Thus, the implementation of a media-assisted PBL model using dioramas can serve as a solution to improve the quality of science learning in elementary schools.

D. CONCLUSION AND SUGGESTIONS

Based on the results of this study, it can be concluded that the implementation of the Problem-Based Learning (PBL) model supported by dioramas has a significant effect on students' understanding of science concepts related to food chains in Grade 5 at SDN Penapali. Thus, the alternative hypothesis (H_1) is accepted and the null hypothesis (H_0) is rejected. These findings indicate that the use of a problem-based learning model

supported by concrete media in the form of dioramas is effective in improving students' conceptual understanding. In addition to providing practical contributions to science education in elementary schools, the results of this study also reinforce the constructivist view that conceptual understanding develops more optimally when students are actively engaged in the problem-solving process and supported by concrete learning experiences.

Based on these findings, the Problem-Based Learning (PBL) model aided by dioramas is recommended for gradual implementation in other schools as an alternative science learning strategy capable of enhancing students' conceptual understanding. This implementation can be adapted to the conditions and availability of resources at each school. Furthermore, future researchers are advised to conduct studies using more complex experimental designs, such as including a control group, expanding the sample size and characteristics, and examining the application of the diorama-assisted PBL model to other science topics or integrating it with digital learning technologies to obtain more comprehensive results with broader generalizability.

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