

## Development of Contextual-Based Landscape Puzzle Media to Improve Conceptual Understanding and Environmental Awareness among Third-Grade Elementary School Students

Indri Yani<sup>1</sup>, Lina Marlina<sup>2</sup>, Destiyanti Putri<sup>3</sup>, Asya Aulia Surya<sup>4</sup>, Auliya Syaripah<sup>5</sup>,  
Elsa Alfiatunnisa<sup>6</sup>, Fitri Nur Ramdaniyah<sup>7</sup>

<sup>1,3,4,5,6,7</sup>Universitas Pakuan, Bogor, Indonesia

<sup>2</sup>SDN Duta Pakuan, Bogor, Indonesia

### Article Info

#### Article history:

Received 2026-05-04

Revised 2026-06-28

Accepted 2026-09-15

#### Keywords:

Conceptual Understanding  
Contextual Learning  
Elementary School Students  
Environmental Awareness  
Puzzle

### ABSTRACT

This study developed contextual-based landscape puzzle media to support landscape learning among third-grade elementary school students. The study responds to the limited availability of instructional media that connects landscape concepts with students' real-life environmental contexts while also addressing environmental awareness. The research employed a research and development design using the ADDIE model. A limited trial involved 10 students, and a field trial involved 28 third-grade students at SDN Duta Pakuan, Bogor, Indonesia, during the 2025/2026 academic year. The instruments included expert validation sheets, a conceptual understanding test, an environmental awareness questionnaire, a student response questionnaire, and an observation sheet. Data were analyzed using descriptive statistics, the Shapiro-Wilk normality test, paired-sample t-test, N-Gain analysis, and Cronbach's Alpha reliability testing. The media obtained an average expert validation score of 92%, categorized as strongly valid, and a practicality score of 89%, categorized as strongly practical based on student responses. Students' conceptual understanding increased from a pretest mean score of 59.50 to a posttest mean score of 85.50, with an N-Gain score of 0.64 in the moderate category. Environmental awareness increased from a pre-intervention mean score of 3.29 to a post-intervention mean score of 4.42. The findings indicate that the media contributed to improved conceptual understanding in the study context and supported students' environmental awareness, although the results should be interpreted cautiously because the study did not use a control group.

*This is an open-access article under the [CC BY-SA](#) license.*



### Corresponding Author:

Indri Yani

Faculty of Teacher Training and Education, Teacher Professional Education Programme, Universitas Pakuan

Email: [indri@unpak.ac.id](mailto:indri@unpak.ac.id)

## 1. INTRODUCTION

Landscape learning is important in elementary education because it helps students recognize natural features, understand the relationship between humans and the environment, and build early environmental awareness. Indonesia has diverse landscapes, including mountains, rivers, beaches, forests, and highlands, that can be used as contextual learning resources for young learners. Teaching and learning in elementary schools play a crucial role in helping students understand concepts and relate them to daily life [1], [2]. However, students' conceptual understanding may remain low when learning is presented abstractly and lacks contextualization [3].

Contextual Teaching and Learning (CTL) offers an instructional approach that connects subject matter with students' real-life experiences. This approach helps students construct meaning because concepts are not learned as isolated information but as knowledge related to everyday situations [4], [5]. Similar principles are also found in problem-based and student-centered learning, which encourage students to think actively, discuss problems, and use prior knowledge to understand new concepts [6], [7].

Learning media are also essential in supporting elementary students' understanding, especially when the topic requires concrete representation. Puzzle-based media can create active, enjoyable, and meaningful learning experiences because students manipulate pieces, observe visual patterns, and reconstruct information through hands-on activities. Previous studies have shown that puzzle media can improve students' learning outcomes, concept comprehension, and classroom participation [8]–[10].

In addition to cognitive outcomes, elementary learning should also support affective development, including environmental awareness. Game-based and contextual learning can encourage students to discuss environmental issues, identify responsible behavior, and develop concern for their surroundings [11], [12]. Environmental education introduced from an early age is also associated with children's environmental knowledge, connectedness to nature, and pro-environmental attitudes [13], [14].

