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The Development of PBL-based Water Cycle Diorama Media to Improve Grade V Learning Outcomes

Rantika Puspita Dewi*, Dewi Nilam Tyas
Department of Primary Education, Universitas Negeri Semarang
Raya Beringin Street No.15, Wonosari, Ngaliyan, Kota Semarang, Jawa Tengah, Indonesia
*Corresponding Author. E-mail: rantikapuspita@students.unnes.ac.id

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Abstract: The lack of use of learning media at Kutowinangun 08 Salatiga Elementary School causes the learning outcomes of water cycle material in class V to be low. Based on these problems, this study aims to develop and test the feasibility and effectiveness of diorama media on water cycle material, hereinafter referred to as PBL-based SIAR in Grade V. This R&D research adapted nine of the ten steps of the Borg and Gall development model. Quantitative and qualitative data were collected using both test and non-test techniques, including questionnaire instruments, observation, interviews, and documentation. These data were then analyzed both descriptively and inferentially. The developed media was validated by media experts and material experts, who applied very valid criteria, achieving percentages of 82% and 90.67%. Based on the results of the paired sample t-test, it is evident that the significance value is 0.000 < 0.05, indicating that H0 is rejected and Ha is accepted. This means that the product developed is effective in improving student learning outcomes. The N-Gain test results obtained a gain value of 0.64 (medium). Based on the results of the response questionnaire, it was received very positively by teachers and students. From these results, it can be concluded that the diorama media SIAR (water cycle) based on PBL developed is highly feasible and effective in improving the learning outcomes of IPAS fifth-grade students at Kutowinangun 08 Salatiga State Elementary School. The contribution of this research to existing knowledge is twofold: it serves as an alternative and enriches the literature on SIAR diorama media based on PBL, which has been proven effective in improving learning outcomes for water cycle material, and provides new insights as a reference for further learning.
Keywords: media, water cycle diorama, IPAS learning outcomes, problem-based learning

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Introduction

Education is a process of shaping personality and developing the potential possessed by students (Manurung & Pappachan, 2025; Sugiyanto et al., 2023). Education can advance the quality of potential possessed by students (Hidayah & Pujiastuti, 2016). Curriculum is key in education (Sukarno et al., 2024; Wulandari & Nawangsari, 2024). Curriculum changes are an effort to improve the quality of education in Indonesia, aligning with the development of science, technology, and societal progress (Chaniago et al., 2025; Toma & Reinita, 2023; Husni et al., 2023). The curriculum is always changing. Currently, the curriculum in Indonesia is independent et al., 2024; Nursalam et al., 2023; Widiastuti et al., 2024; Rahmatulloh et al., 2023; and Widiana & Tyas, 2024). The objectives of the independent curriculum focus on developing students' creativity, independence, social intelligence, and skills (Aliyyah et al., 2023; Wuwur, 2023; and Desyandri et al., 2024). There are new policies in the independent curriculum. One of the new policies in the independent curriculum is that the subjects of science and social studies, which have been taught independently, are now combined under the name Natural and Social Sciences (IPAS). The purpose of combining science and social studies subjects is to prepare students to study more complex science and social studies at the junior high school level, which will have an impact on their learning outcomes (Wijayanti & Ekantini, 2023).

IPAS or Natural and Social Sciences is a discipline that discusses living things, inanimate objects, and how they interact (Arum et al., 2024). In addition to this, science also examines humans as both individual and social beings with a relationship to their environment. Through this understanding, students are expected to develop a greater curiosity in preserving resources with a sense of responsibility (Azzahra et al., 2023; Latifah & Maryani, 2021). The implementation of science learning must be in line with the content standards and educational process standards. According to Permendikbudristek Nomor 7 Tahun 2022, the scope of grade V science material includes interactions between living things and their environment, which includes resource conservation as an effort to maintain survival. Utilization of electricity and magnetism, changes in the earth's surface conditions caused by natural and human factors, and disaster mitigation strategies. According to Permendikbudristek No. 16 of 2022 concerning Process Standards, learning is carried out in a challenging, interactive, fun, inspiring environment. Thus, students can be actively motivated in their learning and develop creativity according to their interests.

