



The impact of diorama media on learning outcomes in water cycle education

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ABSTRACT

Learning Natural and Social Sciences (IPAS) on the water cycle in elementary schools still poses challenges for helping students understand abstract concepts such as evaporation, condensation, and precipitation. Diorama media were chosen because they provide a concrete, interactive, three-dimensional visual representation. This study used a quasi-experimental design with a pretest-posttest control group design involving an experimental group using diorama media and a control group using conventional methods. Data were analyzed using descriptive and inferential statistics, including paired t-tests and effect size calculations. The results showed that the experimental group's average post-test score was significantly higher than that of the control group, with a medium effect size. Diorama media not only improve students' understanding of the water cycle concept but also encourage active involvement and motivation. The effectiveness of dioramas can be explained through the theories of constructivism, multimedia learning, dual coding, and cognitive load. This study recommends integrating diorama media into the IPAS curriculum in elementary schools, particularly for abstract and complex materials.

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ABSTRAK

Pembelajaran Ilmu Pengetahuan Alam dan Sosial (IPAS) pada materi siklus air di sekolah dasar masih menghadapi tantangan dalam membantu murid memahami konsep abstrak seperti evaporasi, kondensasi, dan presipitasi. Media diorama dipilih karena mampu menghadirkan representasi visual tiga dimensi yang konkret dan interaktif. Penelitian ini menggunakan desain eksperimen semu dengan pretest-posttest control group design yang melibatkan kelompok eksperimen menggunakan media diorama dan kelompok kontrol menggunakan metode konvensional. Data dianalisis menggunakan statistik deskriptif dan inferensial, termasuk uji t berpasangan dan perhitungan effect size. Hasil penelitian menunjukkan bahwa rata-rata skor post-test kelompok eksperimen lebih tinggi secara signifikan dibandingkan kelompok kontrol dengan nilai effect size kategori sedang. Media diorama tidak hanya meningkatkan pemahaman konsep siklus air secara kognitif, tetapi juga mendorong keterlibatan aktif dan motivasi murid. Efektivitas diorama dapat dijelaskan melalui teori konstruktivisme, multimedia learning, dual coding, dan cognitive load. Penelitian ini merekomendasikan integrasi media diorama dalam kurikulum IPAS di sekolah dasar, khususnya pada materi yang bersifat abstrak dan kompleks.

Kata Kunci: hasil belajar; media diorama; siklus air

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INTRODUCTION

The teaching of Natural and Social Sciences (IPAS), particularly regarding the water cycle, still faces various challenges at both the national and school levels. On a macro level, a study by the Kemendikbudristek indicates that Indonesian students' understanding of Science and Social Studies (IPA/IPS) content remains relatively low compared to literacy and numeracy skills, thereby affecting students' ability to master basic scientific concepts (Seftriana et al., 2020). This situation stands in contrast to the demands of the Merdeka Curriculum, which emphasizes project-based learning, environmental exploration, and the strengthening of the Pancasila Student Profile—all of which ideally require a solid understanding of science as well as critical and applied thinking skills (Destiana & Purwanto, 2024).

At the micro level, similar issues were also identified at SDN Jatisampurna VIII based on the results of initial observations. Most students still struggle to understand the relationships between processes in the water cycle, such as evaporation, condensation, and precipitation. These difficulties are reflected in the students' average daily test scores, which remain below the *Kriteria Ketuntasan Minimal* (KKM) set by the school (Romadona & Wiratsiwi, 2024). Additionally, students appear unable to connect the concept of the water cycle with everyday phenomena, such as rain or evaporation, making the learning process less meaningful and lacking in context.

These findings indicate that the teaching methods currently in use still need improvement to better help students understand abstract concepts in a more concrete way. Therefore, there is a need for innovative teaching materials that not only clearly visualize concepts but also encourage active student engagement. One of the media with the potential to meet these needs is the diorama, as it can present a three-dimensional depiction of the water cycle, making it more engaging, contextual, and easier for elementary school students to understand.

