



Development of Water Cycle Diorama Media in Science Learning for Grade V Elementary School

Beastrik Yunike Mirino¹, Supriyati Fatma Rabia², & Ernawati Simatupang³

^{1,2,3}Department of Elementary School Teacher Education, Universitas Pendidikan Muhammadiyah Sorong, Southwest Papua Province, Indonesia

*Correspondence: supriyatifatmarabia@unimudasorong.ac.id

ARTICLE INFO

Received: 18 January 2026
Revised: 14 March 2026
Accepted: 1 April 2026
Published Online: 26 June 2026

Keywords:

Learning media, diorama, water cycle, elementary school science, ADDIE model.

ABSTRACT

This study aims to develop a water cycle diorama learning medium and to examine its validity, practicality, and effectiveness in natural science (IPA) instruction for Grade V students at SD Inpres 16, Sorong Regency, during the 2024/2025 academic year. The study employed a Research and Development (R&D) methodology utilizing the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). Data were collected through qualitative approaches, including observation and structured interviews, supplemented by pre-test and post-test instruments comprising 20 multiple-choice items. The study involved 30 Grade V students as a saturated sample. Effectiveness was measured using the N-Gain Score formula, while validity was assessed through expert validation. Results indicate that the diorama medium received a highly valid rating from the media and content expert validator, achieved a mean practicality score of 75 (categorized as practical), and demonstrated an effectiveness level of 80.6%, indicating a high category of mastery. It is therefore concluded that the water cycle diorama medium is valid, practical, and effective as a concrete instructional tool for supporting student learning.

comprehension of the water cycle concept in elementary school science.

How to Cite: Mirino, B. Y., Rabia, S. F., & Simatupang, E. (2026). Development of Water Cycle Diorama Learning Media in Grade V Elementary School Science. *Primary Education Journal*, 2(3), 16-32.

© The Author(s) 2026

INTRODUCTION

Education is a systematically designed process carried out by educational institutions to foster conducive learning environments and purposeful instructional activities that actively promote learner development. Through this process, individuals and groups undergo transformations in attitudes and behavior as part of their progression toward maturity, facilitated through structured training and pedagogical approaches (Dhiku & Saputro et al., 2023). Formal schooling at the elementary level constitutes a critical stage in this developmental continuum, as it provides foundational cognitive frameworks upon which subsequent academic competencies are built (Darling-Hammond et al., 2020).

Natural Science at the elementary school level is designed to cultivate scientific literacy and encourage students to observe, question, and investigate natural phenomena. Among the topics taught in Grade V, the water cycle represents one of the most conceptually challenging units due to its abstract and cyclical nature. Students are expected to understand processes such as evaporation, condensation, precipitation, and infiltration, none of which can be directly observed in a conventional classroom setting. This epistemological challenge necessitates the deployment of concrete, three-dimensional instructional media that can bridge the gap between abstract concepts and tangible experience (Arsyad, 2017; Dale, 1969).

Based on preliminary observations conducted at SD Inpres 16, Sorong Regency, it was found that science instruction in Grade V was predominantly characterised by lecture-based teaching and exclusive reliance on printed

textbooks as the sole learning resource. This conventional instructional approach resulted in diminished student engagement and limited conceptual comprehension, particularly for the water cycle topic. A substantial proportion of students reported difficulty in visualizing the sequential stages of the water cycle, and several did not possess individual textbooks, further compounding the accessibility barrier (Mirino, 2024; Rabia, 2024).

Several prior investigations have demonstrated that the use of concrete instructional media, including three-dimensional models and dioramas, can substantially enhance conceptual understanding and academic achievement among elementary school students (Anggraeni & Istianah, 2017; Kusniawati & Sulistyorini, 2023). Diorama media, in particular, provide immersive, visually rich learning experiences that enable students to observe dynamic processes in a simulated environment. When augmented with interactive components such as electric pumps that simulate water circulation, dioramas can effectively represent the otherwise invisible mechanisms of the water cycle (Rahmatunnisa et al., 2021; Sudjana & Rivai, 2013).