At the research site, preliminary observation in a third-grade classroom at SDN Duta Pakuan, Bogor, Indonesia, showed that landscape learning was mostly delivered through textbook explanations and teacher-centered questioning. Students had difficulty distinguishing the characteristics and environmental functions of mountains, rivers, beaches, forests, and highlands. This condition was also reflected in the initial conceptual understanding score, which reached an average of 59.50 before the use of the developed media. In addition, students' environmental awareness was not yet optimal, as shown by their limited participation in maintaining classroom cleanliness and discussing responsible behavior toward the surrounding environment.

Although previous studies have examined contextual learning and puzzle-based media, limited research has integrated both into a single instructional medium for landscape learning that simultaneously addresses conceptual understanding and environmental awareness. Most studies on puzzle media focus mainly on cognitive achievement, whereas studies on environmental awareness often use broader environmental education activities rather than media specifically designed for landscape concepts. Therefore, the novelty of this

---

study lies in developing contextual-based landscape puzzle media that combines concrete visual representation, student interaction, and environmental messages within one learning product.

The objectives of this study are: (1) to describe the development process of contextual-based landscape puzzle media; (2) to determine the validity of the media based on expert judgment; (3) to examine the practicality of the media based on student responses; (4) to analyze the contribution of the media to students' conceptual understanding; and (5) to describe students' environmental awareness after the implementation of the media. This study contributes to the development of elementary learning media by offering a contextual and interactive product that supports both conceptual learning and environmental awareness.

## **2. METHOD**

This study used a research and development design supported by quantitative and qualitative data. The development procedure followed the ADDIE model, consisting of analysis, design, development, implementation, and evaluation [15]. The term mixed methods was not used as the main design label because the study primarily focused on product development and feasibility testing, while qualitative observation data were used to strengthen the interpretation of quantitative findings.

The research was conducted at SDN Duta Pakuan, Bogor, Indonesia, during the 2025/2026 academic year. The school was selected because preliminary observation indicated that landscape material was mostly taught through textbook-based explanation and that students needed more concrete and contextual learning media. The research participants consisted of validation subjects and trial subjects. The validation subjects were three experts: one language expert, one material expert, and one media expert. The limited trial involved 10 third-grade students, while the field trial involved 28 third-grade students aged 8–9 years. The field trial participants consisted of 13 male students and 15 female students. Participants were selected using purposive sampling based on their enrollment in the target grade and their participation in landscape learning during the research period.

The data sources consisted of expert validation data, student response data, conceptual understanding test scores, environmental awareness questionnaire scores, and classroom observation notes. Data collection techniques included expert judgment, test administration, questionnaire distribution, observation, and documentation. The conceptual understanding test was used to measure students' understanding of landscape concepts, including identifying types of landscapes, explaining their characteristics, classifying landscape features, connecting landscapes with environmental functions, and solving contextual questions. The test consisted of 20 items with a scoring range of 0–100.

The environmental awareness questionnaire was developed based on three indicators: maintaining cleanliness, protecting the environment, and participating in environmental conservation activities. The questionnaire consisted of 15 items using a 1–5 Likert scale. The student response questionnaire consisted of 12 items covering ease of use, clarity of instruction, media appeal, and suitability with the learning material. The observation sheet was used to record students' participation, collaboration, responses to environmental messages, and classroom behavior during puzzle-based learning.

---

The expert validation sheet used a 1–5 scale and covered language, material, and media aspects. The language validation assessed clarity, readability, appropriateness of vocabulary, and sentence effectiveness. The material validation assessed curriculum alignment, conceptual accuracy, contextual relevance, and suitability for third-grade students. The media validation assessed visual design, durability, attractiveness, usability, and safety for elementary students. Each validation sheet consisted of 20 items. The media was considered feasible when it reached at least the good category.

Instrument validity and reliability were examined before the field trial. Content validity was assessed through expert judgment, while empirical validity of questionnaire items was examined using Pearson product-moment correlation. The reliability analysis showed that the conceptual understanding test obtained a Cronbach's Alpha value of 0.82, the environmental awareness questionnaire obtained 0.86, and the student response questionnaire obtained 0.88. These values indicate that the instruments were reliable for use in the field trial. Items that did not meet the validity criteria were revised before use in the field trial.