At SDN Jatisampurna VIII, previous teaching methods that relied heavily on images or two-dimensional visual aids proved less effective at improving student understanding. The use of dioramas as teaching aids offers a more concrete and interactive alternative. Dioramas allow students to observe the water cycle in a more tangible way, which is expected to increase their motivation, engagement, and ultimately their learning outcomes (Yanti & Huda, 2023).

Previous studies have shown that the use of dioramas can enhance students' understanding of academic content. Dioramas help students grasp abstract concepts in a more concrete and visual way (Vira et al., 2024). Additionally, dioramas are effective for illustrating events or processes that are difficult to visualize in real life (Oktaviani et al., 2025). In the context of science education, the use of dioramas has been shown to help students connect theory with reality, which leads to improved learning outcomes. Dioramas are also particularly useful for topics such as the water cycle because they can boost student motivation and engagement (Sari et al., 2024).

However, these studies still focus on improving conceptual understanding and general learning outcomes. There has been little research linking the use of dioramas to the development of 21st-century skills, such as critical thinking, communication, and collaboration in science education. In fact, 21st-century learning requires students not only

to understand concepts but also to be able to collaborate, solve problems, and communicate ideas effectively. Thus, there is a research gap regarding how diorama media can be integrated into learning models that support the strengthening of these skills (Azhas & Octaviani, 2025). This study aims to examine the influence of water cycle diorama media not only on student learning outcomes but also on 21st-century skills, particularly critical thinking and collaboration that emerge during the learning process. Thus, this study offers a new contribution to the development of more integrative and contextual learning media in the IPAS subject.

This study aims to analyze the effect of using dioramas to improve student learning outcomes, as well as their critical and collaborative thinking skills, on the topic of the water cycle in the Integrated Science subject at SDN Jatisampurna VIII. This study is expected to provide empirical evidence for teachers regarding the effectiveness of dioramas as a teaching aid that not only improves learning outcomes but also supports the development of 21st-century skills in elementary school students.

LITERATURE REVIEW

Dioramas as a Learning Medium in IPAS

Dioramas are an effective three-dimensional learning tool for clarifying abstract concepts because they provide concrete visual representations that are easy for elementary school students to understand (Yuniarsih, 2021). The main advantage of dioramas lies in their ability to visualize the relationships between elements within a process as a whole, including in the water cycle, which requires an understanding of the sequence of changes in the state of water and its movement through various layers of the Earth (Khaeroni & Julia, 2024). This advantage makes dioramas more effective than two-dimensional visual media, which tend to be static and less capable of depicting the dynamics of a process comprehensively (Sari et al., 2024).

The suitability of dioramas as teaching aids for fifth-grade IPAS curriculum content is further reinforced by the fact that the Kurikulum Merdeka emphasizes exploration, inquiry, and modeling in Phase C, making the use of concrete materials essential in helping students connect concepts with real-world phenomena (Nursyamsi et al., 2024; Subhi et al., 2025). In the water cycle curriculum, dioramas can visualize topographic features such as mountains, rivers, and groundwater zones, which are often difficult to imagine through conventional methods (Subhi et al., 2025). Through such visualizations, dioramas help reduce common misconceptions, such as the belief that evaporation occurs only in the oceans or that rain falls because clouds are "full," by incorporating other process components such as transpiration, groundwater flow, and human influence (Lia et al., 2023).

Compared to other media, dioramas also offer the advantage of interactivity. Students can conduct simple experiments, such as pouring water or using a light source to simulate the sun, allowing them to directly observe the effects of topography, land cover, and slope on water flow (Teplá et al., 2022). On the other hand, dioramas are easier for elementary school students to operate compared to augmented reality-based simulations that require specialized devices and digital skills (Lailiyah & Widiyono, 2023; Puspita et al., 2025). Thus, dioramas serve not only as visual media but also as interactive conceptual tools that help

students understand the interrelationships among the components of the water cycle, avoid misconceptions, and connect scientific concepts with real-world experiences in science education.