Despite growing evidence supporting the pedagogical efficacy of diorama-based media, research specifically addressing the development and empirical validation of water cycle dioramas in the context of elementary schools within Sorong Regency remains limited. This research gap constitutes the primary justification for the present study. The study contributes an original diorama medium tailored to the cognitive and contextual characteristics of Grade V learners in this region and evaluates its educational merit through rigorous assessment of validity, practicality, and effectiveness.

The objectives of this study are, therefore: (1) to develop a water cycle diorama learning medium using the ADDIE instructional design model; (2) to assess the validity of the medium through expert evaluation; (3) to evaluate the practicality of the medium based on student and teacher responses during trial implementation; and (4) to measure the effectiveness of the medium in improving student learning outcomes in water cycle instruction at the Grade V level.

METHODS

Research Design

This study employed a research and development (R&D) approach, which constitutes a systematic methodology for designing and evaluating instructional products to ensure their effectiveness and suitability for targeted users (Sugiyono, 2019). The development of the water cycle diorama medium was guided by the ADDIE model, comprising five sequential phases: analysis, design, development, implementation, and evaluation. This model is widely employed in instructional design research for its structured and iterative framework, which ensures pedagogical alignment between learning objectives, media characteristics, and learner needs (Branch, 2009; Dick et al., 2015; Aldoobie, 2015).

Research Setting and Participants

The study was conducted at SD Inpres 16, located at Jalan Buncis Malawe, Distrik Aimas, Sorong Regency, West Papua Province, Indonesia. Research activities were carried out between July and November 2024, with institutional permission granted in April 2025. The research population comprised all 30 Grade V students enrolled during the 2024/2025 academic year. A saturated sampling technique was employed, whereby the entire population was designated as the research sample, given that the total number of students was manageable and representative of the research context (Sugiyono, 2019). The final sample therefore consisted of 30 students.

Data Collection Instruments

Data were collected using two primary instruments. First, an expert validation questionnaire was administered to the media and content validator, *Ibu Anis Alfian Fitriani, M.Pd.*, a lecturer at the Faculty of Language, Social, and Sports Education, Universitas Pendidikan Muhammadiyah Sorong, to assess the validity of the diorama medium. Second, a pre-test and post-test instrument consisting of 20 multiple-choice questions was administered to students to evaluate learning outcomes before and after the implementation of the diorama medium. Observation and structured interview protocols were additionally

employed to assess the practicality of the medium during instructional trials.

Data Analysis

The validity of the medium was determined through expert evaluation using a Likert-scale questionnaire, with validity criteria established based on Pearson product-moment correlation coefficients at a significance level of $\alpha = 0.05$. An instrument item was considered valid if the computed r -value exceeded the tabulated r -value ($r_{\text{count}} > r_{\text{table}}$), and was declared drop if it fell below this threshold.

The practicality of the medium was assessed through qualitative analysis of student and teacher responses collected during the trial implementation phase. The effectiveness of the medium was measured using the normalised gain (N-Gain) formula (Hake, 1998), calculated as:

$$\text{N-Gain} = (\text{Post-Test Score} - \text{Pre-Test Score}) / (\text{Ideal Score} - \text{Pre-Test Score})$$

Student learning outcomes were then calculated using the formula: $N = (w/n) \times 100$, where N denotes the student's score, w represents the number of correct responses, and n is the total number of items. The overall class achievement rate was evaluated against a minimum mastery threshold of 75%, consistent with the criteria established by Trianto (2015). Descriptive statistical measures, including mean and percentage, were subsequently computed to characterize learning gains and the distribution of mastery levels across the sample.

RESULTS AND DISCUSSION

ADDIE Model Development Process

Phase 1: Analysis

The analysis phase was designed to identify and establish the learning needs, curricular requirements, and contextual characteristics of the target learners. This phase involved a preliminary observational study at SD Inpres 16 to diagnose instructional challenges encountered by Grade V teachers during science lessons. Findings from the observations and initial interviews revealed

that student engagement was markedly low, primarily attributable to the school's heavy reliance on textbook-centered instruction and the absence of supplementary visual learning aids. Many students had not yet acquired personal textbooks, and teachers tended to deliver instruction through verbal explanation accompanied only by two-dimensional illustrations.

