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Improving the Learning Outcomes of Natural and Social Science (IPAS) through Diorama Media: A Meaningful Learning Study at Madrasah Ibtidaiyah

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Abstract

Diorama media is one of the learning facilities that can be used effectively in learning IPAS at the Madrasah Ibtidaiyah level. This medium has the advantage of presenting abstract concepts, such as the water cycle, in be more concrete and easier-to-understand way for students through three-dimensional visualization. The primary purpose of this study is to observe changes in students' understanding of water cycle aterials before and after the use of diorama media. This study uses a quantitative approach with an experimental method that applies to the One Group Pretest-Posttest Design. All students of class V MI, As Salam Karangawen, went through a total sampling technique. Data was collected using written tests in the form of pretests and posttests to measure the improvement of learning outcomes, observations to see the process and involvement of students in learning, and documentation as supporting data. The results of the study show two main findings. First, the use of diorama media has proven to be effective in improving student learning outcomes in science subjects. This is proven by the average N-Gain obtained, which is 0.6764 or the equivalent of 67. 64%. Based on the N-Gain score interpretation table, this value is in the range of 56-75% which is included in the ”fairly effective” category . Second, this media can create more meaningful learning, where students can relate the concepts learned to real phenomena in daily life.
Keywords: diorama media; learning outcames; meaningful learning; ipas

Introduction

Education in the 21st century demands a learning system that is adaptive to global transformations accelerated by the Fourth Industrial Revolution and Society 5.0 (do Livramento Gonçalves et al., 2023). In this context, students are required not only to master cognitive aspects but also to develop critical, creative, collaborative, and communicative skills (Trummel, 2024). In this context, Natural and Social Sciences (IPAS) learning in primary schools, including Madrasah Ibtidaiyah (MI), is expected to provide meaningful and contextual learning experiences in line with the characteristics of primary school students (Ummu Jauharin Farda, 2024). However, the implementation of IPAS learning in MI faces a number of challenges that require serious attention. One of the main challenges in IPAS learning in MI is how teachers can bridge abstract concepts

such as the water cycle with concrete experiences that are appropriate for the cognitive development stage of primary school students (Cirkony et al., 2025). Moreover, the visualisation of complex phenomena like the water cycle makes abstract concepts tangible, improving retention and comprehension (Alafnan, 2025)

Recent studies reveal that science literacy in MI is still not optimal, indicating in particular the need for media that enable students not only to learn concepts, but also to read and interpret scientific phenomena in IPAS learning (Wafiqni, 2023). In addition, teacher motivation in implementing interactive media and readiness to manage IPAS learning media remain major obstacles in MI/SD (Anggito, 2023). This condition further emphasises the need for research that examines how concrete media can be used as a contextual, affordable, and effective alternative.

Visual and tactile media have been proven to strengthen understanding, increase active participation, and prolong students' memory (Yildirim, 2020). International studies also confirm that multimodal approaches, especially those based on physical representations, are highly effective in helping students relate theory to real-life situations, thereby deepening and broadening their conceptual understanding (OECD, 2019). Learning media play an important role in this process, but the availability of interactive, contextual, and affordable media in MI environments is still limited (Faradita et al., 2024). Dioramas as three-dimensional media offer the potential to bridge this gap. This medium is capable of presenting real representations of natural and social phenomena, allowing students to observe objects visually while exploring them tactilely (Jardioui et al., 2025). This medium allows students to visualise and explore natural phenomena directly, thereby strengthening conceptual understanding and learning engagement (Bogusevschi & Muntean, 2019). Furthermore, dioramas are also in line with the principle of meaningful learning, which emphasises the importance of relating new information to students' existing cognitive structures (Astuti et al., 2022).