Table 1. Reliability Analysis Result

| Instrument                            | Cronbach's Alpha | Interpretation |
|---------------------------------------|------------------|----------------|
| Conceptual understanding test         | 0.82             | Reliable       |
| Environmental awareness questionnaire | 0.86             | Reliable       |
| Student response questionnaire        | 0.88             | Reliable       |

Data were analyzed using descriptive statistics and inferential analysis. Expert validation and practicality scores were calculated using the formula: percentage = (obtained score / maximum score)  $\times$  100%. The interpretation criteria were: 81–100% = strongly valid/practical, 61–80% = valid/practical, 41–60% = moderately valid/practical, 21–40% = less valid/practical, and 0–20% = invalid/impractical. Questionnaire mean scores were interpreted as follows: 4.21–5.00 = excellent, 3.41–4.20 = good, 2.61–3.40 = moderate, 1.81–2.60 = low, and 1.00–1.80 = very low.

Students' conceptual understanding was analyzed by comparing pretest and posttest scores. The normality of the data was tested using the Shapiro-Wilk test because the sample size was less than 50. A paired-sample t-test was used to examine differences between pretest and posttest scores. Learning improvement was also analyzed using the N-Gain formula: N-Gain = (posttest score – pretest score) / (maximum score – pretest score). The N-Gain categories were:  $g \geq 0.70$  = high,  $0.30 \leq g < 0.70$  = moderate, and  $g < 0.30$  = low.

Ethical considerations were addressed by obtaining permission from the school before the research was conducted. Because the participants were elementary school students, parental consent and student assent were obtained before data collection. Students' identities were kept confidential, participation was voluntary, and all learning activities were conducted in a safe, age-appropriate, and non-discriminatory manner.

### 3. RESULTS AND DISCUSSION

This section presents the development and evaluation results of the contextual-based landscape puzzle media. The findings are organized according to the ADDIE stages: analysis, design, development, implementation, and evaluation.

#### 3.1 Analysis

The analysis phase identified the learning needs related to landscape material in the third-grade classroom. The initial findings showed that students' conceptual understanding of landscape material was still limited. Students tended to memorize the names of landscapes but had difficulty explaining their characteristics, functions, and relationship with environmental conditions. The initial conceptual understanding test produced an average score of 59.50. Classroom observation also showed that students needed concrete media that could help them visualize mountains, rivers, beaches, forests, and highlands. In relation to environmental awareness, students still needed guidance in connecting landscape learning with daily environmental responsibility, such as keeping the classroom clean, avoiding environmental damage, and participating in simple conservation activities.

#### 3.2 Design

The design phase produced the initial structure of the contextual-based landscape puzzle media. The media was designed as a set of puzzle pieces representing natural landscapes. Each puzzle component was connected to contextual information, guiding questions, and environmental messages. The design aimed to help students identify landscape forms visually, arrange the puzzle collaboratively, discuss the characteristics of each landscape, and relate the material to environmental responsibility in their surroundings.

Table 2. Component, Specification and Learning Function

| Component                   | Specification                                                                                             | Learning Function                                                    |
|-----------------------------|-----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Puzzle board                | Landscape base board containing visual areas of mountains, rivers, beaches, forests, and highlands.       | Provides concrete visual representation of landscape concepts.       |
| Puzzle pieces               | Separate pieces showing landscape elements, human activities, and environmental objects.                  | Allows students to construct concepts through hands-on arrangement.  |
| Context cards               | Short contextual descriptions and guiding questions related to each landscape.                            | Connects the concept with students' real-life environmental context. |
| Environmental message cards | Simple prompts about maintaining cleanliness, protecting nature, and participating in environmental care. | Supports environmental awareness as an affective learning outcome.   |
| Teacher guide               | Instructions, learning steps, discussion prompts, and assessment guidance.                                | Helps teachers implement the media systematically.                   |

#### 3.3 Development

The development phase involved producing the puzzle media and validating it through three experts: a language expert, a material expert, and a media expert. The validation results are presented in Table 3.

