

Development of A Mixed-Materials-Based Three-Dimensional Diorama Learning Media for The Science Subject on The Metamorphosis of Living Things for Third-Grade Students at SDN Andungsari III

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Abstract: This study aims to develop a 3-Dimensional Diorama Learning medium based on mixed materials for the Science subject of Metamorphosis of Living Creatures for third-grade students at Andungsari III Elementary School. The identified problem is that students have difficulty imagining the metamorphosis process through images and text. Furthermore, students may have never seen or directly observed the natural metamorphosis process. Therefore, this study aims to develop engaging learning media to increase student interest and understanding. This study employed the Research & Development (R&D) method using the ADDIE model, which consists of five stages: (1) Analysis of the problem and learning media needs; (2) Design, in the form of storyboard design; (3) Development of a 3-dimensional diorama product using mixed materials; (4) Implementation through trials with third-grade students at Andungsari III Elementary School; and (5) Evaluation based on validator feedback to assess the media's validity. The results showed that the mixed-materials-based 3-D diorama received a score of 88.46% from media experts, 93.18% from material experts, and 87.5% from classroom teachers, all of which were considered very appropriate. The student response questionnaire received a score of 90.67%, indicating that this medium was highly effective. Student trials showed an increase in material comprehension, with an average pretest score of 76.67 and a posttest score of 91.33. Based on these results, it can be concluded that the mixed-materials-based 3-D diorama effectively improves student comprehension and motivation and is suitable for use as an innovative learning medium in science subjects in elementary schools.

Keywords: 3-Dimensional Diorama; Elementary School; Learning Media; Metamorphosis; Research and Development.

1. Introduction

Education plays a fundamental role in developing students' potential comprehensively, encompassing cognitive, affective, psychomotor, social, and spiritual dimensions. As a formal educational institution, schools have a significant responsibility to foster students' character and competencies so that they are well prepared to face the rapid development of the modern world (Amin Ahmad, 2005). This is in line with Law Number 20 of 2003 concerning the National Education System of Indonesia, which emphasizes that national education aims to develop learners' capabilities, build character, and cultivate individuals who are faithful, knowledgeable, creative, independent, and responsible. These objectives are further strengthened through the implementation of the Merdeka Curriculum, which provides teachers with greater flexibility to design learning activities according to students' needs while emphasizing the development of academic competencies, character, and socio-emotional skills.

At the elementary school level, the subject of Integrated Science and Social Studies (IPAS) requires students to understand various concepts related to living organisms and their environment, including the topic of metamorphosis. According to Abruscato (Sulthon, 2016:43), science is a systematic process involving observation, classification, measurement,

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hypothesis formulation, and conclusion drawing. However, the abstract nature of many IPAS concepts often poses challenges for elementary school students, who are generally in Piaget's concrete operational stage of cognitive development. Therefore, appropriate learning media are needed to transform abstract concepts into concrete learning experiences that facilitate students' understanding. Learning media refer to any instructional tools used to deliver learning messages in ways that enhance students' attention, interest, thinking processes, and emotional engagement (Santyasa, 2007:3).

One instructional medium considered highly effective is the three-dimensional (3D) diorama, a visual learning medium that presents objects in realistic forms, thereby providing more meaningful learning experiences (Munadi, 2013:109). Three-dimensional media enable students to observe objects from multiple perspectives, making complex concepts easier to understand (Syafri, Erwadi, & Enddika, 2020). Furthermore, the application of the Mixed Materials approach, which combines various concrete materials in constructing instructional media, offers multisensory learning experiences that actively engage students throughout the learning process.

Based on classroom observations conducted at SDN Andungsari III, third-grade students experienced difficulties in understanding the process of metamorphosis because classroom instruction primarily relied on textbooks and two-dimensional illustrations. As a result, students found it difficult to visualize the developmental changes of living organisms, demonstrated low learning motivation, became easily bored, and lacked meaningful contextual learning experiences. Previous studies have shown that diorama-based learning media can improve students' learning outcomes and facilitate conceptual understanding by providing more realistic representations of learning objects (Nora Fiy Afnanin, 2024; Munadi, 2013:170; Prastowo, 2015:240).