The strengths of the diorama media lie in its multisensory nature, concreteness, and ability to stimulate student curiosity. It provides direct experience, fosters cooperative learning, and supports visual and kinesthetic learners by involving sight, touch, and interaction. Furthermore, it aligns with the scientific approach students observe, question, try, reason, and communicate through hands-on practice (Chandrasekera et al., 2025). Furthermore, dioramas support the project-based learning approach emphasized in the

Merdeka Curriculum, which encourages students to construct knowledge through direct experience, reflection, and collaboration elements that diorama-based activities can effectively facilitate (Poli et al., 2018).

Although various studies have demonstrated the effectiveness of concrete media in science education, research specifically examining the role of dioramas in IPAS learning in MI is still rare. In the context of Islamic elementary schools, there are still few studies that examine how concrete media such as dioramas can overcome the limitations of learning media and increase student engagement and conceptual understanding in IPAS learning. This has led to a research gap regarding how diorama media can improve learning outcomes and create meaningful learning in the context of Islamic elementary education in Indonesia. Therefore, this study fills this gap.

Based onthis background, this study seeks to answer the main question, namelyto what extent is the use of diorama media effective in improvinglearning outcomes and student engagement in IPAS learning at Madrasah Ibtidaiyah.Theoretically, this study contributes to strengthening the concept of meaningful learning through the use of concrete media that integratesvisual and tactile experiences. Practically, the results of this study providealternative learning strategies that are innovative, affordable, and in line with thecharacteristics of MI students, thereby increasing the effectiveness of IPAS learning and supporting the implementation of the Merdeka Curriculum.

Methods

This study used a quantitative approach with an experimental method to test the effectiveness of using diorama media in improving student learning outcomes in IPAS subjects. The experimental design used was a one-group pretest-posttest design, which only involved one group without a control group (Sugiyono, 2020). In the initial stage, students were given a pretest to measure their understanding before the treatment. Next, learning using diorama media was implemented, and ended with a post-test to see changes in learning outcomes after the treatment. The treatment was carried out during three meetings, each lasting 2 x 35 minutes. Diorama media was used directly in teaching water cycle material. The teacher first delivered an introduction to the concept, then demonstrated the material through dioramas. Students were divided into small groups to discuss, observe, and present their observations. Teacher-student interaction took place

in a two-way manner through questions and answers, guidance during observation, and clarification of concepts at the end of the session.

The research subjects were all 25 fifth-grade students at Madrasah Ibtidaiyah As Salam Karangawen. The sampling technique used total sampling because the entire fifth grade population was used as the research sample (Sugiyono, 2020). This class was selected based on the initial application of the meaningful learning model using diorama media. The research instruments consisted of written tests (pre-test and post-test), observation sheets were used to observe student engagement and the implementation of learning with diorama media. Documentation, in the form of photos of activities, teaching modules, and field notes, was used to supplement the data.

Data collection techniques were carried out through written tests (pre-test and post-test), observations of student activities, and documentation as supporting data. Data analysis techniques were carried out in two stages: a prerequisite analysis test, which included a normality test to ensure data distribution and a homogeneity test to determine the uniformity of variance (Sugiyono, 2020). After the prerequisites are met, the analysis is continued with a hypothesis test using a paired-sample t-test to determine the significance of the difference in pre-test and post-test scores (Sugiyono, 2020). In addition, this study also includes a normalized N-gain analysis to measure the level of treatment effectiveness. Interpretation of N-gain categories namely: N-gain ≥ 0.70 (high), 0.30 ≤ N-gain < 0.70 (medium), and N-gain < 0.30 (low) (Meltzer, 2002). This analysis aims to see the proportional increase in learning outcomes after learning using diorama media. Research Hypothesis as follows: H_0: There is no significant difference between pre-test and post-test scores of student learning outcomes after using diorama media. H_1: There is a significant difference between pre-test and post-test scores of student learning outcomes after using diorama media.