Phase C is for students in grades V and VI of primary school. The phase invites students to recognize a system of interconnected devices that are organized to perform specific functions, particularly in the context of diversity. Students will use their understanding to act, make decisions, or solve problems in life (Anisah et al., 2023). In learning, several important components exist of which is learning media (Lestari et al., 2024; Lailiyah et al., 2023). The origin of the term media is from Latin medius, which means “middle” or “introduction”. Teachers utilize media as tools for delivering information, making it easier for students to understand the material (Wahyuningtyas & Sulasmono, 2020).

Based on the results of pre-research conducted by researchers through interviews, observations, and documentation, several problems have been identified in the IPAS class V learning at Kutowinangun 8 Elementary School. First, student learning outcomes are not yet optimal, as evidenced by the 1st Semester Midterm Summative score on IPAS subject content, which is still below the predetermined completeness of 75. This problem is due to students' lack of enthusiasm and inactivity in their learning participation. This has an impact on student learning outcomes that are still below the expected level of completeness. For the complete IPAS subject formative test results data, see Figure 1.

Based on interviews conducted by researchers with class V teachers, the questions still use C2 or are at the understanding stage. The pre-research process by documenting the learning outcomes of grade V students, the researcher obtained that the learning outcomes of grade V students in the IPAS subject content were low in the Mid-Semester Odd Summative Values of IPAS subjects for grade V students with a total of 20 students, including 13 students (65%) not complete and seven students (35%) complete.

Based on the pre-research data, it can be seen that Material 4, “Let's Get Acquainted with Our Earth,” yielded the lowest average score among the other materials. Therefore, researchers used water cycle material for this study. The following is a diagram of the learning outcomes of IPAS class V Kutowinangun 08 Elementary School in the 2023/2024 learning year:

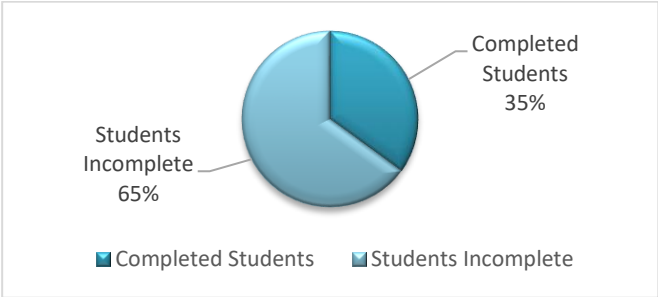

Figure 1. Diagram of Student Learning Completeness Results of IPAS Class V Kutowinangun 08 Elementary School

Second, the learning process still heavily relies on conventional models such as lectures, question-and-answer sessions, discussions, and assignments, which often lead to student boredom and drowsiness during class (Kruk & Zawodniak, 2020). Third, there is a lack of diverse learning media and resources, as teachers seldom incorporate instructional media into their teaching.

Based on these problems, several factors can be identified to improve student learning outcomes, one of which is the use of effective learning media. To achieve learning objectives, the right media is needed during the learning process (Nengsih et al., 2024; Adawiyah et al., 2022; and Febriani, 2017). Media selection must be tailored to child development (Sulthon et al., 2021). The development phase of children aged 7 to 11 years old is known as the concrete operational stage. At that stage, the child is able to think logically but with the help of concrete objects (Aji & Pujiastuti, 2022; Bujuri, 2018). The researcher discussed with the teacher and analyzed the existing problems, so that a solution was found that the development of concrete media in the form of water cycle diorama media abbreviated as SIAR with an innovative learning model is a solution to improve student learning outcomes in the learning content of natural and social sciences in class V Kutowinangun 08 Elementary School.

A diorama is a miniature that depicts historical events or scenes on a small scale. Diorama media is a mock object that describes the original scene (Seftriana et al., 2020). This aligns with Piaget's developmental theory, which posits that children aged 7-11 years are in the elementary school stage of development, characterised by the concrete operational stage. At this stage, children are able to use operational thinking concretely, meaning that they still need the support of concrete objects (Cerovac & Keane, 2024; Sanjaya, 2024; and Nelwati & Rahman, 2022). SIAR diorama media is expected to support teachers in explaining the water cycle process to students.