Three sub-analyses were conducted within this phase. The curriculum analysis revealed that the school operates under the *Kurikulum Merdeka* (Freedom Curriculum), which encompasses four primary assessment dimensions: (1) knowledge (written tests, oral assessments, assignments, and observation); (2) skills (practical demonstrations, reading, writing, and listening); (3) spiritual attitudes (religious belief and practice); and (4) social attitudes (interpersonal behavior and values). The student analysis indicated that Grade V learners were in a developmental stage characterized by emergent abstract reasoning, logical inference, and systemic thinking, capacities relevant to understanding the water cycle (Piaget, 1964; Slavin, 2018). Nevertheless, the majority of students had not yet internalized the sequential stages of the water cycle in their daily observational context. The material analysis identified three core learning indicators: (1) students should be able to enumerate the stages of the water cycle; (2) students should be able to explain each stage; and (3) students should be able to describe the process of precipitation.

Phase 2: Design

The design phase entailed the systematic planning of the diorama medium in alignment with the identified learner characteristics and curricular objectives. This phase involved the following: (a) the formulation of specific learning indicators and instructional objectives; (b) the selection of the diorama as the appropriate media type; (c) the preparation of a preliminary design layout prior to prototype construction; (d) the planning of instructional scenarios; and (e) the development of evaluation instruments. The physical design of the diorama incorporated a glass aquarium structure, a styrofoam base and backing, miniature tree models, cotton cloud representations, origami

paper sunlight symbols, and a battery-powered electric pump with tubing to simulate dynamic water circulation.

The material preparation phase required the procurement of scissors, double-sided tape, a hot glue gun, white adhesive (Fox glue), a cutter, a ruler, a glass cutter, an electric pump, and adhesive tape. Consumable materials included recycled glass panels, flexible tubing, styrofoam sheets, paint, cotton wool, and miniature plant models. The glass panels were measured and cut to approximately 25–30 cm in both height and width, while the styrofoam base was prepared at 20 × 30 cm to provide structural support (Sulistiyowati et al., 2020).

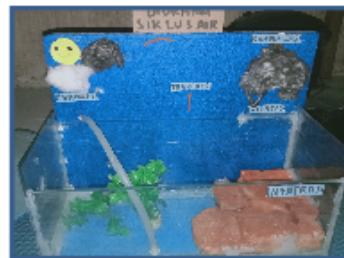


Figure 1. tools and materials **Figure 2.** Diorama Learning Media

Phase 3: Development

The development phase involved the physical construction of the diorama medium based on the previously established design specifications. The completed diorama was built using glass panels assembled in an aquarium-like configuration on a styrofoam base. The interior of the structure incorporated miniature trees, a styrofoam terrain, cotton-wool clouds, and a styrofoam sun representation, all arranged to depict the sequential stages of the water cycle in three dimensions. An electric pump connected to transparent tubing was integrated to simulate the continuous circulation of water, thereby providing a dynamic, interactive representation of the hydrological cycle processes, including evaporation/transpiration, condensation, precipitation, and infiltration.

The primary advantages of this medium include (1) its capacity to

deliver three-dimensional visual representation of the water cycle, facilitating greater conceptual clarity; (2) its ability to depict the water cycle dynamically through the pump mechanism; (3) its reusability across multiple instructional sessions; (4) its potential to increase student motivation and interest in science; and (5) its promotion of interactive, student-centered learning through direct engagement with the medium (Sadiman et al., 2014; Smaldino et al., 2019).

Phase 4: Implementation

During the implementation phase, the completed diorama medium was introduced into the Grade V classroom at SD Inpres 16 following instructional planning aligned with the Kurikulum Merdeka framework. Students were provided opportunities to interact directly with the diorama, present their understanding of the water cycle stages, and articulate explanations of the processes visualized by the medium. Each student was asked to describe the sequence of the water cycle and explain the mechanism of precipitation based on their observation of the diorama. Implementation sessions were conducted in groups, encouraging collaborative learning, peer discussion, and cooperative knowledge construction.