Based on these findings, this study aims to develop a Mixed-Materials-Based Three-Dimensional Diorama Learning Media for teaching the topic of the metamorphosis of living organisms to third-grade students at SDN Andungsari III. Furthermore, this study seeks to evaluate the validity, practicality, and effectiveness of the developed learning media in improving students' learning outcomes. The developed instructional media are expected to serve as an alternative learning resource that is more engaging, interactive, and appropriate for the developmental characteristics of elementary school students, thereby enhancing students' conceptual understanding of metamorphosis, increasing learning motivation, and promoting active participation throughout the instructional process.

2. Literature review

Learning Media

Learning media are instructional tools that facilitate the communication of knowledge from teachers to students and enhance the effectiveness of the teaching and learning process. According to Gagné (1977), learning occurs when external instructional conditions stimulate and support learners' internal cognitive processes. Similarly, learning media are defined as any tools or resources that can attract students' attention, stimulate their thinking, and improve learning outcomes (Arsyad, 2015; Karim, 2014). The Indonesian National Education System Law No. 20 of 2003 also emphasizes that learning is an interaction between students, teachers, and learning resources.

The implementation of appropriate learning media is particularly important in elementary education because students are still at the concrete operational stage of cognitive development. Therefore, instructional media should present abstract concepts in concrete and meaningful forms. Previous studies have consistently reported that the use of learning media increases students' motivation, participation, conceptual understanding, and academic achievement (Asyhar, 2011). Consequently, selecting suitable instructional media is considered one of the essential competencies of teachers in creating effective learning experiences.

Three-Dimensional Diorama Learning Media

A three-dimensional (3D) diorama is a visual instructional medium that represents real-life scenes through miniature models arranged within a realistic setting (Prastowo, 2019; Daryanto, 2013). Dioramas integrate three-dimensional objects, background illustrations, and supporting elements to provide authentic visual representations of learning materials. This medium enables students to observe objects from multiple perspectives, thereby making abstract concepts easier to understand.

Several studies have demonstrated that diorama media improve students' engagement, motivation, and conceptual understanding because they provide direct and meaningful learning experiences (Kartika, 2018). In addition, dioramas encourage active learning by allowing students to interact with concrete representations rather than relying solely on verbal explanations or textbook illustrations. Despite requiring considerable preparation time and creativity, dioramas remain an effective instructional medium for elementary education due to their ability to visualize complex concepts realistically.

Integrated Science and Social Studies (IPAS)

Integrated Science and Social Studies (IPAS) is a subject introduced in Indonesia's Merdeka Curriculum by integrating Natural Science and Social Science into a single interdisciplinary subject. This integration reflects the holistic thinking characteristics of elementary school students, who tend to perceive natural and social phenomena as interconnected (Rahman & Fuad, 2023; Wijayanti, 2023).

The primary objective of IPAS is to develop students' scientific literacy, critical thinking, curiosity, and problem-solving abilities while fostering the competencies described in the Pancasila Student Profile (Sugih, 2022). Learning activities emphasize inquiry, observation, exploration, and real-world problem solving, allowing students to understand relationships between humans, society, and the natural environment (Purba et al., 2023). Consequently, effective instructional media are essential to support meaningful IPAS learning, particularly when teaching scientific concepts that require concrete visualization, such as the metamorphosis of living organisms.

Previous Studies

Previous studies have consistently reported the effectiveness of diorama-based instructional media in elementary education. Saputri (2022) found that three-dimensional diorama media integrated with character education improved students' learning participation and character development. Agustina et al. (2025) developed a water cycle diorama and reported excellent validity and positive student responses using the ADDIE model. Similarly, Putri and Tyas (2026) demonstrated that a cultural diversity diorama significantly improved students' learning outcomes based on paired t-test and N-Gain analyses.

