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Development of Diorama Media to Improve Students' Understanding of Ecosystem Topic

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ABSTRACT

This study aims to develop learning media in the form of a diorama specifically designed to improve third-grade elementary school students' understanding of ecosystem topic in the Natural and Social Sciences (IPAS) subject. The study employed a Research and Development (R&D) approach based on the stages proposed by Borg and Gall, including needs analysis, planning, product development, implementation trials, revision, and final evaluation. The results of the statistical analysis showed that the calculated t-value was 0.0961, while the critical t-value (t-table) was 0.0948; therefore, the calculated t-value was higher than the critical value. This indicated a significant difference between students' understanding before and after using the diorama learning media. In other words, the diorama was effective in improving students' understanding of ecosystem topic. In addition, qualitative analysis based on teacher observations and students' responses showed that the diorama media increased students' learning motivation, interest, and active participation in the learning process. The diorama was also considered engaging and easy to understand by third-grade elementary school students. The study concluded that the development of diorama learning media was relevant, effective, and dynamic, and it was recommended for broader use in ecosystem topic learning at the elementary school level.

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INTRODUCTION

Education is an interactive process between teachers and students. It is organized to develop students' potential abilities (Rahayu et al., 2023; Simanjorang & Naibaho, 2023). These potentials are directed toward achieving specific educational goals, ultimately forming individuals who respect and humanize others. The authors view education as the primary foundation for children's development; therefore, every educational effort must be holistic and meaningful. Education not only imparts knowledge but also shapes character, making it essential for sustainable living.

According to Sujana (2019), education supports children's development both physically and spiritually (Fauzi et al., 2023; Pristiwanti et al., 2022; Sari et al., 2022; Suyanti & Waluyo, 2024). Education guides individuals from their natural traits toward becoming civilized human beings and serves as a bridge to a better life. This perspective is reinforced by Government Regulation of the Republic of Indonesia No. 19 of 2005 concerning National Education Standards, which emphasizes interactive learning processes(Peraturan Pemerintah Republik Indonesia Nomor 19 Tahun 2005 Tentang Standar Nasional Pendidikan, 2005). Learning activities should be enjoyable, challenging, and motivating (Widiningsih & Abdi, 2021). To achieve optimal student development, education must provide space for initiative, creativity, and independence. Therefore, teachers must consistently apply appropriate strategies to achieve these goals.

In the Independent Curriculum, the Natural and Social Sciences (IPAS) subject is taught from Grade III to Grade VI. Teachers play a crucial role in the educational process (Andini et al., 2024; Mingkid et al., 2022; Palunga & Marzuki, 2017; Sianturi et al., 2022). Effective teaching requires not only theoretical knowledge but also practical application. Teachers are expected to create learning experiences that are enjoyable and easy to understand (Andini et al., 2024). Otherwise, students may experience learning difficulties, resulting in incomplete achievement. The authors observed that teachers' instructional skills strongly influence learning success; therefore, improving these skills is a priority.

Students' learning behavior is influenced by both internal and external factors(B et al., 2022; Chamidy et al., 2023). The IPAS subject develops competencies in attitudes, knowledge, and skills, as well as critical thinking through logical observation. However, observations in schools revealed relatively low learning outcomes in the IPAS subject, particularly in ecosystem topic. Students' motivation was also low. This issue was identified at SDN Curug 3, where the authors conducted observations and interviews. Therefore, innovative solutions were urgently needed.

Based on observations at SDN Curug 3, students' learning outcomes in IPAS were below the expected standard. Students were less active during lessons, often losing focus, feeling sleepy, or engaging in conversations with peers. One contributing factor was the lack of engaging learning media (Amaliyah et al., 2024; Aulia et al., 2024; Mupa & Isaac, 2015). Conventional methods, such as lectures, tended to make students bored and reduced learning effectiveness. The authors identified instructional media as a key factor for improvement; therefore, media development became the focus of this research.