Phase 5: Evaluation

The evaluation phase integrated both formative and summative assessment components. Formative evaluation was conducted iteratively throughout each phase to identify and address design and content deficiencies. Summative evaluation was conducted following implementation to assess the overall pedagogical outcomes of the diorama medium, drawing on data from validity assessments, student response surveys, and pre-test and post-test results. Subsequent revisions to the medium were made based on evaluative feedback to enhance comprehensibility and instructional alignment for use in elementary school science classrooms.

Product Trial Results

The water cycle diorama medium was trialled with 30 Grade V students at SD Inpres 16 with the primary aim of improving active student participation in the learning process. Observational data gathered during the trial sessions indicated that students demonstrated sustained engagement, collaborative behavior, and active participation during group-based activities involving the diorama. The medium's concrete, three-dimensional representation of abstract concepts notably reduced instances of disengagement and supported the affective development of learners by fostering curiosity and cooperative interaction.

Two principal advantages were identified through the trial process. First, students demonstrated increased physical and cognitive engagement throughout the learning session, actively interacting with the medium and asking exploratory questions. Second, the medium fostered a positive classroom atmosphere characterised by peer collaboration, motivational engagement, and improved retention of previously learned material (Arsyad, 2017; Hamalik, 2011).

Validity Assessment

The validity of the water cycle diorama learning medium was evaluated through expert validation conducted by a designated media and content specialist. The validation process employed a structured rubric assessing the diorama across dimensions of content accuracy, media quality, pedagogical alignment, and visual clarity. Validity was computed using the Pearson product-moment correlation formula at a significance level of $\alpha = 0.05$.

The validation results indicated that the diorama medium received a rating of "very good," confirming that it met the established criteria for instructional validity. The expert validator confirmed that the medium accurately represented the water cycle stages, was visually engaging, structurally sound, and pedagogically appropriate for Grade V learners. The achievement of valid status signifies that the medium can serve as a legitimate instructional tool that

supports conceptual learning through direct observation, consistent with findings from related studies on concrete science media (Kusniawati & Sulistyorini, 2023; Rahmatunnisa et al., 2021; Candra, 2019).

Practicality Assessment

An effective instructional medium must be readily usable and practically implementable within authentic classroom contexts. The practicality of the water cycle diorama medium was assessed through a structured trial involving 30 students, yielding a mean practicality score of 75, which falls within the “practical” category. Six key positive effects were attributed to the medium’s practical implementation: (1) a constructive shift in the teacher’s instructional role toward facilitation; (2) the promotion of positive student behaviors and increased active participation; (3) measurable improvements in the quality of learning outcomes; (4) greater efficiency in the use of instructional time; (5) increased interactivity between teacher and students; and (6) an aesthetically engaging and motivating learning environment.

The practicality evaluation incorporated three phases: (a) a group-based trial in which students interacted with the diorama collaboratively, with observers monitoring discussion quality, cooperation patterns, and material comprehension; (b) qualitative data collection through observational checklists and structured interviews with students regarding their experience with the medium; and (c) qualitative data analysis to yield an in-depth understanding of student interaction with the medium. These findings are consistent with the assertion by Nieveen (1999) that instructional media practicality is determined by the ease of use perceived by practitioners and the positive responses elicited from learners.

Effectiveness Assessment

The effectiveness of the water cycle diorama medium was assessed through pre-test and post-test instruments administered to all 30 Grade V students. Test scores were converted using the formula $N = (w/n) \times 100$, and N-Gain scores were computed for each student to quantify the magnitude of

learning improvement (see on **Table 1**).