Furthermore, a normalized N-gain analysis was used to measure the effectiveness of the treatment. The range of N-gain categories used in the study is presented in the following table:

Table 1

Interpretation of N-gain Range

N-gain Value Range	**Category**
N-gain ≥ 0,70	Tall
0,30 ≤ N-gain < 0,70	Currently

N-gain Value Range	Category
N-gain < 0,30	Low

Sources: (Meltzer, 2002)

N-gain analysis aims to see the proportional increase in learning outcomes after learning using diorama media. Data processing in this study was carried out using SPSS, including descriptive statistical analysis, prerequisite tests, paired sample t-tests, and effect size calculations. This study also reported an effect size using Cohen's dz, which was calculated based on the difference between pre-test and post-test scores. The Cohen's dz value obtained was 4.924, indicating that the implementation of diorama media had a significant impact on improving student learning outcomes.

Result

The use of diorama media in IPAS learning for fifth-grade students at MI As Salam Karangawen provides a real, interactive learning experience that encourages student development. Through demonstration activities using diorama media, students can more easily relate theoretical concepts to concrete visual representations, thereby giving them a more meaningful understanding of the water cycle material. Based on the results of the pretest data, most students showed a low level of understanding of the water cycle material. However, after participating in problem-based learning supported by water cycle diorama media, there was a significant increase in posttest results. This increase in scores reflects an improvement in overall conceptual understanding. The pretest and posttest results show a significant improvement in student learning outcomes. The statistical summary presents this improvement descriptively as follows:

Table 2
Descriptive Statistics of Pretest and Posttest Scores

Statistic	Pretest	Posttest
Mean	58.68	86.28
Minimum	40.00	75.00
Maximum	75.00	95.00
Average Gain	27.60	-

Source: Personal Documents

Table 3
Pretest and Posttes Scores

Learning outcome	Highest Score	Lowest Score	Mean
Pretest	75	40	58.68
Posttest	95	75	86.28

Source: Personal Documents

Based on the descriptive statistics of the learning outcomes of fifth-grade students at MI As Salam Karangawen, there was a significant increase between the pre-test and post-test scores. In the pretest stage, the highest score obtained by students was 75.00, while the lowest score was 40.00, with an average of 58.68. After being taught using dioramas, the posttest scores showed an increase, with the highest score reaching 95.00, the lowest score 75.00, and an average score of 86.28.

Table 4
Normality Test Result

Tests of Normality			
	Shapiro-Wilk		
	Statistic	df	Sig.
Learning outcome Pretest	0.969	25	0.631
Learning outcome Posttest	0.958	25	0.376

Source: Personal Documents

Based on the results of the normality test using the Shapiro-Wilk method, the significance value (Sig.) for the pre-test learning outcomes was 0.631 and the post-test learning outcomes was 0.376. Referring to the test criteria, if the significance value is greater than 0.05, the data is considered to be normally distributed. Since the significance values for the pretest (0.631) and posttest (0.376) are both greater than 0.05, it can be concluded that the data for the pretest and posttest learning outcomes of fifth-grade students at MI As Salam Karangawen are normally distributed. This data meets the assumption of normality and can be further analysed using parametric statistical methods.

Table 5
Homogeneity Test Result

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
Students Learning Outcomes	Based on the Mean	3.871	1	48	0.055
	Based on the Median	3.529	1	48	0.066

Test of Homogeneity of Variance				
Based on Median and with adjusted df	3.529	1	41.125	0.067
Based on the trimmed mean	3.892	1	48	0.054

Source: Personal Documents

The results of the homogeneity test using Levene's test showed a significance value based on the mean of 0.055, based on the median of 0.066, based on the median with an adjusted degree of freedom of 0.067, and based on the trimmed mean of 0.054. According to the test criteria, if the significance value is greater than 0.05, the data is considered to have homogeneous variance.

Based on the results obtained, all approaches showed a significance value above 0.05, so it can be concluded that the student learning outcome data had uniform or homogeneous variance. Thus, the pretest and posttest data of students in class V of MI As Salam Karangawen meet the assumption of homogeneity. This indicates that the data distribution does not experience significant differences in terms of variance, so that the data is suitable for further analysis using parametric statistical methods.