Learning with diorama media is more effective if the learning model used supports active learning. One model that emphasizes student activity and problem-solving is the PBL model (Zhao et al., 2020; Nurtanto et al., 2020; Haikal et al., 2025; and Selirowangi et al., 2024). In this learning model, students are required to work together to find solutions to real-life problems (Susanti et al., 2023; Ndiung & Menggo, 2024; Darmawati & Mustadi, 2023; Pratiwi & Setyaningtyas, 2020; Sari, 2018; and Harokah et al., 2024). Learning that utilizes PBL enables students to discover independently and continuously (Walck-Shannon et al., 2025; Seibert et al., 2021; Trullàs et al., 2022; Triwahyuningtyas et al., 2020; and Fadilah et al., 2025). Relevant research shows that diorama media gets a feasibility score of 94.44 from media experts and 95.33 from individual tests. The results of the analysis concluded that this media is feasible to use in learning science grade V, supporting the learning process for both teachers and students (Putra & Suniasih, 2021). This research contributes to education in Indonesia by presenting PBL-based SIAR diorama media that is innovative and different from previous research. The difference between this research and previous research lies in the use of technology and process skills. The technology used is a smartphone to scan barcodes containing manuals, student worksheets, and PowerPoint presentations. In addition, students not only observe the media but also practice process skills, such as spraying water with a spray bottle to simulate rain.

Methods

The type of research used in this study was Research and Development (R&D), which involved developing a product in the form of a PBL-based SIAR diorama for fifth-grade students at Kutowinangun 08 Salatiga State Elementary School. The research and development method was a scientific approach used by the researchers to investigate, design, produce, and test the validity of the developed product (Sugiyono, 2019; Yulianti & Herpratiwi, 2024). Due to time and funding limitations, the researchers implemented 9 out of the 10 steps of the Borg and Gall development model. The steps of the development process were illustrated in Figure 2 of Sugiyono (2019).

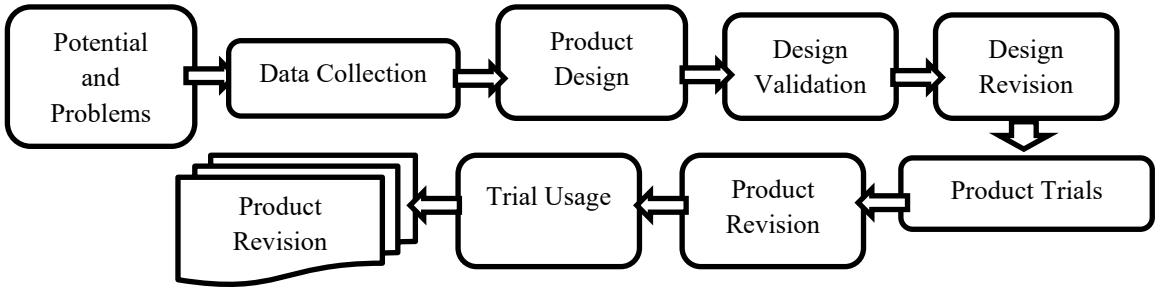

Figure 2. Research and Development (R&D) Model

The beginning of the research is to identify potential problems. Potential refers to something that if utilized will add value, while problems arise when expectations and reality do not match. In research, we must examine potential problems in empirical data. To overcome existing problems, effective solutions are necessary (Sugiyono, 2019). Researchers have conducted preliminary research through interviews, observations, and documentation, showing that the learning outcomes of IPAS are still low and have not yet reached the desired level of completeness (75). The lack of media use is a primary factor that motivates researchers to develop new products to address this issue.

After identifying the potential and problems, the next step is to gather data and information as the basis for designing a product that can address the issues (Sugiyono, 2019). A needs questionnaire was distributed to teachers and students as a reference for developing the diorama media. This research produced a diorama media design for teaching the water cycle in natural and social sciences. The product design was then validated by experts who assessed each component (Sugiyono, 2019). Based on their input, the product was revised to improve its quality. The revised design was not immediately used by students but was further developed and tested in small-scale trials. These trials aimed to evaluate the effectiveness of the PBL-based SIAR diorama media. If the results are satisfactory and no further revisions are needed, the product will proceed to larger-scale testing.