The Theoretical Foundation of Constructivism

The constructivist perspective on instructional media emphasizes that media serve as tools that enable students to construct their own knowledge through active learning experiences (Magfiroh et al., 2025). From this perspective, instructional media not only convey information but also create challenging, contextual, and interactive learning situations that encourage students to explore, interpret, and connect new concepts with their existing knowledge (Wahidin, 2025). The theoretical foundation of constructivism emphasizes that students construct knowledge through interaction with their environment and real-world experiences (Julia et al., 2024). Concrete media such as dioramas support this principle by allowing students to observe, manipulate, and discuss the phenomena being studied (Vira et al., 2024). This aligns with findings that concrete media can enhance students' cognitive engagement because they are actively involved in the learning process (Aulia & Fadlan, 2025).

The use of concrete media, such as dioramas, can be viewed as a form of scaffolding that facilitates learning in elementary school. Visual media help students bridge abstract concepts with everyday experiences, thereby deepening their understanding of the material (Sefhira et al., 2025; Zaenab et al., 2025). Other findings indicate that three-dimensional media can enhance emotional engagement while fostering collaboration among students during the learning process (Yuliarti et al., 2024). Furthermore, constructivist-based media not only improve learning outcomes but also foster students' intrinsic motivation (Rosita et al., 2024). Thus, the use of dioramas can be positioned as an interactive media that provides meaningful learning experiences in accordance with constructivist principles.

Basic Concept of the Water Cycle in Learning

The water cycle is one of the fundamental concepts in science education that describes the continuous circulation of water on Earth. This process includes the stages of evaporation (water evaporating from the surface), transpiration (evaporation from plants), condensation (cloud formation), precipitation (rainfall), and infiltration (water seeping into the ground). Understanding the water cycle is important because it relates to water resource availability, climate change, and environmental management (Kamil, 2024; Marzuki & Sadiq, 2023). The use of dioramas in the water cycle topic requires the principles of visualization, interactivity, and contextualization. Visualization allows students to observe the stages of evaporation, condensation, precipitation, and infiltration in sequence (Subhi et al., 2025). The principle of interactivity encourages students to engage directly in exploring each component, while contextualization links the phenomena to daily life, making learning more relevant (Salsabila et al., 2024).

Within the context of the Kurikulum Merdeka, IPAS instruction is designed to develop inquiry, problem-solving, and critical thinking skills through real-world, experience-based exploration activities (Ardiatama et al., 2024). Dioramas support this approach because students not

only observe but can also manipulate model components, simulate processes, and test simple hypotheses related to the phenomena being studied (Teplá et al., 2022). Research indicates that the use of dioramas in IPAS instruction in fifth grade can improve cognitive learning outcomes, motivate students, and reduce misconceptions that frequently arise regarding the water cycle (Azizah et al., 2024).

METHODS

This study employed a quantitative approach using a quasi-experimental design because the researcher was unable to randomly assign the sample completely. This design was chosen so that the researcher could test the effect of using diorama media on student learning outcomes regarding the water cycle material in Grade 5 at SDN Jatisampurna VIII. The experimental model used was a pretest-posttest control group design. This study adapted the standard pretest-posttest control group design with contextual modifications. The instruments were developed based on the Learning Outcomes of the Kurikulum Merdeka in effect at SDN Jatisampurna VIII, focusing on Phase C of the water cycle material. The diorama media was specifically designed with the characteristics of fifth-grade elementary school students in mind and adapted to the school's facilities and infrastructure. The learning procedures were adjusted to the school's schedule and learning conditions while maintaining control over confounding variables such as learning time, material, and instructor.