Table 6
T-Test (Paired Samples Test) Result

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Learning outcome Pretest Posttest learning outcome	-27.60000	5.60506	1.12101	-29.91365	-25.28635	-24.621	24	0.000

Source: Personal Documents

Based on the results of the T-test (Paired Samples Test), there was a difference in the average learning outcomes of students before and after learning using Diorama media. The t-test results showed a significance value (Sig. 2-tailed) of 0.000, which was less than 0.05. There was a significant difference between the learning outcomes of students before and after using Diorama media in learning about the water cycle. The hypothesis accepted in this study is Ha: There is a difference in the average learning outcomes of students, so

it can be concluded that the use of Diorama media significantly improves the learning outcomes of fifth-grade students at MI As Salam Karangawen.

Based on the pretest and posttest results of 25 students, the data analysis indicates a significant improvement in learning outcomes after the implementation of the diorama-based learning intervention in the IPAS subject. The normalized gain (*N-gain*) was used to measure the effectiveness of the learning process in improving students' understanding. The results show that the average *N-gain* value was 0.6764, which corresponds to a 67.64% improvement rate, categorized as quite effective.

The *N-gain* values ranged from 0.40 (40%) to 0.85 (85%), indicating that all students experienced a positive increase in their posttest scores compared to their pretest scores. Specifically, three students (12%) coded as MRP, NN, and RP achieved the effective category with *N-gain* values between 0.80 and 0.85, showing a high level of conceptual mastery. Meanwhile, the majority of students (84%) were in the quite effective category, with *N-gain* values ranging from 0.56 to 0.75, reflecting a consistent improvement in conceptual understanding and engagement during the learning process. Only one student (4%) fell into the less effective category, with an *N-gain* of 0.40, suggesting minimal improvement.

These findings demonstrate that the diorama-based learning approach effectively enhances students' comprehension of IPAS material. The consistent increase in posttest scores indicates that the intervention successfully facilitated students' ability to connect abstract scientific and social concepts with tangible, real-world representations. The data also confirm that students were able to reconstruct prior knowledge through active exploration and observation core indicators of meaningful learning.

The relatively high mean *N-gain* value (0.6764) supports the conclusion that the use of diorama media was effective in improving students' cognitive learning outcomes. Moreover, the narrow range between the minimum and maximum *N-gain* N-gain values (0.40–0.85) suggests that learning improvements occurred uniformly across participants, demonstrating the inclusivity and adaptability of this learning medium for diverse student abilities.

From an analytical perspective, the quantitative evidence substantiates that the diorama-based learning intervention meets the criteria for pedagogical effectiveness according to Hake's (1999) standard, where an *N-gain* value between 0.3–0.7 is

considered moderate effectiveness, and above 0.7 indicates high effectiveness. Thus, the present findings empirically confirm that the intervention not only improved conceptual mastery but also provided equitable learning opportunities.

In conclusion, the data processing and analysis provide robust empirical support for the study's hypothesis that diorama-based learning significantly contributes to enhancing students' understanding and engagement in IPAS learning at the Madrasah Ibtidaiyah level. This reinforces the theoretical premise that concrete, multimodal instructional media can bridge the gap between abstract knowledge and real-world experience, leading to more meaningful and sustainable learning outcomes.