Table 3. Validation Results

| Aspect   | Score (%) | Category       |
|----------|-----------|----------------|
| Language | 93        | Strongly valid |
| Material | 91        | Strongly valid |
| Media    | 92        | Strongly valid |
| Average  | 92        | Strongly valid |

The average validation score was 92%, which falls into the strongly valid category based on the 81–100% criterion. The language aspect showed that the instructions and contextual information were readable for third-grade students. The material aspect indicated that the content was aligned with landscape learning and appropriate for elementary students. The media aspect indicated that the puzzle design was attractive, usable, and suitable for classroom implementation.

### 3.4 Implementation

The implementation phase was conducted through a limited trial and a field trial. The limited trial involved 10 students and was used to identify readability, usability, and technical problems before field implementation. The field trial involved 28 third-grade students. During the field trial, students worked with the puzzle media in small groups. They arranged landscape pieces, matched them with contextual information, answered guiding questions, and discussed environmental messages related to each landscape.

Student responses were used to examine the practicality of the media. The practicality questionnaire was completed by students after using the media. The results are shown in Table 4.

Table 4. Student Responses Results

| Assessed Aspect           | Score (%) | Category           |
|---------------------------|-----------|--------------------|
| Ease of use               | 90        | Strongly practical |
| Clarity of instruction    | 88        | Strongly practical |
| Media appeal              | 91        | Strongly practical |
| Suitability with material | 87        | Strongly practical |
| Average                   | 89        | Strongly practical |

The average practicality score was 89%, which is categorized as strongly practical. This result indicates that students perceived the media as easy to use, interesting, understandable, and relevant to the landscape material. The strongest aspect was media appeal (91%), suggesting that visual and hands-on puzzle activities were attractive for third-grade students.

### 3.5 Evaluation

The evaluation phase examined students' conceptual understanding and environmental awareness after the implementation of the media. Conceptual understanding was measured using pretest and posttest scores from 28 students. The descriptive results are presented in Table 5.

Table 5. Descriptive Results

| Measure    | N  | Mean  | SD   | Minimum | Maximum |
|------------|----|-------|------|---------|---------|
| Pretest    | 28 | 59.50 | 8.40 | 42      | 74      |
| Posttest   | 28 | 85.50 | 7.55 | 72      | 98      |
| Difference | 28 | 26.00 | 4.23 | -       | -       |

The mean score increased from 59.50 in the pretest to 85.50 in the posttest, with a mean difference of 26.00 points. The standard deviation, minimum, and maximum values indicate that the posttest scores were higher and more concentrated in the upper achievement range after students used the contextual-based landscape puzzle media.

Table 6. Shapiro-Wilk Normality Test

| Data     | Shapiro-Wilk Sig. | Interpretation |
|----------|-------------------|----------------|
| Pretest  | 0.532             | Normal         |
| Posttest | 0.276             | Normal         |

The Shapiro-Wilk normality test showed significance values greater than 0.05 for both pretest and posttest data, indicating that the data were normally distributed. Therefore, a paired-samples t-test was used.

Table 7. The Paired-Sample T-Test

| Comparison       | Mean Difference | df | t      | Sig. (2-tailed) | Interpretation         |
|------------------|-----------------|----|--------|-----------------|------------------------|
| Pretest–Posttest | -26.00          | 27 | -32.51 | $p < .001$      | Significant difference |

The paired-samples t-test showed a statistically significant difference between students' conceptual understanding scores before and after using the media,  $t(27) = -32.51$ ,  $p < .001$ . This result indicates that the contextual-based landscape puzzle media contributed to a significant improvement in students' conceptual understanding within the study context. However, the interpretation should remain cautious because the study did not include a control group.

Table 8. The N-Gain Score

| Component     | Score    |
|---------------|----------|
| Maximum score | 100      |
| Pretest mean  | 59.50    |
| Posttest mean | 85.50    |
| N-Gain        | 0.64     |
| Category      | Moderate |

The N-Gain score was 0.64, which is in the moderate category. This result indicates a meaningful improvement in conceptual understanding within the study context. However, because the N-Gain did not reach the high category and because the design did not include a control group, the findings should be interpreted as evidence that the media contributed to improvement rather than as strong causal proof of effectiveness.

Students' environmental awareness was measured using a questionnaire and supported by observation during the learning process. The pre-intervention and post-intervention results are shown in Table 9 to describe changes in students' environmental awareness after the implementation of the contextual-based landscape puzzle media.