The types of data used in this study are quantitative and qualitative. The subjects of this research include fifth-grade students and teachers from Kutowinangun 08 Elementary School, as well as experts and researchers. The research time starts from pre-research in March 2024 to data analysis in January 2025. The researchers in this study employed data collection techniques that included both tests and non-tests. Test techniques were obtained through pretests and posttests done by students, while non-test techniques were collected through interviews, observations, questionnaires, and documentation.

In the research on PBL-based SIAR diorama media development, questionnaires are used to analyze needs, test feasibility with validators, and assess students' experiences as users of PBL-based SIAR diorama media. The data collection instrument used is a questionnaire containing items for a feasibility test of the SIAR diorama media. The lattice of questionnaire instruments used in the study is presented in Tables 1, 2, 3, 4, and 5.

Table 1. Media Expert Feasibility Assessment Instrument Grid

No.	Aspects	Question Number
1	Media	1,2,3,4,5,6,7
2	Media display	8,9,10,11,12,13,14,15,16
3	Usage	17,18,19,20

Table 2. Grids of Feasibility Assessment Instruments by Material Experts

No.	Aspects	Question Number
1	Material suitability	1, 2, 3, 4, 5
2	Linguistics	6, 7, 8, 9
3	Presentation	10, 11
4	The usefulness of the material in the manual	12, 13
5	The usefulness of the material in the guidebook	14, 15

Table 3. Teacher Response Instrument Grid

No.	Aspects	Question Number
1	Appropriateness of media and material	1, 2, 3
2	Media	4, 5
3	Technical quality	6, 7
4	Linguistics	8
5	Presentation	9, 10, 11
6	Media display	12, 13, 14, 15
7	Usage	16, 17, 18
8	The usefulness of the material in the guidebook	19, 20

The subjects of the small-scale trial consisted of nine students from class VB, while the large-scale trial involved 20 students from class VA of Kutowinangun 08 Salatiga Elementary School. The feasibility analysis of the product validation results, conducted in collaboration with media experts and

material experts, involved calculating the average score of the assessment from the validator using a Likert scale.

$$NP = \frac{R}{SM} \times 100$$

The percentage results of the data will be converted based on the following criteria:

Table 4. Expert Assessment Criteria

Percentage	Feasibility
81% - 100%	Very Feasible
61% - 80%	Eligible
41% - 60%	Decent enough
21% - 40%	less feasible
1% - 20%	Not Feasible

A media can be declared valid for use in learning if it has "feasible" criteria. The results of the questionnaire responses to the PBL-based SIAR diorama media in this study involved teachers and fifth-grade students of Kutowinangun 08 Salatiga Elementary School. The data analysis employed included a normality test for the pretest and posttest, a T-test comparing the pretest and posttest, and an N-Gain test. The normality test was conducted to determine whether the pretest and posttest results were normally distributed. If the data showed a normal distribution, then the analysis was carried out using parametric statistical techniques. The t-test was used to determine the average difference between pretest and posttest on the use of SIAR diorama media. The N-gain test was conducted to determine the average increase in pretest and posttest results of fifth-grade students of Kutowinangun 08 Salatiga Elementary School. To calculate N-Gain, the following formula can be used:

$$\text{N - Gain} = \frac{posttest\ score - pretest\ score}{ideal\ maximum\ score - pretest\ score}$$

The N-Gain results obtained will be classified into the following criteria:

Table 5. N-Gain Value Criteria

Gain Index	Criteria
N-gain ≥ 0.70	high
0.30 < N-gain < 0.70	medium
N-gain ≤ 0.30	low

Results and Discussion

Results

This research is a development project, or R&D, that aims to produce new products. The result of this research is a SIAR diorama media-based on PBL to improve the learning outcomes of natural and social sciences for class V at Kutowinangun 08 Salatiga Elementary School. SIAR diorama media will support the learning process and make it easier for students to understand the material related to the water cycle. This media displays a scene that looks like the original. The advantage of diorama media is that it can be applied to various subjects, including history, physics, biology, and others. In addition, the diorama presents a picture of conditions resembling the original, making students' understanding of the water cycle concept easier (Ariani & Sukmawarti, 2023).

The Research and Development (R&D) approach used in this study follows a model adapted from Borg and Gall. In this study, the researchers carry out only up to step 9 of the model, which includes: (1) identifying potentials and problems; (2) data collection; (3) product design; (4) design validation; (5) design revision; (6) small-scale product trials; (7) product revision; (8) large-scale or usage trials; and (9) final product revision.