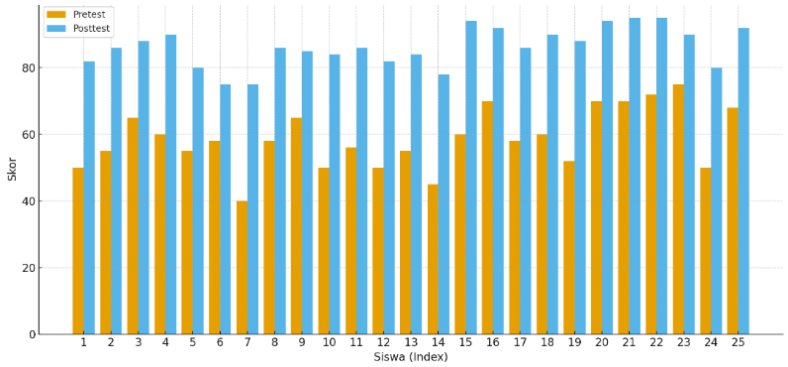

Figure 1
Comparison of Pretest and Posttest Scores

The paired sample t-test showed a significant difference between the pretest and posttest scores, t (24) = 24.621, p < 0.001. The effect size (Cohen's dz) was 4.924, indicating a very large effect. The normalised reinforcement mean (ḡ) was 0.677, which is classified as moderate effectiveness.

In addition to a significant increase in pretest–posttest scores ($p < 0.05$) and an N-gain of 0.6764 (moderate category), the observation results also showed that the use of dioramas supports the achievement of meaningful learning. Student engagement was observed through six indicators based on the Science and Education rubric. A summary of the observation results is shown in table 8.

Table 7
Student Engagement Observation Results

No	Indicator (IPAS Rubric)	Score	Category	Description
1	Active Student Engagement	4	Very Good	Students actively observed the diorama, asked questions, and responded to peers' explanations.
2	Conceptual Understanding	3	Good	Most students were able to correctly explain the stages of the water cycle.

No	Indicator (IPAS Rubric)	Score	Category	Description
3	Connection to Everyday Life	3	Good	Students connected the processes shown in the diorama to real phenomena such as rain and evaporation.
4	Scientific Process Skills	3	Good	Students conducted observations and drew conclusions with minimal guidance.
5	Collaboration and Communication	4	Very Good	Group discussions were active, and students shared ideas alternately.
6	Reflection and Scientific Attitude	3	Good	Students expressed simple reflections and demonstrated curiosity.

Score Description: 1 = Poor, 2 = Adequate, 3 = Good, 4 = Very Good

Observations showed that students were actively engaged during the learning process, particularly in the aspects of participation and collaboration (score 4). Their conceptual understanding, ability to connect material to experience, and science process skills were in the good category (score 3). These findings confirm that the use of dioramas not only improves cognitive outcomes but also facilitates meaningful learning through directed observation, discussion, and reflection. The following is documentation of the results of observations of student engagement in using dioramas:

Source: Personal Pictures

Figure 2

Student involvement in using diorama media

Theoretically, this study confirms that IPAS learning based on concrete media such as dioramas can reinforce the theory of meaningful learning by integrating visual, kinesthetic, and reflective aspects into the learning process. This contributes to the development of an experience-based learning model in madrasahs, especially in the context of Islamic education, which emphasises a balance between rationality and spirituality. In practical terms, the results of this study provide recommendations for Madrasah Ibtidaiyah teachers to integrate diorama media into IPAS learning as a strategy to increase student engagement and learning outcomes. The use of this media supports the implementation of the Merdeka Curriculum, which is oriented towards contextual and collaborative learning. In addition to improving cognitive outcomes, diorama media also

plays a role in shaping scientific attitudes, curiosity, and values of responsibility towards the environment in accordance with the character of Islamic education.

Discussion

First, Effectiveness of Using Diorama Media

The use of diorama media in IPAS learning in class V MI As Salam Karangawen shows high effectiveness in improving the quality of learning and student understanding. The diorama used is a three-dimensional miniature that describes the water cycle concretely, complete with components such as mountains, clouds, rivers, rain, and water flow to the sea. Each part is made from simple materials such as cardboard, clay, cotton, and dyes so that it resembles actual natural conditions. During learning, students not only observe the visual display but also interact directly with the diorama components, for example, pointing out the evaporation process, water transfer, or precipitation process. This direct involvement makes it easier for them to connect theoretical concepts with real-life representations. Compared to conventional lecture methods, diorama-based learning provides a more engaging, concrete, and participatory learning experience, thereby strengthening students' understanding of the material (Guedes et al., 2023).