The use of learning media facilitates the delivery of knowledge(Millah et al., 2025; Studies et al., 2023). However, teachers at SDN Curug 3 relied mainly on textbooks. As a result, students showed low interest and limited comprehension. Of the 25 third-grade students, 10 scored below the Minimum Completion Criteria (KKM) of 75, highlighting the need for intervention. The authors believed that appropriate media can enhance students' motivation and concentration. Concrete learning media, in

particular, are considered effective. Therefore, this study aimed to improve students' understanding through the development of learning media.

Learning media can significantly enhance students' achievement by presenting material clearly and interactively, thus making the learning process more efficient in terms of time and energy. Media also attract students' attention, making it easier for them to retain information. According to Ulfah (2013), instructional media increase learning motivation(Budiarti et al., 2024; Puspitarini & Hanif, 2019). Based on this principle, the authors selected a diorama as the primary solution for teaching ecosystem topic in IPAS subject.

A diorama is a three-dimensional miniature representation of a real environment. It helps students understand abstract ecosystem concepts by allowing them to directly observe interactions between biotic and abiotic components. This approach aligns with Piaget's theory of the concrete operational stage, which states that elementary school children learn effectively through concrete objects. In addition, Vygotsky's constructivist perspective supports active interaction in the learning process. Therefore, the authors developed a durable acrylic diorama for teaching ecosystem topics, which is sturdy and easy to transport.

An interview with Ms. Fatimah at SDN Curug 3 confirmed that students' learning outcomes in ecosystem topic were low. The use of question-and-answer methods and textbooks alone was considered less effective, as students had difficulty visualizing the interdependence among living organisms. Ms. Aliyah and Ms. Lutfi, as IPAS teachers, stated that they had not previously used diorama media and were not fully aware of the benefits of visual learning tools. According to Arsyad (2015), instructional media can stimulate students' thinking and interest. Therefore, developing a diorama was considered a strategic step to address this issue.

This research produced a diorama learning medium that was valid, practical, and effective. Validation was conducted by material experts, media experts, and teachers. A limited trial was also carried out to measure improvements in students' understanding. The developed media is constructive and contextual for elementary school learning and contributes to educational practice and scientific references. This study is entitled "*Development of Diorama Media to Improve Students' Understanding of Ecosystem Topic for Grade III*." The authors are committed to improving the quality of learning through solution-oriented innovation, and the acrylic diorama serves as a practical response to the identified problems.

RESEARCH METHODOLOGY

This study is categorized as Research and Development (R&D) (Ricu Sidiq & Najuah, 2020), which aims to develop and evaluate the feasibility and effectiveness of learning media in the form of a diorama for the ecosystem topic in the Grade III IPAS subject at the elementary school level. This research not only seeks to produce an educational product but also to examine the extent to which the product is acceptable and effective in improving students' understanding.

The development model employed in this study is the Borg and Gall model, which consists of ten stages of product development. This model was selected because it provides systematic and structured steps for designing, developing, testing, and refining educational products, particularly those intended to enhance learning outcomes in elementary school IPAS instruction.

RESULT & DISCUSSION

The results of this study indicate that the development of acrylic diorama learning media

successfully improved third-grade students' understanding of the ecosystem topic in the IPAS subject. This research was carried out through ten main stages based on the Borg and Gall development model. The findings were obtained from observations, learning outcome tests, and validation processes conducted at SDN Curug 3 and a partner school.

Step 1: Problem Identification

Initial observations conducted at SDN Curug 3 in May 2025 revealed that students were less active, had low concentration, and experienced difficulties in understanding the ecosystem topic. Of the 25 students, 10 scored below the Minimum Completion Criteria (KKM) of 75 on the pretest, with a class average score of 44. Interviews with teachers, including Ms. Fatimah, confirmed that conventional teaching methods were less effective in generating students' interest. Therefore, the use of a diorama was identified as a concrete and appropriate solution to address these issues.