Based on a preliminary study conducted in Grade V at Kutowinangun 08 Salatiga State Elementary School and interviews with homeroom teachers, several issues have been identified. These include the use of conventional, teacher-centered learning methods that make students feel bored and sleepy; suboptimal learning media limited to textbook images, and the fact that 65% of students do not achieve mastery in the IPAS subject. Among the topics, "Let's Get Acquainted with Our Earth" records the lowest average score of 67.3. To address these problems, the researchers developed a PBL-based SIAR diorama aimed at helping students better understand the water cycle.

Questionnaire results indicate that teachers perceive existing media as inadequate for motivating students and express a need for more engaging, three-dimensional tools (Handayani & Hayati, 2020). Students also express interest in media that realistically depict natural landscapes and support interactive, simulation-based learning. In response, the SIAR diorama is designed with attractive visuals, clear language, durable materials, and a guidebook containing structured and easy-to-understand content. It also includes a barcode that links additional resources such as student worksheets and PowerPoint presentations, making it a comprehensive learning package. The innovation of this media lies in its ability to develop students' process skills by enabling them to simulate the rain process using spray bottles, thus enhancing engagement and improving IPAS learning outcomes tailored to the needs of fifth-grade students.

Figure 3. PBL-based SIAR (Water Cycle) Diorama Media Design

PBL-based SIAR diorama media is made using the following tools and materials: (1) plywood 35cm x 23 cm for the background of the media, 35cm x 20cm for the base of the media, 20cm x 5cm for the left and right sides of the media, 35cm x 5cm for the front of the media; (2) cork to make mountains, sun, and sea then painted as needed; (3) magnets for clouds; (4) filter cotton to make clouds; (5) plastic ornamental plants for coconut trees and other plants; and (6) dishwashing sponge for soil visualization. The procedure for creating PBL-based SIAR diorama media is illustrated in Figure 4 and 5.

Figure 4. Making the SIAR Diorama Media Framework

Figure 5. Making the components of the SIAR diorama media mountain

Figure 6. Attach other components to the SIAR Diorama Media

In addition to developing products, researchers also made test questions. The test questions were used to obtain pretest and posttest questions. To determine whether the test questions are suitable for pretest and posttest purposes, researchers analyzed the validity, reliability, difficulty level, and differentiating power of the questions presented in Tables 7, 8, 9, and 10.

Table 6. Test Question Analysis Results

Criteria	Question Number	Number of questions	Description
Valid question	3, 4, 5, 6, 10, 11, 12, 14, 15, 16, 23, 24, 26, 28, 29, 30, 32, 35, 36, 37, 38, 39	22	Used
Invalid question	1, 2, 7, 8, 9, 13, 17, 18, 19, 20, 21, 22, 25, 27, 31, 33, 34, 40	18	Not Used
Total		**40 questions**	

Based on Table 6, it can be seen that 22 questions are declared valid. Furthermore, researchers will analyze the reliability of the questions using Microsoft Excel.

Table 7. Results of Reliability Analysis of Test Questions

Question Number	Reliability Coefficient	Criteria
4, 5, 6, 10, 11, 12, 14, 15, 16, 23, 24, 25, 26, 28, 29, 30, 32, 35, 37, 38, 39	0.91231	Very reliable

Based on Table 7, the results indicate that the reliability of the question is very high, with a reliability coefficient of 0.91231. Furthermore, researchers analyzed the level of difficulty associated with the question.

Table 8. Result of Analysis of Level of Difficulty

Question Number	Criteria
1, 2, 3, 4, 5, 6, 7, 9, 10, 17, 23, 27, 34, 37, 40	Easy
8, 11, 12, 13, 14, 15, 16, 18, 19, 20, 24, 25, 26, 28, 29, 30, 31, 32, 33, 35, 36, 38, 39	Medium
21, 22	Difficult
Total	**21**

Based on Table 8, out of the 40 test questions, 15 were categorized as easy, 23 as moderate, and two as difficult. Furthermore, the researcher analyzed the items' discrimination power.