Dioramas serve as a bridge between abstract material and students' concrete experiences. In the context of the water cycle, students not only hear the teacher's explanation but also witness how the processes of evaporation, condensation, precipitation, and infiltration are visualised in three-dimensional miniatures. This strengthens their memory and understanding because it involves more senses in the learning process (Harrington, 2020). This visualisation is beneficial for students who have visual and kinesthetic learning styles. Pretest data showed that most students did not yet have a deep understanding of the water cycle concept. The relatively low initial test results reflect that previous approaches have not been able to stimulate their understanding optimally. This is an important basis for the application of a meaningful media-based learning approach. After the treatment, namely learning using dioramas, there was a significant increase in learning outcomes at the post-test. This change shows that the diorama media intervention has a positive impact on the construction of students' knowledge.

The improvement in post-test results reflects conceptual changes that occurred during the learning process. Students not only memorised the stages of the water cycle but were also able to explain the process logically and concisely. This shows that the use of diorama media not only improved learning outcomes quantitatively but also deepened qualitative understanding. Students' understanding became more complete because they could see the relationship between one process and another in the water cycle.

In addition to improving conceptual understanding, learning with dioramas also encourages social interaction and cooperation among students (Scheersoi & Tunnicliffe, 2019). When students work in groups to observe, discuss, and present their observations of the diorama, an effective collaborative learning process occurs. This activity also trains students' communication, critical thinking, and responsibility skills (Trowbridge, 2019). Learning is no longer teacher-centred, but has shifted to active, participatory, and student-centred learning.

Observations during the learning process showed that students were enthusiastic and actively involved. They seemed more motivated to ask questions, answer questions, and express their opinions during group discussions. This shows that dioramas can create a fun and meaningful learning environment. High motivation contributes directly to learning outcomes because students are more focused and interested in following the lesson until the end.

The paired t-test results show a significant difference between students' pretest and posttest scores, confirming that the use of diorama media has a positive impact on IPAS learning outcomes. Normalised N-gain analysis in the moderate to high category further strengthens these findings. When compared to other concrete media-based studies, this improvement shows a similar trend and even tends to be higher. For example, two-dimensional image media in research (Trowbridge, 2019) only produced moderate improvements, while the use of interactive digital media produced varied N-gains that were not always consistent in the high category (Guedes et al., 2023). Compared to these findings, dioramas are superior because they provide a multisensory experience, allow for direct interaction, and encourage meaningful group discussion. Thus, the effectiveness of dioramas is not only in line with the principles of constructivism and meaningful learning, but also demonstrates advantages over several other media-based interventions.

Meaningful learning through dioramas is also in line with constructivist theory, which emphasises that students construct knowledge based on their experiences and interactions. In this case, dioramas are tools that facilitate the process of meaning construction. Students do not only receive information from teachers, but also experience and reconstruct that information through the media they observe and discuss together.

Thus, the use of dioramas can be recommended as an effective active learning strategy in science subjects, especially material that requires an understanding of processes or sequences, such as the water cycle. Its advantage lies in its ability to integrate cognitive, affective, and psychomotor aspects in the learning process. This enables students to not only be academically intelligent, but also to develop social skills and higher-order thinking skills.

Overall, this study proves that diorama media not only functions as a visual aid, but also as a trigger for active student engagement in the learning process. These findings provide an important contribution for teachers at Madrasah Ibtidaiyah to be more creative and innovative in selecting learning media that are appropriate for student characteristics and teaching materials. Through meaningful and contextual learning, student learning outcomes can be significantly and sustainably improved.