Table 1. Pre-Test and Post-Test Score Results and N-Gain Score Calculations

No.	Student Code	Post-Test	Pre-Test	Post-Pre ePost	Ideal Score (100-Pre)	N-Gain Score	N-Gain (%)
1	A N M	70	60	10	40	0.25	25
2	A B R	80	75	5	25	0.20	20
3	B L W	75	60	15	40	0.375	37.5
4	B W S	80	75	5	25	0.20	20
5	D I H S	80	60	20	40	0.50	50
6	E N R	85	75	10	25	0.40	40
7	E G K	80	75	5	25	0.20	20
8	G M A B	80	75	5	25	0.20	20
9	H F A	80	75	5	25	0.20	20
10	I E I S	90	75	15	25	0.60	60
11	J E M L	80	75	5	25	0.20	20
12	M K B M	80	75	5	25	0.20	20
13	M R A W K	80	75	5	25	0.20	20
14	M W	80	75	5	25	0.20	20
15	M S W B	83	75	8	25	0.32	32
16	M F K	75	60	15	40	0.375	37.5
17	N P	80	75	5	25	0.20	20
18	N A I	80	75	5	25	0.20	20
19	P V M	83	75	8	25	0.32	32
20	P R A	80	75	5	25	0.20	20
21	R A F W	80	60	20	40	0.50	50
22	R V S	85	76	9	24	0.375	37.5
23	R M P	90	75	15	25	0.60	60
24	S S S	80	75	5	25	0.20	20
25	S E F	80	60	20	40	0.50	50
26	S I H	76	60	16	40	0.40	40
27	S N A P P	80	75	5	25	0.20	20
28	S T W	85	70	15	30	0.50	50
29	T A M	80	75	5	25	0.20	20
30	V A Y K	85	80	5	20	0.25	25
	TOTAL	2422	2146	276	854	9.265	926.5
	MEAN	80.73	71.53	9.20	28.47	0.309	30.88

Analysis of the pre-test and post-test data for 30 students revealed a mean N-Gain score of 0.309, corresponding to an N-Gain percentage of 30.88% per student. However, overall learning effectiveness was assessed using the class achievement rate: 80.6% of students attained scores at or above the minimum mastery threshold of 75, classifying the medium's effectiveness as "high" according to the categorical framework presented in **Table 2** (Trianto, 2015). These findings align with those of Anggraeni and Istianah (2017), who reported significant improvements in science achievement following the integration of diorama media in elementary school instruction, and with Amelia (2018), who documented positive effects on thematic learning outcomes through diorama use. The categorisation criteria employed in this study are as follows:

Table 2. Effectiveness Category of Water Cycle Diorama Learning Medium

No.	Mastery Level (%)	Category
1	9-34	Very Low
2	35-54	Low
3	55-64	Moderate
4	65-84	High
5	85-100	Very High

The attainment of a class mastery rate of 80.6% demonstrates that the diorama medium successfully supported learner comprehension of the water cycle concept, surpassing the minimum mastery benchmark of 75%. These results are consistent with theoretical frameworks positing that three-dimensional, hands-on media substantially enhance conceptual retention by engaging multiple sensory modalities and providing learners with direct experiential contact with the subject matter (Dale, 1969; Bruner, 1966; Smaldino et al., 2019). Furthermore, the interactive electric pump mechanism, which simulates continuous water movement, contributed to a dynamic learning experience that sustained student attention and facilitated the internalisation of cyclical hydrological processes.

CONCLUSION

This study successfully developed, validated, and empirically evaluated a water cycle diorama learning medium for Grade V Natural Science instruction at SD Inpres 16, Sorong Regency, using the ADDIE instructional design model. Three principal conclusions are drawn from this investigation. First, the development of the water cycle diorama medium followed a systematic five-phase process, analysis, design, development, implementation, and evaluation, that ensured the medium was both pedagogically aligned and contextually appropriate for the target learner population. The medium was constructed using accessible materials including glass panels, styrofoam, miniature trees, cotton-wool clouds, and a battery-powered pump, resulting in a three-dimensional, interactive instructional tool.

Second, the medium achieved a valid status as determined by the designated expert validator, confirming that it accurately represents the water cycle concept, meets pedagogical quality standards, and is appropriate for use with Grade V elementary school students. The validity of the medium suggests that it can reliably serve as an instructional tool that bridges abstract scientific content and concrete student experience, thereby facilitating the attainment of specified learning objectives.

Third, the medium demonstrated high levels of both practicality and effectiveness. The practicality mean score of 75 indicates that the medium is user-friendly and positively received by students and teachers. The effectiveness rate of 80.6% class mastery, exceeding the 75% minimum mastery benchmark, confirms that the diorama contributed meaningfully to improved learning outcomes. It is therefore concluded that the water cycle diorama medium is valid, practical, and effective as a concrete instructional resource for elementary school science education, particularly in resource-limited educational contexts such as Sorong Regency.