Table 9. Differentiability Analysis Results

Nomor Soal	Criteria
4, 11, 12, 14, 15, 16, 23,2 8, 29, 30	Good
5, 6, 10, 24, 25, 26, 32, 35, 37, 38, 39	Fair
1, 2, 3, 7, 8, 9, 13, 17, 18, 19, 20, 21, 22, 27, 31, 33, 34, 36, 40	Poor
Total	**21**

Based on Table 9, of the 40 test questions, 10 questions met good criteria, 11 questions met sufficient criteria, and 19 questions met poor criteria. To be used in pretests and posttests, questions must meet the criteria of validity, difficulty level, and good differentiation.

At this stage, the researchers conducted the product validation process with two PGSD lecturers from Semarang State University. The media expert validator is a lecturer in the Elementary School Learning Media and Teaching Materials course, evaluated the feasibility of the media. The material expert validator is a lecturer in the Elementary Science Learning Development course, assessed the material's feasibility. After both validators provided their evaluations, feedback, and suggestions on the developed product, the researchers made revisions based on their input to improve the quality and suitability of the media.

Table 10. Media Expert Validation Tabulation

Assessment Aspect	Percentage	Criteria
Media Media display Material Suitability	82%	Very Feasible

Table 11. Material Expert Validation Tabulation

Assessment Aspect	Percentage	Criteria
Appropriateness of Material Language Presentation The usefulness of the Material in the Guidebook Technical Quality	90.67%	Very Feasible

It can be seen from Table 10 and Table 11 that the validation results, as classified by media expert validators and material experts, are deemed very feasible, with acquisition values exceeding 80% in accordance with the criteria for very feasible. Based on the validation results, the SIAR diorama media based on PBL is declared feasible overall, in terms of both media, materials, appearance, and language. However, there are some areas for improvement, as suggested by media experts and material experts. Suggestions from both experts on PBL-based SIAR diorama media are: 1) improve the guidelines (logo, author's name, table of contents, bibliography, profile); 2) the diorama is improved according to the suggestions; 3) complete the finalization with clear spray paint; 4) tidy up the diorama; 5) LKPD is placed in the guidebook, not in the appendix; 6) adjust to the syntax of PBL; 7) TP adjust to CP, the evaluation is also adjusted; 8) the material is adjusted to TP; and 9) the guidebook adjusts to the media and vice versa.

Design Revision

Researchers made improvements to the PBL-based SIAR diorama media in line with suggestions from media experts and material experts. Researchers have made revisions, including adding a logo and the name of the second maker, a table of contents, a bibliography, an author's bio, and student worksheets to the manual, as well as incorporating material on human activities that affect the water cycle. Other media improvements are listed in Table 12.

Table 12. Media and Guidebook Revision

Media		**Description**
Before Revision	After Revision	1. Before the researchers made revisions, the media did not have pictures of soil layers, had not been sprayed with clear paint and had not been tidied up. 2. Based on input from media experts, it needs to be given a layer of soil, painted clear and tidied up. Researchers made revisions according to this input.
		
After Revision		1. Before the researchers made revisions, there were shortcomings in the PBL syntax. 2. Based on input from material experts, it is necessary to add problems to stimulate students

in learning. Researchers made revisions according to this input.

Researchers have made revisions to the evaluation, specifically to the trial questions. Before the revision of the trial questions, there were 40 questions with four learning objectives, but the distribution of questions was uneven. According to the advice of the material expert lecturer, the researchers revised the questions so that each learning objective had 10 questions.

Small-Scale Product Trial

After being validated and revised, the SIAR diorama media based on PBL proceed to the next stage, which is small-scale product testing. This small-scale research was conducted in class VB of Kutowinangun 08 Salatiga Elementary School, involving nine students, using purposeful sampling to select a sample with specific considerations, namely three top-ranked students, three middle-ranked students, and three lower-ranked students. The purpose of small-scale product testing was to determine the effectiveness of PBL-based SIAR diorama media in improving IPAS learning outcomes before being used in large-scale tests. The knowledge value was obtained from the pretest and posttest results using PBL-based SIAR diorama media. In the small-scale product trial, students obtained an average pretest score of 47.7. Students obtained an average posttest score of 87.2. The learning completeness of the pretest and posttest has increased. After students finished learning, teachers and students were given a response questionnaire with eight aspects: suitability of media and materials, media, technical quality, language, presentation, appearance, use, and usefulness of the material in the guidebook for PBL-based SIAR diorama media. Researchers utilized responses from teachers and students as a basis for improving the media that researchers developed. The following is a recapitulation of teacher and student responses to the small-scale product trial.