Second, Enhancing Meaningful Learning through the Use of Diorama Media

The results of the study indicate that the use of diorama media in teaching the water cycle in Grade V at MI As Salam Karangawen had a positive impact on improving student learning outcomes. This can be seen from the average N-Gain of 0.6764, or equivalent to 67.64%, which is in the moderately effective or moderately high category, with a maximum score of 0.85. This value exceeds the set success indicator, which is a minimum improvement in learning outcomes in the moderate category, thus confirming that diorama media is effective in achieving learning objectives and supporting meaningful learning. This phenomenon is in line with meaningful learning theory, which emphasises the importance of linking new information with students' existing knowledge (Blown, 2024). Dioramas act as advance organisers that facilitate students in connecting abstract concepts with concrete representations. Furthermore, these results support Vygotsky's view that social interaction in learning groups contributes to the formation of conceptual meaning through scaffolding and collaboration 8 (Cole & John-steiner, 1978). Thus, improved learning outcomes not only demonstrate the ability to remember

information, but also indicate the construction of a more meaningful conceptual understanding.

This data reinforces that diorama media can consistently facilitate meaningful learning. These findings are in line with studies on visual and experience-based learning interventions, which show that concrete representations and multimodality contribute to improved conceptual understanding (Phillips, B. M., Clements, D. H., & Sarama, 2021). Additionally, media that enhance engagement and learning motivation also have a direct impact on improving student understanding (van der Sande, L., Segers, E., & Verhoeven, 2023). In the context of creative learning, innovative media, including narrative or visual media, can strengthen students' thinking and literacy skills (Herder & Rau, 2022). If dioramas are developed with consideration for the cultural context or local environment, the relevance of learning can be expanded (Sakti, S. A., Rahman, A., & Wahyuni, 2024).. Thus, the effectiveness of diorama media in this study is not only proven quantitatively but also aligns with contemporary pedagogical principles that emphasise contextual, visual, and meaningful learning.

Meaningful learning is characterised by students' active involvement in the learning process and a deep understanding of the concepts being studied. Previous research has reinforced this, showing that meaningful learning can strengthen concepts that students have already understood (Méndez-Hinojosa & Segura-Arévalo, 2022). In this context, dioramas provide a more concrete learning experience through three-dimensional visualisation. Students not only read or listen but also see and observe the water cycle process directly through the physical forms displayed. The presence of dioramas as a learning medium contributes significantly to facilitating students' understanding of the water cycle, which is an abstract concept. By seeing the sequence of events such as evaporation, condensation, precipitation, and infiltration in real life, students find it easier to understand how these processes occur in nature. This encourages them to relate these concepts to the reality around them.

One characteristic of meaningful learning is the ability of students to relate the knowledge they acquire in class to authentic experiences in their daily lives (Lenilda Austrilino et al., 2023). In this case, students who learn using dioramas are more likely to connect the water cycle process with phenomena they observe, such as rain, fog, or dew

in the morning. This indicates that their understanding is not merely rote memorisation but is based on deep meaning.

The effectiveness of learning using dioramas is also reflected in the variation in N-gain scores obtained by students. Although the average score was in the fairly effective category, some students achieved scores of up to 0.85 (85%), indicating a very high level of understanding. This variation in achievement shows that not all students respond to learning in the same way. These differences can be influenced by several factors, such as students' varying initial abilities, visual or kinesthetic learning styles that are more suited to the characteristics of dioramas, and individual levels of motivation in participating in learning. By considering this variation, teachers can use it as a basis for implementing differentiated learning so that the needs of students with different characteristics can still be accommodated optimally.

The significant improvement in learning outcomes indicates that dioramas stimulate students' visual memory. Since most primary school-aged students tend to learn visually, the use of media that emphasises visual aspects will be more easily accepted and understood. This also helps students internalise scientific concepts that may have previously been difficult for them to imagine (Nurhalimah & Waluyo, 2025).

The use of dioramas in learning not only enhances cognitive aspects but also affective and psychomotor aspects. In the process of making and observing dioramas, students learn to work together, discuss, and express their opinions. They are also directly involved in active and enjoyable learning activities, which can increase learning motivation and curiosity (Moro Ramos, 2024, Li & Zhang, 2025). Learning also provides increasingly diverse experiences, especially in completing tasks that students can do (Kong, 2021).