Step 2: Initial Data Collection

Data were collected through observations, interviews, and preliminary tests. The observation results indicated that 100% of the identified issues were related to students' lack of enthusiasm and the use of abstract teaching materials. The instrument validity test showed that all 10 test items were valid (r-count > 0.396), and the reliability coefficient was 0.70, indicating that the instrument was reliable. Furthermore, 52% of the students scored below 75, the Minimum Completion Criteria (KKM). These findings served as the foundation for the development of the learning media.

Step 3: Initial Product Design

The diorama was designed with dimensions of 40 × 20 × 40 cm using 2–3 mm acrylic material. It represents both terrestrial (rice field) and aquatic (marine) ecosystems, complete with miniature biotic and abiotic components. The diorama includes several supporting elements, such as labelled stickers, modular assembly components, and instructional leaflets.

The visual design was developed using Canva to ensure an engaging and attractive appearance. The initial product was aligned with the Core Competencies and Basic Competencies (KI-KD) of the Merdeka Curriculum for the Grade III IPAS subject.

Step 4: Experts Design Validation

The media experts awarded a score of 70% (categorized as good) in terms of graphics, size, and durability. Meanwhile, the material experts gave a score of 75% (categorized as adequate) regarding alignment with the core competencies. Several recommendations were provided, including improving the layout, using brighter colors, and ensuring clearer text presentation.

Overall, the validation results indicate that the diorama media is feasible for field testing with minor revisions. The high validity scores suggest that the product meets quality standards and is appropriate for implementation in the learning process.

Step 5: Revision of Draft 1

Based on the experts' recommendations, the revisions included improving the layout to make it neater, increasing the size of certain components, using brighter colors, and applying clearer lettering. In addition, chloroform adhesive was used to enhance the durability of the acrylic structure.

After these revisions, Draft I of the diorama media was considered ready for field testing at

SDN Curug 3. The improvements also facilitated clearer identification of each ecosystem component, thereby enhancing the instructional value of the media.

Step 6: Product Trial 1

During the field testing at SDN Curug 3 involving 25 students, the teacher questionnaire results reached 89%, categorized as very appropriate in terms of efficiency and durability. Students' responses were also highly positive, with 85% expressing favorable feedback through an emoji-based response sheet.

The average pretest score was 44, while the posttest average increased to 75, reflecting a 71% improvement. Classroom observations indicated that students were more active and enthusiastic during the learning process. In addition, the teacher stated in the interview, "*It is easier to explain the interdependence of living things using this media*," highlighting the practical benefits of the diorama in supporting instruction.

Step 7: Revision of Draft 1 to Draft 2

Feedback from the field testing suggested several improvements, including enhancing the Canva-designed thumbnails, refining the background design, and improving text clarity. In addition, it was recommended that more interactive features be incorporated to further engage students.

As a result of these revisions, Draft 2 of the diorama was developed with improved safety and durability. The addition of a mica layer made the product more secure and waterproof. These refinements optimized the visual quality and overall appeal of the media, making it more suitable for implementation in partner schools.

Step 8: Product Trial 2

A pilot field test was conducted at SD Serambi Islamic and SDIT Nuurul Jamaal, involving a total of 85 students. The results of the teacher and student questionnaires indicated a score of over 90%, categorized as very appropriate.

The average pretest score was 43.53, which increased to 75.06 on the posttest, demonstrating a substantial improvement in students' understanding. Classroom observations showed that students were able to differentiate between biotic and abiotic components and correctly arrange food chains within the ecosystem.

In teacher interviews, one teacher stated, "*Students are enthusiastic and understand the material quickly*," indicating that the diorama media effectively supported the learning process.

Step 9: Statistical Analysis

The results of the Liliefors normality test indicated that the data were normally distributed (Sig. > 0.05). Therefore, parametric statistical analysis could be applied. The paired-sample t-test showed that the t-count value was −14.18, while the t-critical value was 1.99 (Sig. < 0.05). Since the significance value was below 0.05 and |t-count| was greater than t-critical, H_0 was rejected. This result indicates a statistically significant increase in students' learning outcomes after the implementation of the diorama media.

Furthermore, the N-gain score was 0.56, which falls into the moderate category. These findings provide empirical evidence that the developed diorama learning media is effective in improving students' understanding of ecosystem topic.