Other studies have expanded diorama development by incorporating audiovisual elements (Anggraini et al., 2026) and Augmented Reality technology (Sitepu et al., 2026), both of which showed high feasibility and effectiveness in improving students' conceptual understanding. However, limited studies have focused on developing a Mixed-Materials-Based Three-Dimensional Diorama for teaching the metamorphosis of living organisms within the IPAS curriculum for third-grade elementary students. Therefore, this study addresses this research gap by developing and evaluating a learning medium that integrates multiple concrete materials to improve students' conceptual understanding, learning motivation, and learning outcomes.

3. Research Methods

Research Design

This study employed a Research and Development (R&D) approach using the ADDIE instructional design model, which consists of five sequential phases: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009; Richey & Klein, 2007). The ADDIE model was selected because it provides a systematic framework for developing, validating, and evaluating educational products.

The final product developed in this study was a Mixed-Materials-Based Three-Dimensional Diorama Learning Media designed to support the teaching of the metamorphosis of living organisms in the Integrated Science and Social Studies (IPAS) subject for third-grade elementary school students.

Research Procedures

The research followed the five stages of the ADDIE model.

- a. Analysis. A needs analysis was conducted through classroom observations and interviews with the third-grade teacher at SDN Andungsari III to identify instructional problems, students' learning characteristics, and curriculum requirements related to the topic of metamorphosis.
- b. Design. Based on the analysis results, the learning objectives, media specifications, instructional content, and evaluation instruments were designed. The diorama was planned using a combination of natural and artificial materials (Mixed Materials) to provide realistic and multisensory learning experiences.
- c. Development. The diorama was produced according to the design specifications and subsequently validated by both media and subject-matter experts. Revisions were made based on their recommendations before classroom implementation.
- d. Implementation. The validated learning media were implemented in a third-grade classroom at SDN Andungsari III during IPAS instruction on the topic of metamorphosis.
- e. Evaluation. The effectiveness of the developed media was evaluated through expert validation, teacher and student response questionnaires, and comparisons of students' pre-test and post-test learning outcomes.

Participants

The study involved one subject-matter expert, one instructional media expert, one third-grade classroom teacher, and 15 third-grade students of SDN Andungsari III during the 2025/2026 academic year. The experts evaluated the validity of the instructional media, while the teacher and students participated in the classroom implementation and product evaluation.

Data Collection

Data were collected using both qualitative and quantitative techniques. Qualitative data were obtained from classroom observations, interviews, and expert feedback during the validation process. Quantitative data were collected through expert validation questionnaires, teacher and student response questionnaires, and pre-test and post-test assessments administered before and after the implementation of the learning media.

Research Instruments

The research instruments consisted of (1) expert validation questionnaires to assess the content and media quality, (2) teacher and student response questionnaires to evaluate the practicality of the developed product, and (3) pre-test and post-test instruments consisting of ten multiple-choice questions designed to measure students' conceptual understanding of metamorphosis.

Data Analysis

Qualitative data obtained from observations, interviews, and expert suggestions were analyzed descriptively and used to revise the developed learning media. Quantitative data were analyzed using descriptive statistics. The validity and practicality of the product were determined based on percentage scores obtained from expert, teacher, and student questionnaires. The effectiveness of the developed media was evaluated by comparing students' pre-test and post-test scores to determine improvements in learning outcomes. A product was considered highly valid and feasible for classroom implementation when the validation score exceeded 81%, following the criteria proposed by Sugiyono (2016).

4. Results and Discussion

Product Development

This study successfully developed a Mixed-Materials-Based Three-Dimensional Diorama as an instructional medium for teaching the topic of metamorphosis in the Integrated Science and Social Studies (IPAS) subject for third-grade students at SDN Andungsari III. The product was developed using the ADDIE instructional design model, which includes the stages of Analysis, Design, Development, Implementation, and Evaluation.