Meaningful learning is an effort to develop higher-order thinking skills through intellectual engagement, by recognising patterns and connecting various concepts in information or knowledge. This process includes creative and critical thinking activities, asking questions, solving problems, using metacognitive skills, and communicating information effectively (Wang, 2023). The concepts and theories of meaningful learning explain that information is easier to understand if it can be linked to prior knowledge (Pinandito et al., 2025). Meaningful learning focuses not only on academic achievement but also on the development of students' character and life skills (Nurfirdaus et al., 2024).

Meaningful learning also provides valuable experiences for students. This is reinforced by previous research findings that highlight the importance of emphasising meaningful learning (Maldonado-Trapp & Bruna, 2024,Cheng et al., 2019). When students see and understand the water cycle through dioramas, they become more aware of the importance of protecting the environment, clean water, and the natural processes that support life. This is a form of internalisation of values that is important in 21st-century education.

Learning activities involving dioramas also enable students to develop critical and creative thinking skills. They are encouraged to observe, analyse and conclude the processes that occur in the water cycle. In addition, if students are involved in making dioramas, they learn to express ideas, use materials and solve problems independently.

Learning using diorama media can be implemented as a contextual learning model that is closer to students' real lives. This type of learning encourages students to realise that science is not something separate from their lives, but something that is alive and can be observed directly in their daily lives. In the context of an independent curriculum that emphasises fun, differentiated, and meaningful learning, the use of diorama media is very relevant. Teachers can use dioramas as one of the student-centred learning strategies. Students are not only recipients of information, but also active subjects who play a role in the learning process. This is reinforced by previous research showing that students become more active and creative.

The use of diorama media in learning is also in line with the scientific approach, namely observing, questioning, trying, reasoning, and communicating. This media facilitates all five stages naturally in the learning process. Students observe models, ask questions about the processes that occur, try to understand and organise information, reason about the relationships between processes, and finally communicate their understanding.

In terms of evaluation, dioramas help students demonstrate their understanding more comprehensively. Teachers can assess not only through written tests but also through presentations, group discussions, and observation of the learning process. This provides a more holistic picture of student learning outcomes. This is relevant to research on innovative diorama learning media used as a means to improve the learning achievements of primary school students in science and social studies (Fitriyani, 2024).

Through learning experiences with dioramas, students can apply their knowledge in real life (Marín-Rodríguez et al., 2025), such as understanding the importance of protecting water catchment areas, not littering, and appreciating the role of water in life. This understanding is not only conceptual but also encourages concrete actions that reflect its meaning.

Overall, the results of this study indicate that diorama media contribute significantly to improving the quality of learning. The positive impact is not only seen in quantitative improvements in learning outcomes, but also in strengthening conceptual understanding, critical thinking skills, social interaction, and students' ability to relate the material to everyday contexts. In the context of the Merdeka Curriculum, diorama media can be integrated through various student-centred learning strategies, such as projects to strengthen the Pancasila Student Profile, problem-based learning, or differentiated learning. Teachers can involve students in the process of designing, compiling, and presenting dioramas as part of formative and summative assessments. In addition, the use of dioramas allows for the strengthening of intracurricular and cocurricular elements through collaboration, creativity, and cross-subject exploration. Thus, this medium is not only relevant as a visual aid, but also as a means of implementing the Merdeka Curriculum in a contextual, participatory, and meaningful way for MI students.

Conclusion

This study concludes that the use of diorama media in IPAS learning at MI As Salam Karangawen is empirically effective in improving students cognitive understanding and engagement. The results of the paired t-test showed a significant difference between pretest and posttest scores ($p < 0.05$), supported by an average N-Gain score of 0.6764 or 67.64%, which falls within the “quite effective” category. The Cohen's dz value obtained was 4.924, indicating that the implementation of diorama media had a significant impact on improving student learning outcomes. These findings indicate that diorama based learning facilitates the development of meaningful understanding by helping students connect abstract scientific concepts such as the water cycle with real life phenomena.

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Declaration of Conflicting Interests

All authors declare that there are no conflicts of interest in this research.

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