Step 10: Final Product Specification

The final product consists of an acrylic-based diorama enhanced with a mica layer for additional protection. It is designed in a modular format and is accompanied by an instructional leaflet to guide its use in the classroom. The diorama offers several advantages, including durability, three-dimensional visual representation, and support for kinaesthetic learning. From a theoretical perspective, the media aligns with Piaget's theory of the concrete operational stage and Vygotsky's constructivist approach, as it encourages active and concrete learning experiences. Practically, the implementation of the media resulted in an average improvement of 31 points in students' learning outcomes. Pedagogically, the diorama promotes holistic learning by integrating cognitive engagement, motivation, and active participation. Overall, the product is considered ready for wider dissemination and implementation in elementary school science learning, particularly for ecosystem topics.

The discussion of the research findings on the development of the acrylic diorama media can be connected to relevant previous studies and established learning theories. The results demonstrate that the developed product is not only practically feasible for classroom implementation but also theoretically well-grounded. These findings indicate that the media meets both empirical and conceptual standards, as it aligns with educational theories and is supported by measurable improvements in students' learning outcomes.

1. Accordance with the Borg and Gall Model

The research procedures—consisting of problem identification, planning, initial product development, limited trials, revisions, extensive trials, further revisions, and final product development—were aligned with the ten stages of Research and Development proposed by Borg and Gall, ranging from research and information gathering to dissemination and implementation. This model emphasizes two essential components: product development and effectiveness testing. The present study fulfilled both requirements through the systematic design of the diorama media and the implementation of pretest–posttest evaluations conducted in four elementary schools.

These findings indicate that the research procedures were consistent with established and accountable educational R&D standards, ensuring both methodological rigor and practical relevance.

2. Diorama Media and Improved Learning Outcomes

Several previous studies had demonstrated that diorama media were effective in improving learning outcomes in the IPAS subject, particularly in ecosystem topic. For example, Amalia (2023) reported that the use of dioramas in ecosystem learning at an elementary school in Campaka reduced students' boredom and enhanced their conceptual understanding, as students were more actively and visually engaged in the learning process (Fitriani et al., 2023; Hasanah et al., 2024). Other studies on the development of ecosystem-based diorama media similarly concluded that dioramas significantly increased students' interest and comprehension and were suitable for repeated classroom use.

The findings of the present study revealed a comparable pattern. The average pretest score across the three development schools was 43.53, which increased to 75.06 in the posttest. The N-gain score of 0.56 falls into the moderate category. This result was consistent with previous research indicating that concrete learning media interventions in experimental classes generally produce moderate to high N-gain scores, often outperforming classes that rely solely on conventional instruction.

Therefore, the improvement in learning outcomes observed in this study aligns with empirical evidence suggesting that diorama media are effective in supporting students' understanding of ecosystem topic in elementary education.

3. Concrete Media and the Concrete Operational Stage (Piaget)

According to Jean Piaget, elementary school students aged approximately 7–11 years are in the concrete operational stage of cognitive development. At this stage, children begin to think logically; however, their understanding still depends largely on concrete objects and real-life examples. Previous studies on the use of concrete media in elementary science learning had shown a positive and significant effect on learning outcomes, with t-count values exceeding t-critical values and contributing approximately 41.6% to improvements in achievement.

The acrylic diorama developed in this study presents rice field and marine ecosystems in a three-dimensional miniature form, complete with biotic and abiotic components and the interactions among them. This design aligns with the cognitive characteristics of the concrete operational stage, as students do not merely receive verbal explanations but also observe and manipulate tangible representations of ecosystem concepts.

The observed improvements in students' ability to differentiate between biotic and abiotic components, construct food chains, and explain the interdependence of living organisms—supported by classroom observations and teachers' interviews—strengthen the argument that this medium is appropriate for their cognitive developmental stage.