Acknowledgments

The authors extend their sincere appreciation to Ibu Supriyati Fatma

Rabia, M.Pd., for her invaluable guidance and support throughout the process of developing and publishing this manuscript. Gratitude is also due to the academic community of Universitas Pendidikan Muhammadiyah Sorong for providing the institutional framework and scholarly environment in which this research was conducted. Special thanks are extended to the principal, teachers, and students of SD Inpres 16, Sorong Regency, for their cooperation and participation during the research implementation phase.

Declarations

- Author Contribution** : Beastrik Yunike Mirino: Conceptualization, Writing – Original Draft, Data Collection; Supriyati Fatma Rabia: Writing – Review & Editing, Supervision, Methodology; Ernawati Simatupang: Validation and Supervision.
- Funding Statement** : This research received no external funding and was conducted as part of the undergraduate thesis programme at Universitas Pendidikan Muhammadiyah Sorong.
- Conflict of Interest** : The authors declare no conflict of interest.
- Additional Information** : Additional information is available for this paper.

REFERENCES

- Aldoobie, N. (2015). ADDIE model. *American International Journal of Contemporary Research*, 5(6), 68–72.
- Amelia, M. D. (2018). Pengembangan media diorama pada tematik terintegrasi tema “Indahnya Negeriku” untuk meningkatkan hasil belajar siswa. *Paedagogia: Jurnal Pendidikan*, 7(1), 1–12.
- Anggraeni, R., & Istianah. (2017). Penggunaan media diorama untuk meningkatkan hasil belajar IPA tentang daur air siswa di sekolah dasar. *Jurnal Pendidikan Guru Sekolah Dasar*, 2(1), 45–56.
- Angko, N. (2013). Pengembangan bahan ajar dengan model ADDIE untuk mata pelajaran matematika kelas 5 SDS Mawar Sharon Surabaya. *Jurnal KWANGSAN*, 1(1), 1–15.
- Arsyad, A. (2017). *Media pembelajaran (edisi revisi)*. PT Raja Grafindo Persada.
- Branch, R. M. (2009). *Instructional design: The ADDIE approach*. Springer. <https://doi.org/10.1007/978-0-387-09506-6>

- Bruner, J. S. (1966). *Toward a theory of instruction*. Harvard University Press.
- Candra, K. D. (2019). Pengembangan media pembelajaran siklus air dan dampaknya pada tema peristiwa dalam kehidupan untuk siswa kelas V SDN Jetis II. *Jurnal Pendidikan Ke-SD-an*, 5(2), 112-121. <https://doi.org/10.30738/trihayu.v5i2.4219>
- Dale, E. (1969). *Audio-visual methods in teaching* (3rd ed.). Dryden Press.
- Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, 24(2), 97-140. <https://doi.org/10.1080/10888691.2018.1537791>
- Dhiku, K., & Saputro, H. (2023). Inovasi media pembelajaran berbasis teknologi di era digital. *Jurnal Pendidikan dan Kebudayaan*, 8(1), 22-35. <https://doi.org/10.24832/jpnk.v8i1.2145>
- Dick, W., Carey, L., & Carey, J. O. (2015). *The systematic design of instruction* (8th ed.). Pearson.
- Fatma Rabia, S., Zakaria, G. A. N., Muhimmah, H. A., Wibowo, A. H. (2024). Study on reading literacy in elementary schools: Bibliometric analysis 2013-2023. *EduStream: Jurnal Pendidikan Dasar*, 8(1), 58-70. <https://doi.org/10.26740/eds.v8n1.p58-70>
- Genc, N. E., & Rabia, S. F. (2024). Augmented reality book-based "Nasreddin Hoca" folklore to improve reading literacy for elementary school students. *EduStream: Jurnal Pendidikan Dasar*, 8(2), 1-15. <https://doi.org/10.26740/eds.v8n2>
- Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, 66(1), 64-74. <https://doi.org/10.1119/1.18809>
- Hamalik, O. (2011). *Kurikulum dan pembelajaran*. Bumi Aksara.
- Hakim, L. (2018). Pengembangan media pembelajaran PAI berbasis augmented reality. *Lentera Pendidikan: Jurnal Ilmu Tarbiyah dan Keguruan*, 21(1), 59-72. <https://doi.org/10.24252/lp.2018v21n1i5>
- Hernawan, A. H., Zaman, B., & Riyana, C. (2021). *Media pembelajaran sekolah dasar*. UPI Press.
- Febriola, I., Rabia, S. F., & Kusumaningrum, S. (2025). Pengembangan Diorama Tata Surya pada Pembelajaran IPAS di Kelas VI SD. *Jurnal Papeda: Jurnal Publikasi Pendidikan Dasar*, 7(2), 164-170.