Table 13. Results of Teacher and Student Responses to PBL-based SIAR Diorama Media in Small-Scale Product Trial

Respondent	Percentage	Information
Teacher	100%	Very Positive
Students	99.4%	Very Positive

As shown in Table 13, the results of the questionnaire responses from teachers and students regarding the diorama media SIAR based on PBL yield positive outcomes.

Product Revision

Researchers get a positive assessment of the results of the questionnaire that has been distributed. Therefore, researchers did not make product revisions.

Large Scale or Usage Trial

A large-scale product trial was conducted on VA class students from Kutowinangun 08 Salatiga State Elementary School, comprising a total of 20 students. Before getting the material, students were given a pretest to determine their initial ability. At the end of the learning process, students were given a posttest to determine the improvement they had made after receiving the water cycle material. The results of the pretest and posttest scores can be seen in the following table.

Table 14. Pretest and Posttest Results of the Usage Trial

Test Type	Average	Average Difference
Pretest	58	25.5
Posttest	83.5	

In Table 14, it is known that the average student learning outcomes in the usage trial showed an increase of 25.5. The data shows a change between before and after the use of PBL-based SIAR diorama media. Furthermore, to determine whether the pretest and posttest results were normally distributed or not, a normality test was conducted using SPSS version 25 with the Shapiro-Wilk formula. Data is declared normal if the sig value> 0.05. The following are the results of the normality test conducted with SPSS version 25.

Table 15. Pretest and Posttest Normality Test

	Statistic	df	Sig.
Pretest	.941	20	.249
Posttest	.944	20	.283

Based on Table 15, the sig value is 0.283. Because the p-value of the posttest in the large-scale trial is greater than 0.05, it is concluded that the posttest data are normally distributed. Furthermore, the researcher conducted a t-test. A t-test was conducted to determine the average difference between the pretest and posttest scores on the use of SIAR diorama media. The pretest and posttest results were analyzed using a two-tailed t-test with a significance level of 5%. The following are the results of the t-test conducted with Microsoft Excel.

Table 16. Pretest and Posttest t-Tests

	t	df	Sig. (2-tailed)
Pretest Posttest	8.469	19	0.000

As can be seen from the test results in Table 16, the t count obtained is 8.469. T-table with df-19 is 2.093. T count> t table, then there is a difference in the average value of students before using PBL-based SIAR diorama media. Based on these data, the sig value. (2-tailed) is smaller than 0.05, which is 0.000. So it can be concluded that H0 is rejected and Ha is accepted. The formulation of the hypothesis indicates that there are differences in the learning outcomes of class V when using PBL-based SIAR diorama media. After understanding the difference between the before and after using PBL-based SIAR diorama media, the N-Gain test was then conducted.

The N-gain test was conducted to determine the average increase in pretest and posttest results of fifth-grade students of Kutowinangun 08 Salatiga Elementary School. The calculation of the N-gain value was done using Microsoft Excel. The following are the results of the N-Gain test calculation.

Table 17. N-Gain Test on the Usage Trial

N-Gain Test Results on the Usage Trial	
Average pretest score	58
Average posttest score	83.5
Mean difference	25.5
N-Gain Score	0.64
Criteria	Medium

As shown in Table 17, the results of the large-scale trial involving 20 students demonstrated an increase of 0.64 in the moderate category. The average difference between pretest and posttest is 25.5. Based on these data, it can be seen that the PBL-based SIAR diorama media has a more significant influence on improving student learning outcomes, categorized as moderate or feasible.