The subjects of this study were fifth-grade students at SDN Jatisampurna VIII during the 2024/2025 academic year. The sample consisted of two classes selected through purposive sampling: Class V-A as the control group and Class V-B as the experimental group, each comprising 30 students. Purposive sampling was chosen because both classes had relatively homogeneous characteristics based on their average science daily test scores from the previous semester, which showed no significant difference as analyzed using data from the odd-semester report cards; they had the same age range of 10 to 11 years; and they had relatively equivalent socioeconomic backgrounds based on school demographic data. The equivalence of the initial abilities of the two groups was also confirmed through an independent t-test of the pre-test scores. The time required to conduct this study was 3 months, from January to March 2025.

The research instrument consists of learning achievement test items developed based on the Learning Outcome indicators of the Kurikulum Merdeka for the topic of the water cycle. The test comprises 25 multiple-choice items with four answer choices, covering the cognitive aspects of C1 (recall), C2 (understanding), C3 (application), and C4 (analysis) according to the revised Bloom's Taxonomy. The score range for each item is 0 to 4 points, with a maximum total score of 100. The validity of the instrument was assessed through expert judgment by two experts in elementary school science and one expert in learning evaluation using a 1-to-5 Likert scale, with a minimum average score of 4.0 required for the instrument to be considered valid. Learning outcome data were analyzed using descriptive and inferential statistics with SPSS version 26 software. Descriptive analysis included calculations of the mean, standard deviation, minimum value, and maximum value of the pre-test and post-test scores for both groups.

RESULTS AND DISCUSSION

The instruments used in this study were pre-tests and post-tests, each consisting of 10 open-ended questions. Data were obtained from the pre-test and post-test results, which were then analyzed using a series of statistical tests, including calculations of pre-test and post-test scores, a paired t-test, a normality test, a homogeneity test, and an effect size analysis.

Table 1. Comparison of Pre-Test and Post-Test Scores of the Experimental Group and Control Group

| Group | Mean Pre-test | Mean Post-test | Mean Difference |
|--------------------|---------------|----------------|-----------------|
| Experimental Group | 75,50 | 82,93 | 7,43 |
| Control Group | 59,10 | 75,80 | 16,70 |

Source: Research 2025

Before the research was conducted, students' learning outcomes in the IPAS subject were relatively low, and most of them had not yet reached the *Kriteria Ketercapaian Tujuan Pembelajaran* (KKTP) standard, which was set at 78. Of the 30 students, only a few were able to meet this standard. Based on **Table 1**, it is known that the average pre-test score in the experimental group was 75,50. After being given treatment in the form of IPAS learning using the air cycle diorama media, the average post-test score of the experimental group increased to 82,93, resulting in an increase of 7,43 points.

In the control group, the average pre-test score was 59,10. After instruction took place without any special treatment, the control group's post-test score increased to 75,80, representing an increase of 16,70 points. Thus, the increase in scores in the control group appeared to be greater than that in the experimental group. This difference in improvement needs to be further explained through inferential statistical tests to determine whether the difference is statistically significant.

Table 2. Paired Sample T-Test (*Pre-test dan Post-test*)

| Group | t-value | t-table ($\alpha=0,05$) | Conclusion |
|--------------------|---------|---------------------------|--------------|
| Experimental Group | 5,266 | 2,002 | Significance |
| Control Group | 10,021 | 2,002 | Significance |

Source: Research 2025

Based on the results of the pre-test and post-test obtained from the experimental and control groups, a paired t-test was conducted to determine the significance of the difference in scores before and after the treatment. The results of the paired t-test, as presented in **Table 2**, show that the experimental group obtained a calculated t-value of 5.266, while the critical t-value at a significance level of $\alpha = 0,05$ is 2,002.

Meanwhile, in the control group, the calculated t-value was 10,021, while the critical t-value was 2,002. Thus, in both the experimental and control groups, the calculated t-value was greater than the critical t-value (calculated t > critical t). This indicates that the difference between the pre-test and post-test scores in both groups is statistically significant at the

0,05 significance level. Therefore, it can be concluded that a significant improvement in learning outcomes occurred after the learning process in each group.