During the analysis stage, classroom observations and interviews with the classroom teacher revealed several instructional problems. Most students experienced difficulty understanding the metamorphosis process because classroom instruction primarily relied on textbooks and two-dimensional pictures. Although these learning resources provided theoretical explanations, they did not adequately help students visualize the sequential changes occurring during animal life cycles. Consequently, students tended to memorize concepts rather than understand them meaningfully. This condition also reduced students' learning motivation because classroom activities were predominantly teacher-centered and lacked interactive learning experiences.

The needs analysis further indicated that third-grade students require concrete learning experiences because they are still in the concrete operational stage of cognitive development. Therefore, learning media that present realistic representations are more suitable for helping students understand abstract scientific concepts. Based on these findings, a three-dimensional diorama was selected as the most appropriate instructional medium because it allows students to observe each stage of metamorphosis directly while interacting with realistic objects from multiple perspectives.

During the design stage, the learning media were carefully planned to represent both complete and incomplete metamorphosis. Various natural and artificial materials were combined to construct realistic models of butterflies, grasshoppers, plants, flowers, grass, fences, and other environmental components. In addition, removable information cards were incorporated into the diorama so that teachers could organize interactive learning activities by asking students to identify or rearrange the stages of the life cycle.

The development stage involved constructing the prototype and conducting expert validation. The product was revised according to the recommendations provided by the validators before classroom implementation. During the implementation stage, the validated media were used in IPAS learning activities involving 15 third-grade students. Finally, the evaluation stage assessed the validity, practicality, and effectiveness of the developed product through expert judgments, teacher evaluations, student responses, and learning outcome assessments.

Product Validation

The quality of the developed learning media was evaluated by one instructional media expert, one subject-matter expert, and one classroom teacher. The validation results are summarized in Table 1.

Table 1. Product Validation Results.

Validator	Score (%)	Category
Media Expert	88.46	Highly Valid
Subject-Matter Expert	93.18	Highly Valid
Classroom Teacher	87.50	Highly Practical

The media expert awarded an overall score of 88.46%, indicating that the developed diorama met the criteria of a highly valid instructional medium. The evaluator particularly appreciated the three-dimensional visualization, structural durability, safety of the materials, and the integration of mixed materials. However, minor improvements were suggested regarding the contrast between several objects and the background to improve visibility for young learners.

Similarly, the subject-matter expert provided an excellent validation score of 93.18%, demonstrating that the instructional content accurately represented the scientific concepts of complete and incomplete metamorphosis. The evaluator confirmed that the sequence of life-cycle stages, terminology, and visual representations were consistent with the learning objectives specified in the Grade III IPAS curriculum.

The classroom teacher also evaluated the practicality of the developed media, resulting in a score of 87.50%. According to the teacher, the diorama was easy to operate during classroom instruction and successfully stimulated student participation. The teacher also noted that the removable labels and realistic representations facilitated classroom discussions and reduced repetitive verbal explanations that commonly occur during conventional teaching.

Overall, these findings demonstrate that the developed learning media fulfilled the requirements of validity and practicality, indicating that it is suitable for classroom implementation.

Student Responses

Student perceptions of the developed learning media were examined using a response questionnaire administered after the classroom implementation. The overall results are presented in Table 2.

Table 2. Student Response Results.

Indicator	Score (%)	Category
Student Responses	90.67	Excellent

The student response questionnaire produced an overall percentage of 90.67%, indicating a highly positive perception of the developed learning media. Most students stated that the three-dimensional diorama made the learning process more enjoyable, easier to understand, and more interesting than conventional classroom instruction.

The realistic models and the use of various textures attracted students' attention throughout the lesson. Unlike textbook illustrations, the three-dimensional visualization enabled students to observe each developmental stage directly while comparing complete and incomplete metamorphosis simultaneously. Such learning experiences encouraged students to ask questions, participate actively in discussions, and explain the observed phenomena using their own words.

These findings suggest that the incorporation of mixed materials successfully enhanced students' sensory experiences during learning. By engaging both visual and tactile senses, students became more actively involved in constructing scientific concepts rather than merely memorizing information presented by the teacher.