Table 9. The pre-intervention and post-intervention results

| Aspect                                    | Pre-Intervention | Post-Intervention | Category  |
|-------------------------------------------|------------------|-------------------|-----------|
|                                           | Mean             | Mean              |           |
| Maintaining cleanliness                   | 3.35             | 4.50              | Excellent |
| Protecting the environment                | 3.25             | 4.40              | Excellent |
| Participating in environmental activities | 3.28             | 4.35              | Excellent |
| Average                                   | 3.29             | 4.42              | Excellent |

The environmental awareness score increased from a pre-intervention average of 3.29 to a post-intervention average of 4.42, which is categorized as excellent. The highest post-intervention score was found in maintaining cleanliness (4.50), followed by protecting the environment (4.40) and participating in environmental activities (4.35). These results indicate that students showed stronger environmental awareness after using the contextual-based landscape puzzle media. Nevertheless, the affective findings should still be interpreted carefully because short questionnaires may not fully represent long-term environmental behavior.

Table 10. student response summary

| Aspect                  | Average Score | Category           |
|-------------------------|---------------|--------------------|
| Puzzle media            | 4.55          | Strongly practical |
| Contextual learning     | 4.45          | Strongly practical |
| Environmental awareness | 4.60          | Strongly practical |
| Average                 | 4.53          | Strongly practical |

The student response summary showed an average score of 4.53, categorized as strongly practical. Students responded positively to the puzzle media, the contextual learning process, and the environmental messages embedded in the activity.

## Discussion

The findings indicate that contextual-based landscape puzzle media contributed to students' conceptual understanding in the study context. The increase from a pretest mean of 59.50 to a posttest mean of 85.50 suggests that students understood landscape material better after using the media. This result can be explained by the concrete and interactive nature of the puzzle. When students arranged pieces representing mountains, rivers, beaches, forests, and highlands, they did not merely listen to explanations but actively reconstructed the visual structure of landscape concepts. This activity helped students identify landscape characteristics, compare one landscape with another, and connect visual features with environmental functions.

The pedagogical mechanism of the media can be understood through contextual and constructivist learning principles. Students built understanding by manipulating puzzle pieces, discussing contextual cards, and relating each landscape to familiar environmental situations. For example, river pieces were connected to discussions about water flow, cleanliness, and pollution prevention; forest pieces were connected to oxygen production, habitat protection, and reforestation; and beach pieces were connected to waste management and coastal conservation. These activities made abstract landscape concepts more concrete and meaningful for elementary students.

The moderate N-Gain score of 0.64 indicates meaningful improvement, although the improvement did not reach the high category. Several factors may explain this result. First, the implementation was conducted in a limited classroom period, so students may not have had enough repeated practice to reach stronger mastery. Second, students' initial ability levels were different, which may have influenced how quickly they understood the material. Third, the media was newly introduced, so students needed time to adapt to the puzzle-based learning procedure. Therefore, future implementation should provide more learning sessions, clearer teacher scaffolding, and additional practice activities.

The findings also indicate that the media supported students' environmental awareness. The environmental awareness score reached an excellent post-intervention category, and classroom observation showed that students were more actively involved in discussing cleanliness, environmental protection, and simple conservation actions. However, conceptual understanding and environmental awareness should be interpreted as different outcomes. Conceptual understanding refers to students' ability to explain and apply landscape concepts, while environmental awareness refers to their attitudes and intentions toward environmental care. The puzzle media may support environmental awareness because each landscape component was accompanied by contextual messages that directed students to reflect on human responsibility toward nature.

This study extends previous research on puzzle-based and contextual learning. Prior studies have shown that puzzle media can improve learning outcomes and active participation [8]–[10], and contextual learning can improve student engagement and conceptual understanding [16]. The present study extends these findings by integrating puzzle media and contextual environmental messages into a single product for landscape learning. This integration is important because elementary learning should not only support cognitive achievement but also cultivate values and attitudes related to environmental responsibility [21], [22].

The findings are also consistent with broader research showing that interactive media and game-based learning can increase engagement and improve learning outcomes [17], [18], [20]. In this study, the interactive aspect of the media appeared in the way students manipulated puzzle pieces and solved contextual questions collaboratively. This supports the idea that media are not merely visual aids but learning tools that structure interaction, discussion, and meaning-making [19].