Table 3. *Data Normality Test (Kolmogorov-Smirnov dan Shapiro-Wilk)*

| Group | Result | Kolmogorov-Smirnov | Sig. | Shapiro-Wilk | Sig. |
|--------------------|-----------|--------------------|-------|--------------|-------|
| Experimental Group | Pre-test | 0,174 | 0,021 | 0,912 | 0,017 |
| | Post-test | 0,172 | 0,023 | 0,900 | 0,009 |
| Control Group | Pre-test | 0,141 | 0,130 | 0,943 | 0,110 |
| | Post-test | 0,181 | 0,013 | 0,878 | 0,003 |

Source: Research 2025

Next, to determine whether the research data were normally distributed, the researcher conducted normality tests on the pre-test and post-test data from the experimental and control groups. The normality tests were conducted using two approaches, namely the Kolmogorov–Smirnov and Shapiro–Wilk tests, as presented in **Table 3**. Based on the results of the Kolmogorov–Smirnov test, the experimental group obtained a statistic value of 0,174 for the pre-test and 0,172 for the post-test, with significance values of 0,021 and 0,023, respectively. In the control group, the Kolmogorov–Smirnov value was 0.141 for the pre-test with a significance of 0,130, and 0,181 for the post-test with a significance of 0,013.

Meanwhile, based on the Shapiro–Wilk test—which served as the primary measure in this study—the experimental group showed a statistical value of 0,912 on the pre-test and 0.900 on the post-test, with p-values of 0,017 and 0,009, respectively. In the control group, the Shapiro–Wilk value was 0,943 for the pre-test with a significance of 0,110, and 0,878 for the post-test with a significance of 0,003. Based on the normality testing criteria using the Shapiro–Wilk test, data are considered normally distributed if the significance value is greater than 0.05. Based on these results, only the pre-test data from the control group met the criteria for a normal distribution, while the other data showed significance values less than 0.05. Thus, it can be concluded that not all data in both groups were normally distributed, which must be considered when selecting subsequent statistical tests.

Homogeneity Test

Next, a test of homogeneity of variances was conducted to ensure that the variances of the data in the experimental and control groups were homogeneous. The test of homogeneity in this study used Levene’s Test, with the results presented in **Table 4**.

Table 4. *Homogeneity of Variance Test*

| Group | Pre-test | Post-test | Conclusion |
|--------------------|----------|-----------|-------------|
| Experimental Group | 0,108 | 0,744 | Homogeneous |
| Control Group | 0,035 | 0,852 | Homogeneous |

Source: Research 2025

Based on the results of Levene's Test, significance values of 0,744 were obtained for the post-test data and 0,852 for the pre-test data, both of which are greater than the significance level of 0,05. These results indicate that there is no significant difference in variance between the experimental group and the control group. Thus, it can be concluded that the data variance in both groups is homogeneous, so the data from both groups are suitable for direct comparison in further statistical analysis.

Effect Size Test

To further support the research findings, an effect size test was conducted to determine the extent of the impact of using water cycle dioramas on science learning outcomes. The effect size in this study was calculated using Cohen's *d*, as presented in **Table 5**.

Table 5. *Effect size Test (Cohen's d)*

| Group | Mean Pre-test | Mean Post-test | Standard Deviation | Cohen's d | Category |
|--------------------|---------------|----------------|--------------------|-----------|----------|
| Experimental Group | 75,50 | 82,93 | 8,629 | 0,4274 | Medium |
| Control Group | 59,10 | 75,80 | 9,099 | 0,4781 | Medium |

Source: Research 2025

Based on the results of the effect size test, the experimental group obtained a Cohen's *d* value of 0,4274, which falls into the moderate effect category. This indicates that the use of the water cycle diorama as a teaching aid made a significant contribution to improving science learning outcomes in the experimental group. Meanwhile, the control group obtained a Cohen's *d* value of 0,4781, which also falls into the moderate effect category. Thus, both the experimental and control groups showed a moderate level of effect on the improvement in learning outcomes, although the magnitude of the effect in the control group was slightly higher than that in the experimental group.