Learning Outcomes

The effectiveness of the developed learning media was measured using a one-group pre-test and post-test design involving 15 third-grade students. The results are summarized in Table 3.

Table 3. Students' Learning Outcomes.

Assessment	Mean Score
Pre-test	76.67
Post-test	91.33
Improvement	14.66

Before using the developed learning media, students obtained an average pre-test score of 76.67, indicating that several students had not yet achieved the expected level of conceptual understanding regarding metamorphosis. Many students experienced difficulties distinguishing between complete and incomplete metamorphosis and arranging the correct sequence of developmental stages.

Following the implementation of the Mixed-Materials-Based Three-Dimensional Diorama, the average post-test score increased to 91.33, representing an improvement of 14.66 points. This increase indicates that the developed instructional media effectively improved students' conceptual understanding.

The improvement in learning outcomes can be attributed to the characteristics of the developed media. Unlike conventional learning resources, the three-dimensional diorama enabled students to observe realistic life-cycle models from multiple perspectives while directly connecting textual explanations with physical representations. Consequently, students were able to construct stronger conceptual understanding through observation, exploration, and discussion.

Furthermore, classroom observations showed noticeable changes in students' learning behavior. Students demonstrated greater enthusiasm, actively interacted with the media, and confidently answered teachers' questions during classroom discussions. These findings indicate that the developed media not only improved cognitive achievement but also enhanced learning motivation and classroom engagement.

Product Revision

Following expert validation and classroom implementation, only minor revisions were required before producing the final version of the learning media.

Table 4. Product Revisions.

Validator	Recommendation	Revision
Media Expert	Improve background color contrast	Background colors were adjusted to enhance visual clarity.
Subject-Matter Expert	No revision required	No modifications were necessary.

The revision process primarily focused on improving visual clarity without altering the instructional content. After these revisions, the developed learning media fully satisfied the quality standards established by both experts and classroom practitioners. Therefore, the final version of the Mixed-Materials-Based Three-Dimensional Diorama can be considered a valid, practical, and effective instructional medium for teaching metamorphosis in elementary school science learning.

Discussion

The findings of this study demonstrate that the Mixed-Materials-Based Three-Dimensional Diorama is valid, practical, and effective for improving elementary school students' understanding of the metamorphosis of living organisms. The high validation scores obtained from the media expert (88.46%), subject-matter expert (93.18%), and classroom teacher (87.50%) indicate that the developed learning media satisfy both instructional and technical quality standards. These findings suggest that integrating realistic three-dimensional representations with various natural and artificial materials creates an instructional medium that is appropriate for elementary science education.

The positive responses from students (90.67%) further indicate that the developed media successfully attracted learners' attention and increased their motivation during classroom activities. Young learners generally experience difficulty understanding scientific concepts that involve gradual changes occurring over time, such as metamorphosis. The three-dimensional diorama enabled students to observe every developmental stage simultaneously, making the learning process more meaningful and easier to understand than conventional two-dimensional illustrations.

These findings are consistent with the work of Munadi (2013), who argued that three-dimensional instructional media provide more realistic learning experiences because students are able to observe objects from different perspectives. Similarly, Syafrizal, Erwadi, and Enddika (2020) reported that three-dimensional media improve students' conceptual understanding by transforming abstract scientific concepts into concrete visual representations. Therefore, the present study supports previous evidence that realistic visualization plays an important role in elementary science learning.

The improvement in students' learning outcomes also confirms the effectiveness of the developed media. The average score increased from 76.67 in the pre-test to 91.33 in the post-test, representing an improvement of 14.66 points. This substantial increase indicates that the diorama not only enhanced students' conceptual understanding but also encouraged active participation throughout the learning process. Unlike traditional lecture-based instruction, students were able to observe, discuss, and directly relate each phase of metamorphosis to realistic physical models. Such learning experiences promote meaningful learning because students construct knowledge through direct observation rather than memorizing information.