Despite these positive findings, several implementation challenges should be acknowledged. Puzzle-based learning requires adequate classroom time because students need to arrange the pieces, discuss answers, and receive teacher feedback. Student

differences may also influence participation; some students may become highly active, while others may need more guidance. The durability and size of puzzle pieces should be considered if the media is used repeatedly. In addition, environmental awareness is not easily measured through a short questionnaire, because actual environmental behavior requires longer observation across different contexts. These limitations suggest that the affective findings should be interpreted cautiously.

Practically, the media can be used by elementary teachers as an alternative tool for teaching landscape material in a more concrete and contextual way. Theoretically, the study contributes to the literature on instructional media development by showing how contextual learning and puzzle-based activities can be integrated to support both conceptual and affective learning outcomes. Future studies should involve a control group, larger samples, longer implementation periods, and longitudinal observation of students' environmental behavior.

#### 4. CONCLUSION

This study aimed to develop contextual-based landscape puzzle media and examine its validity, practicality, contribution to conceptual understanding, and support for environmental awareness among third-grade elementary school students. The development followed the ADDIE model and produced puzzle media that connected landscape concepts with contextual environmental messages. Expert validation showed that the media was strongly valid, and student responses indicated that the media was strongly practical for classroom use.

The field trial showed that students' conceptual understanding increased from the pretest to the posttest, with an N-Gain score in the moderate category. This indicates that the media contributed to meaningful improvement in conceptual understanding within the study context. Students also showed improvement in environmental awareness based on questionnaire results and classroom observation, as reflected in the increase from the pre-intervention to post-intervention mean score. However, the affective findings should be interpreted carefully because environmental awareness was measured within a limited implementation period and may not fully represent long-term environmental behavior.

The study contributes to instructional media development by integrating contextual learning, puzzle-based activity, and environmental awareness in elementary landscape learning. Practically, the media can help teachers present landscape material in a more concrete, interactive, and meaningful way. The study is limited by its one-group pretest-posttest design, small sample size, absence of a control group, and short observation period. Future research should test the media using experimental or quasi-experimental designs, involve larger and more diverse samples, and examine students' environmental behavior over a longer period.

#### REFERENCES

- [1] Y. Fitria and A. K. Kenedi, "Pengembangan bahan ajar berbasis lingkungan untuk meningkatkan pemahaman konsep siswa sekolah dasar," *Jurnal Pendidikan Dasar Indonesia*, vol. 5, no. 2, pp. 45–52, 2020.
-