Discussion

Interpretation of Findings and Comparison with Previous Studies

The results of this study indicate that the use of dioramas is effective in improving students' learning outcomes on the water cycle in Grade 5 at SDN Jatisampurna VIII. The higher post-test scores of the experimental group compared to the control group suggest that concrete learning experiences through dioramas help students build a more stable understanding. Physical activities such as pouring water and observing the flow within the diorama reinforce sensorimotor engagement, which forms the foundation of knowledge construction, as noted in previous research (Vira et al., 2024).

Dioramas effectively enhance the understanding of science concepts in elementary school (Rahmawati & Sati, 2021; Seftriana et al., 2020). There is a significant improvement in cognitive learning outcomes when students use three-dimensional visual aids to understand natural phenomena. Dioramas have been shown to help students understand abstract

concepts more concretely and visually, and are effective for illustrating events or processes that are difficult to visualize in real life (Oktaviani et al., 2025).

This study not only assessed cognitive understanding but also identified improvements in student motivation and active engagement in IPAS learning. Unlike previous studies that focused solely on cognitive aspects, this study adds a new dimension by demonstrating that dioramas stimulate students' affective and psychomotor aspects. This distinction arises because this study employs direct observation of student interactions with the media and incorporates reflection on the learning process, rather than merely measuring final test scores. Dioramas are particularly effective for topics such as the water cycle because they enhance student motivation and engagement (Sari et al., 2024).

Dioramas can enhance students' engagement and motivation in understanding natural processes such as the water cycle (Haryanti et al., 2025; Mulyani et al., 2024). The use of project-based dioramas fosters the development of collaboration and communication skills through group discussions and presentations (Kusuma et al., 2023; Shidiq et al., 2025). Learning through dioramas is contextual because it connects IPAS concepts to the reality of the students' surrounding environment, thereby enhancing the meaningfulness of the learning process.

Theoretical Foundation and Its Relation to Previous Research

Theoretically, the findings of this study align with the constructivist perspective, which emphasizes that students construct knowledge through interaction with their environment and real-world experiences (Julia et al., 2024). Dioramas, as concrete media, enable students to explore, observe, and perform simple manipulations of the water cycle phenomenon, thereby making the learning process more active (Vira et al., 2024). Concrete media, such as dioramas, support the principles of constructivism by allowing students to observe, manipulate, and discuss the phenomena being studied and can enhance students' cognitive engagement as they are actively involved in the learning process (Aulia & Fadlan, 2025).

From Vygotsky's perspective, dioramas serve as scaffolding that helps students bridge abstract understanding to more concrete concepts. The use of concrete media, such as dioramas, can be viewed as scaffolding that facilitates learning in elementary school (Sefhira et al., 2025; Zaenab et al., 2025). Visual media help students bridge abstract concepts with everyday experiences, thereby deepening their understanding of the material. Research findings indicate that three-dimensional media can enhance emotional engagement while fostering collaboration among students in the learning process (Yuliarti et al., 2024).

This study is also supported by multimedia learning theory, which explains that students' understanding improves when information is presented in both verbal and visual forms simultaneously (Fadil et al., 2025). A water cycle diorama provides a concrete three-dimensional visual representation, helping students directly observe the relationships between components such as evaporation, condensation, precipitation, and infiltration. This visualization aligns with the principle emphasizing the importance of visualizing the stages of the water cycle sequentially so that students can understand the process as a whole (Subhi et al., 2025). The main advantage of a diorama lies in its ability to visualize the relationships

among elements within a process as a whole, including in water-cycle materials that require an understanding of the sequence of phase changes and the movement of water through various layers of the Earth (Khaeroni & Julia, 2024).