These findings support the learning media theory proposed by Santyasa (2007), who emphasized that instructional media should stimulate students' attention, interest, emotions, and cognitive processes to facilitate effective learning. In the present study, the combination of visual objects, realistic textures, and interactive activities successfully engaged multiple senses, enabling students to remain focused and actively participate throughout the lesson.

Furthermore, the incorporation of mixed materials contributed significantly to students' engagement. Different textures, colors, and natural objects provided multisensory experiences that cannot be obtained from printed textbooks alone. This finding aligns with the opinion of Prastowo (2015), who stated that attractive instructional media increase students' curiosity, motivation, and classroom participation, ultimately leading to improved learning outcomes.

From the perspective of cognitive development, the effectiveness of the developed media can also be explained by the characteristics of elementary school students. Learners at this stage require concrete learning experiences before they can understand abstract concepts. The developed diorama successfully addressed this need by providing realistic representations of butterfly and grasshopper life cycles that students could observe directly. Consequently, students experienced fewer misconceptions regarding the differences between complete and incomplete metamorphosis.

Overall, the findings indicate that the Mixed-Materials-Based Three-Dimensional Diorama is not only a feasible instructional product but also an effective learning innovation for elementary science education. By combining realistic visualization, interactive learning activities, and multisensory experiences, the developed media successfully improved students' conceptual understanding, learning motivation, and classroom participation. Therefore, this instructional medium has considerable potential for wider implementation in elementary schools, particularly for science topics involving abstract biological processes.

5. Conclusions and Suggestions

Conclusion

This study successfully developed a Mixed-Materials-Based Three-Dimensional Diorama as an instructional medium for teaching the topic of Metamorphosis of Living Organisms in Grade III elementary science (IPAS). The product was developed using the Research and Development (R&D) approach based on the ADDIE model, which consists of the stages of analysis, design, development, implementation, and evaluation. Throughout the development process, the product underwent expert validation, classroom implementation, product revision, and limited field testing to ensure its instructional quality and suitability for elementary school students.

The validation results indicate that the developed learning media achieved a very high level of validity. The media expert evaluation obtained a validity score of 88.46%, the subject-matter expert evaluation reached 93.18%, and the classroom practitioner evaluation obtained 87.50%. Furthermore, the student response questionnaire produced a positive response rate of 90.67%, indicating that students considered the learning media attractive, easy to use, and helpful for understanding the learning material.

The effectiveness test also demonstrated a significant improvement in students' learning outcomes. The average pre-test score increased from 76.67 to 91.33 on the post-test, indicating that the developed three-dimensional diorama effectively improved students' conceptual understanding of animal metamorphosis. In addition to improving academic achievement, the learning media increased students' learning motivation, classroom participation, and enthusiasm during science learning activities.

Overall, the findings confirm that the Mixed-Materials-Based Three-Dimensional Diorama is valid, practical, and effective as an innovative instructional medium for elementary science education. The combination of realistic three-dimensional visualization and mixed materials successfully transformed abstract concepts into concrete learning experiences, enabling students to understand the metamorphosis process more easily and meaningfully.

Suggestions

Practical Implications. Teachers are encouraged to utilize the developed three-dimensional diorama interactively through collaborative learning activities, educational games, or inquiry-based discussions. For example, students may be asked to rearrange the narrative labels according to the correct stages of metamorphosis to enhance active participation and critical thinking. Since the media is constructed using mixed materials such as synthetic grass, chenille stems, ice-cream sticks, and Styrofoam, regular maintenance and proper storage are recommended to preserve its durability and long-term usability. **Recommendations for Future Development.** Future studies are encouraged to further improve the developed learning media by adapting its design to different student characteristics and curriculum developments. In addition, the application of the three-dimensional mixed-materials diorama can be expanded beyond the topic of butterfly and grasshopper metamorphosis to include other biological life cycles, ecosystems, food chains, or additional science topics. Broader implementation involving larger sample sizes and different educational settings is also recommended to further examine the effectiveness and generalizability of the developed instructional media.

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