4. Vygotsky's Social Constructivism and Student Engagement

From the perspective of Vygotsky's social constructivist theory, effective learning occurs through social interaction and the use of tools that mediate understanding between students, teachers, and learning objects. Instructional media function as cultural tools that support students in constructing knowledge collaboratively, particularly within the Zone of Proximal Development (ZPD) (Azis et al., 2025). Therefore, effective media should facilitate discussion, cooperation, and shared problem-solving activities.

The findings of this study indicate that when the diorama was implemented, students became more active in discussing concepts, asking questions, and working collaboratively to observe ecosystem components. In several partner schools, students not only observed the diorama but also explained the relationships among ecosystem components, constructed food chains, and discussed the potential impact of the loss of one living organism within the system.

These findings are consistent with previous research suggesting that integrating media grounded in social constructivist principles enhances student engagement, strengthens collaborative interaction, and promotes meaningful knowledge construction. Thus, the diorama functions not merely as a visual aid but as a mediating tool that encourages dialogue, cooperation, and deeper conceptual understanding.

5. The Effectiveness of Dioramas Compared to Abstract Media

Several studies have reported that low learning outcomes in the IPAS subject at the elementary level are often associated with instructional practices that rely heavily on textbooks and abstract explanations. This situation was also reflected in the initial conditions at SDN Curug 3, where teaching was predominantly lecture-based and supported only by textbooks, without the use of concrete learning

media. As a result, students tended to be passive and bored, and scores in the ecosystem topic was below the Minimum Competency Criteria (KKM) (Hasanah et al., 2024).

The findings of the present study demonstrate significant improvements after the implementation of the diorama media. Teachers reported that the diorama facilitated the explanation of abstract ecosystem concepts, while students became more focused, enthusiastic, and actively involved in classroom activities. The overall classroom atmosphere also became more interactive and conducive to learning.

These results are consistent with previous research indicating that dioramas, as three-dimensional representations of real environments, provide meaningful visual learning experiences and enhance students' understanding and retention of ecosystem concepts. Therefore, the findings of this study reinforce the argument in the literature that concrete instructional media—particularly dioramas—are more effective than purely abstract media for teaching ecosystem topics in elementary education.

6. Statistical Analysis and Strength of Evidence

From a methodological perspective, the application of the Liliefors normality test, paired-sample t-test, and N-gain analysis strengthens the validity of the study's conclusions. The normal distribution of the pretest and posttest data met the assumptions required for conducting parametric testing using the t-test.

The paired-sample t-test yielded a t-count value of −14.18, which greatly exceeded the critical t-value of 1.99, with a significance level far below 0.05 ($p \ll 0.05$). This indicates a highly significant difference between students' mean scores before and after the implementation of the diorama media. Furthermore, the N-gain value of 0.56, categorized as moderate according to Hake's criteria, demonstrates that the improvement achieved represents a substantial and meaningful learning gain for an educational intervention.

When compared with other studies on the use of concrete instructional media that similarly report t-count values significantly higher than t-critical values and meaningful contributions to IPAS learning outcomes, the present findings align with established empirical patterns. This suggests that the positive impact of diorama media on students' learning outcomes is not merely incidental or context-specific, but part of a broader and consistently supported trend in educational research.

CONCLUSION

Concepts in the IPAS subject related to changes in the state of matter, particularly those observables in everyday objects, can be more easily understood by students when presented through appropriate learning resources. However, various factors contribute to low student interest in the Grade III IPAS subject, which in turn affects their level of conceptual understanding. This condition encouraged the authors to develop teaching materials aimed at optimizing students' learning outcomes, particularly in terms of comprehension.

The research employed a Research and Development (R&D) approach, which is designed to produce specific educational products and evaluate their effectiveness. One of the developed products is an e-module, defined as an electronic teaching material designed in the form of an interactive application. This product represents an innovation in instructional materials, integrating user-generated media and interactive features that allow users to navigate, edit, or manipulate content within the presentation.

The e-module covers the topic of changes in the state of matter, including transitions between solid, liquid, and gaseous states. The material is structured to provide students with a deeper conceptual understanding of how and why changes in physical states occur in everyday life.

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