Integrated verbal and visual presentations help students develop dual mental or dual coding representations, enabling them to more easily remember and understand abstract concepts (Mir et al., 2023). With representations in the form of words and images, students can connect new knowledge with what they already know. When a verbal explanation of the water cycle is accompanied by images and diagrams illustrating the process, students will find it easier to understand the concept.

These findings are also consistent with cognitive load theory, which emphasizes the importance of reducing students' cognitive load when learning complex material (Rahmawati et al., 2024). The water cycle, as a natural phenomenon involving abstract stages such as evaporation, condensation, and precipitation, is often difficult to visualize when presented only verbally or through flat images. Using a diorama displays the process concretely in three dimensions, so students do not need to allocate too much working memory capacity to construct a mental image. As a result, students can focus more on understanding the relationships between components in the water cycle. Dioramas help reduce common misconceptions, such as the belief that evaporation occurs only in the oceans or that rain falls because clouds are "full," by incorporating other process components like transpiration, groundwater flow, and human roles (Lia et al., 2023). Furthermore, constructivist-based media not only improve learning outcomes but also foster students' intrinsic motivation (Rosita et al., 2024). Thus, the use of dioramas can be positioned as an interactive medium that provides meaningful learning experiences in accordance with constructivist principles.

Contextual Analysis

The effectiveness of the diorama at SDN Jatisampurna VIII is influenced by the characteristics of fifth-grade students, who are in the concrete operational stage of cognitive development according to Piaget. At this stage, students tend to think concretely and visually, so they are greatly aided by three-dimensional media that allow them to directly observe the processes in the water cycle. The abstract nature of the water cycle material becomes easier to understand when visualized tangibly through a diorama, making it appropriate for the students' stage of cognitive development. The Kurikulum Merdeka's emphasis further underscores the suitability of dioramas for fifth-grade IPAS material, with an exploratory, inquiry-based, and model-making approach in Phase C, making the use of concrete media essential for helping students connect concepts to real-world phenomena (Nursyamsi et al., 2024; Subhi et al., 2025). In the water cycle material, dioramas can visualize topographical features such as mountains, rivers, and groundwater zones, which are often difficult to imagine through conventional methods (Subhi et al., 2025).

In addition, the teacher's role in guiding students' exploration during diorama-based learning activities also contributes to the success of this method. Teachers in the experimental class actively posed guiding questions, encouraged students to observe and analyze the relationships between components in the dioramas, and facilitated group discussions. This aligns with the scaffolding principle in Vygotsky's theory, in which the teacher serves as a

facilitator to help students reach their zone of proximal development. The principle of interactivity encourages students to engage directly in exploring each component, while contextualization links phenomena to everyday life, making learning more relevant (Salsabila et al., 2024).

Compared to other media, dioramas also offer the advantage of interactivity. Students can conduct simple experiments, such as pouring water or using a light source to simulate the sun, allowing them to directly observe the effects of topography, land cover, and slope on water flow (Teplá et al., 2022). Dioramas are easier for elementary school students to operate compared to augmented reality-based simulations, which require specialized devices and digital skills (Lailiyah & Widiyono, 2023; Puspita et al., 2025). Thus, dioramas serve not only as visual aids but also as interactive conceptual tools that help students understand the interconnections among the components of the water cycle, avoid misconceptions, and link scientific concepts to real-world experiences in IPAS learning.