- Jonassen, D. H. (2011). *Learning to solve problems: A handbook for designing problem-solving learning environments*. Routledge.
- Kusniawati, S., & Sulistyorini. (2023). Pengembangan media Diosidro (Diorama Siklus Hidrologi) pada mata pelajaran IPA kelas V SDN 272 Wadeng. *Jurnal Penelitian Pendidikan Guru Sekolah Dasar*, 11(3), 1-10.
- Mayer, R. E. (2021). *Multimedia learning* (3rd ed.). Cambridge University Press. <https://doi.org/10.1017/9781316941355>
- McKenney, S., & Reeves, T. C. (2019). *Conducting educational design research* (2nd ed.). Routledge. <https://doi.org/10.4324/9781315105642>
- Nieveen, N. (1999). Prototyping to reach product quality. In J. van den Akker, R. M. Branch, K. Gustafson, N. Nieveen, & T. Plomp (Eds.), *Design approaches and tools in education and training* (pp. 125-135). Springer. https://doi.org/10.1007/978-94-011-4255-7_10
- Piaget, J. (1964). Part I: Cognitive development in children: Piaget development and learning. *Journal of Research in Science Teaching*, 2(3), 176-186. <https://doi.org/10.1002/tea.3660020306>
- Rahmatunnisa, S., Sulistyorini, & Sintia, S. (2021). Pengembangan media diorama materi siklus air pada muatan IPA kelas V sekolah dasar. *Jurnal Ilmiah Pendidikan dan Pembelajaran*, 5(2), 289-298. <https://doi.org/10.23887/jipp.v5i2.34101>
- Sadiman, A. S., Rahardjo, R., Haryono, A., & Harjito. (2014). *Media pendidikan: Pengertian, pengembangan dan pemanfaatannya* (edisi revisi). PT Raja Grafindo Persada.
- Slavin, R. E. (2018). *Educational psychology: Theory and practice* (12th ed.). Pearson.
- Smaldino, S. E., Lowther, D. L., Mims, C., & Russell, J. D. (2019). *Instructional technology and media for learning* (12th ed.). Pearson.
- Sudjana, N., & Rivai, A. (2013). *Media pengajaran* (cetakan ke-11). Sinar Baru Algensindo.
- Sugiyono. (2019). *Metode penelitian pendidikan: Pendekatan kuantitatif, kualitatif, dan R&D* (edisi revisi). Alfabeta.
- Sulistyowati, N., Purbaningrum, E., & Handayani, S. (2020). Development of three-dimensional learning media for natural science in elementary school. *International Journal of Elementary Education*, 4(3), 348-357. <https://doi.org/10.23887/ijee.v4i3.28345>

Trianto. (2015). Mendesain model pembelajaran inovatif-progresif: Konsep, landasan, dan implementasinya pada kurikulum tingkat satuan pendidikan (KTSP) (cetakan ke-9). Prenada Media Group.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Yaumi, M. (2018). *Media dan teknologi pembelajaran*. Prenadamedia Group.

Yusuf, M., & Syam, A. R. (2022). The effect of three-dimensional learning media on science learning outcomes in elementary schools. *Jurnal Prima Edukasia*, 10(1), 82-93. <https://doi.org/10.21831/jpe.v10i1.43021>