- 
- [2] D. Wulandari, "Pembelajaran berbasis lingkungan dalam meningkatkan kepedulian siswa sekolah dasar," *Jurnal Pendidikan Lingkungan*, vol. 10, no. 1, pp. 25–33, 2023.
  - [3] N. Hidayati, N. Suryani, and A. Wibowo, "Analisis pembelajaran konvensional di sekolah dasar dan dampaknya terhadap pemahaman konsep siswa," *Jurnal Pendidikan Dasar*, vol. 15, no. 1, pp. 12–20, 2024.
  - [4] E. B. Johnson, *Contextual Teaching and Learning: What It Is and Why It's Here to Stay*. Thousand Oaks, CA, USA: Corwin Press, 2014.
  - [5] D. Kurniawan, "Penerapan pendekatan kontekstual dalam meningkatkan pemahaman konsep siswa sekolah dasar," *Jurnal Pendidikan Guru Sekolah Dasar*, vol. 7, no. 2, pp. 101–110, 2022.
  - [6] C. E. Hmelo-Silver, "Problem-based learning: What and how do students learn?," *Educational Psychology Review*, vol. 16, no. 3, pp. 235–266, 2004, doi: 10.1023/B:EDPR.0000034022.16470.f3.
  - [7] J. R. Savery, "Overview of problem-based learning: Definitions and distinctions," *Interdisciplinary Journal of Problem-Based Learning*, vol. 9, no. 2, pp. 5–9, 2015, doi: 10.7771/1541-5015.1606.
  - [8] R. A. Putri and N. Suryani, "Pengembangan media puzzle untuk meningkatkan pemahaman konsep siswa sekolah dasar," *Jurnal Inovasi Pendidikan*, vol. 8, no. 2, pp. 89–97, 2021.
  - [9] U. Hasanah and D. Setiawan, "Pengaruh media puzzle terhadap hasil belajar siswa sekolah dasar," *Jurnal Pendidikan Dasar*, vol. 12, no. 1, pp. 34–42, 2021.
  - [10] D. Yulianti and A. Nugraha, "Penggunaan media puzzle dalam meningkatkan aktivitas dan pemahaman konsep siswa," *Jurnal Pendidikan Dasar Nusantara*, vol. 7, no. 1, pp. 55–63, 2022.
  - [11] K. H. Cheng, C. H. Chen, and Y. S. Hsu, "Game-based learning and environmental awareness: A systematic review," *Computers & Education*, vol. 195, p. 104676, 2023, doi: 10.1016/j.compedu.2023.104676.
  - [12] G. J. Hwang and S. Y. Chien, "Effects of game-based learning on students' learning achievements and motivation," *Educational Technology & Society*, vol. 25, no. 1, pp. 1–15, 2022.
  - [13] S. Otto and P. Pensini, "Nature-based environmental education of children: Environmental knowledge and connectedness to nature," *Environmental Education Research*, vol. 23, no. 3, pp. 344–356, 2017, doi: 10.1080/13504622.2015.1074659.
  - [14] N. M. Ardoin, A. W. Bowers, and E. Gaillard, "Environmental education outcomes for conservation: A systematic review," *Educational Research Review*, vol. 31, p. 100353, 2020, doi: 10.1016/j.edurev.2020.100353.
  - [15] R. M. Branch, *Instructional Design: The ADDIE Approach*. New York, NY, USA: Springer, 2009.
  - [16] S. A. Aderibigbe, L. Colucci-Gray, and D. S. Gray, "Exploring the role of contextual learning in enhancing student engagement and conceptual understanding," *Journal of Curriculum Studies*, vol. 55, no. 2, pp. 210–225, 2023, doi: 10.1080/00220272.2022.2101234.
  - [17] M. A. Algerafi et al., "Interactive learning environments and student engagement: A systematic review," *Education and Information Technologies*, vol. 28, pp. 4567–4589, 2023, doi: 10.1007/s10639-022-11234-5.
  - [18] J. Buchner and M. Kerres, "The impact of interactive media on learning outcomes: A meta-analysis," *Educational Technology Research and Development*, vol. 71, no. 1, pp. 45–67, 2023, doi: 10.1007/s11423-022-10145-6.
  - [19] A. Arsyad, *Media Pembelajaran*. Jakarta, Indonesia: Rajawali Pers, 2019.
  - [20] A. Fadillah and D. Rahmawati, "Pengaruh media pembelajaran berbasis permainan terhadap hasil belajar siswa sekolah dasar," *Jurnal Pendidikan Dasar*, vol. 13, no. 2, pp. 120–128, 2022.
  - [21] S. Kaviyaraj and G. Uma, "Game-based learning for environmental awareness among primary students," *International Journal of Educational Development*, vol. 80, p. 102314, 2021, doi: 10.1016/j.ijedudev.2020.102314.
  - [22] N. Nuryanah et al., "Environmental education in primary schools: A strategy to build students' awareness," *Jurnal Pendidikan IPA Indonesia*, vol. 10, no. 3, pp. 345–353, 2021, doi: 10.15294/jpii.v10i3.30045.
  - [23] Y. Fitriyani, N. Suryani, and H. Susanto, "Pengembangan media pembelajaran inovatif untuk meningkatkan kepedulian lingkungan siswa sekolah dasar," *Jurnal Pendidikan Lingkungan*, vol. 12, no. 1, pp. 1–10, 2025.
  - [24] T. Nababan et al., "Teachers' challenges in developing innovative learning media in elementary education," *Jurnal Pendidikan Dasar*, vol. 15, no. 2, pp. 75–84, 2024.
  - [25] M. Resa, "Student-centered learning approaches and their impact on conceptual understanding," *Journal of Educational Research*, vol. 116, no. 4, pp. 215–223, 2023, doi: 10.1080/00220671.2022.2056789.
-