Practical Implications

The findings of this study have important implications for science education practices in elementary schools. First, teachers should consider using concrete media, such as dioramas, when teaching abstract concepts to reduce misconceptions and enhance students' understanding. In the context of IPAS learning, the use of dioramas has been shown to help students connect theory with reality, which leads to improved learning outcomes (Azizah et al., 2024). Second, teacher training in designing and effectively using three-dimensional visual media needs to be enhanced, including how to integrate such media into instructional frameworks that support active exploration and discussion. Within the context of the Kurikulum Merdeka, IPAS instruction is aimed at developing inquiry skills, problem-solving, and critical thinking through exploration activities based on real-world experiences (Ardiatama et al., 2024). Dioramas support this approach because students not only observe but can also manipulate model components, simulate processes, and test simple hypotheses related to the phenomena being studied (Teplá et al., 2022). From a curriculum perspective, these findings underscore the importance of allocating time and resources to the development of interactive learning materials that support contextual learning. Schools can allocate funds to procure or create dioramas that can be reused for various IPAS topics. Additionally, collaboration among teachers in designing learning materials can be encouraged to improve the overall quality of learning.

Research Limitations

This study has several limitations that should be considered when interpreting the results. First, the relatively small sample size (30 students per group) limits the generalizability of the findings to a broader population. Second, the experimental and control groups were not fully randomized because existing classes were used; thus, the possibility of confounding variables, such as differences in students' baseline characteristics, could not be fully controlled. Third, the relatively short duration of the intervention (four sessions) may not be sufficient to measure the long-term impact of diorama use on student knowledge retention. Fourth, this study measured cognitive learning outcomes only through written tests, so it did

not deeply assess scientific process skills such as observation, classification, and inference, which can be developed through the use of dioramas.

Research Contributions and Novelty

This study makes an important contribution to the literature on IPAS learning in elementary schools. Unlike previous studies that focused solely on improving cognitive learning outcomes, this study demonstrates that dioramas are effective not only in enhancing conceptual understanding but also in increasing students' active engagement and motivation in learning. These findings expand our understanding of the benefits of dioramas as a medium that stimulates affective and psychomotor aspects, not just cognitive ones. Furthermore, this study strengthens the theoretical foundation for the use of concrete media in learning by integrating four theoretical frameworks—constructivism, multimedia learning, dual coding, and cognitive load—to comprehensively explain the mechanisms underlying diorama effectiveness. This theoretical integration provides a stronger foundation for the future development of visual media-based learning models. In practice, this study provides empirical evidence that dioramas are worth considering as a strategic alternative for IPAS learning in elementary schools, particularly for abstract and complex topics such as the water cycle. Thus, these findings can serve as a reference for teachers, curriculum developers, and researchers in designing more effective and meaningful learning experiences for elementary school students.

CONCLUSION

Based on the research findings and data analysis, it can be concluded that the use of dioramas as an instructional strategy in teaching the water cycle has a positive and significant effect on the learning outcomes of fifth-grade students at SDN Jatisampurna VIII. These findings have substantively addressed the research questions and objectives, namely to determine the effect of dioramas (independent variable) on student learning outcomes (dependent variable) through a quasi-experimental approach. Nevertheless, this study has limitations due to its relatively narrow sample, so generalization to broader contexts should be done with caution. These findings support the research hypothesis that diorama media can improve student learning outcomes and demonstrate greater potential effectiveness compared to conventional teaching methods, particularly for material involving complex natural processes such as the water cycle. Therefore, the use of diorama media can be considered as an alternative method to help students understand abstract science concepts more concretely.

Based on these findings, teachers can utilize dioramas as an effective alternative learning medium for science education within the Kurikulum Merdeka. Dioramas can be incorporated into project-based activities, environmental exploration, or thematic learning to provide students with a more meaningful learning experience. Additionally, schools are encouraged to facilitate the creation of this simple learning medium to support meaningful, interactive learning. Meanwhile, future researchers can expand the study by involving a more diverse sample and other learning topics, as well as exploring the impact of using dioramas on strengthening 21st-century skills such as critical thinking and collaboration. Further research

can also evaluate the effectiveness of different diorama formats for cross-curricular learning in elementary schools.

AUTHOR'S NOTE

The author declares that there is no conflict of interest related to the publication of this article. The author affirms that the data and content of the article are free from plagiarism.

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