Discussion

Development of PBL-Based SIAR (Water Cycle) Diorama Media

The development of PBL-based SIAR diorama media was informed by considering problem identification, a teacher's needs questionnaire, and a student's needs questionnaire. The Borg and Gall model is the model used in this study. However, because researchers are limited in time and money, they typically limit their scope to the ninth step, namely product revision after large-scale trials. The initial stage involves identifying potential problems through pre-research activities. Based on the results of the pre-research, several problems were identified, including the teacher's continued use of conventional models and teacher-centred learning, which made students bored and sleepy. Additionally, the learning media were not optimal and lacked simplicity, with only pictures used in student books. This has not been able to increase student learning motivation. These problems make researchers want to develop new products to overcome them. Diorama media offer important benefits that enable students to explore their knowledge directly and provide opportunities for independent learning experiences (Aprilia & Putri, 2020). Learning media provides concrete experiences for students, making learning less monotonous and boring (Widiana & Tyas, 2024).

Based on the results of the analysis of the teacher and student needs questionnaire that has been filled in, teachers and students need media for learning the IPAS water cycle material. To motivate students in learning, students need media with an attractive appearance that can be used for simulation and practice (Hoppe et al., 2024). Then the researchers designed the media, starting with making the product design into a prototype, preparing a guidebook for using the media from several references, and making the media with the tools and materials that had been prepared. Furthermore, researchers validated the feasibility of the product to media experts and material experts. The results of validation in the form of input and suggestions from experts were used as a reference in improving the PBL-based SIAR diorama.

After conducting validation, the researchers conducted a small-scale trial on nine fifth-grade students of Kutowinangun 08 Salatiga Elementary School. In the small-scale test, the responses of teachers and students to the PBL-based SIAR diorama media were overwhelmingly positive, so the researchers did not make any product revisions. In the final stage, the researchers conducted a large-scale trial involving 20 fifth-grade students from Kutowinangun 08 Salatiga Elementary School. In use trials or large-scale studies, student learning outcomes can be measured by researchers through the comparison of pretests and posttests.

Feasibility of PBL-based SIAR (Water Cycle) Diorama Media

The SIAR diorama media, based on PBL, has been validated by media experts and material experts. Validation from both experts aims to obtain an assessment until the SIAR diorama media is declared a valid medium for learning. Media experts and material experts also provide input and suggestions to maximize the utilization of media in learning.

The assessment conducted by media experts comprises three aspects with 20 descriptors: media, display, and usage aspects. The total assessment of media experts on three aspects is 82. When used as a percentage, 82% has very feasible criteria to be tested with revisions. The assessment from material experts encompasses five aspects, each with 15 descriptors, including material suitability, language, presentation, the usefulness of the material in the guidebook, and technical quality. The total assessment from material experts on five aspects is 68, corresponding to a percentage of 90.67%, with criteria that are very feasible to be tested with revision. Other supporting research indicates that the validation results from media experts on the water cycle diorama in science lessons are highly feasible, with a response category of "very feasible" obtained from 32 students(Humaira & Ninawati, 2023).

After experts validated the diorama media, researchers made improvements based on the suggestions provided. The next stage is a small-scale trial. Small-scale trials were conducted to determine the feasibility and readiness of teachers for the PBL-based SIAR diorama media by administering a response questionnaire to both teachers and students. Based on the results of the student response questionnaire, it is evident that the feasibility of the PBL-based SIAR diorama media is 99.4% with the criterion “very feasible”. Based on the results of the teacher response questionnaire, it is evident that the feasibility of the PBL-based SIAR diorama media is 100% with the criterion of “very feasible”.

Effectiveness of SIAR (Water Cycle) Diorama Media

The effectiveness of SIAR diorama media can be observed in the results of the pretest and posttest conducted with class V Kutowinangun 08 students at Salatiga Elementary School, involving 20 children. The average pretest score was 58, and the average posttest score was 83.5. There were six students who completed the pretest. In the post-test, 18 students were complete.

The learning outcomes obtained are then tested for normality using the Shapiro-Wilk test. The results of the pretest value normality test have a significance of 0.249, greater than the table value of 0.050, so the pretest value is normally distributed. Furthermore, the posttest normality test has a p-value of 0.283, which is greater than the table value of 0.050. Therefore, the posttest value is normally distributed. Because the data is normally distributed, the next t-test is carried out using parametric statistical techniques.

Calculations with parametric statistical techniques are carried out by testing the difference in average pretest and posttest scores using a two-sample t-test, also known as a paired sample t-test, in Microsoft Excel. The results obtained by researchers using Microsoft Excel are a significance value (2-tailed) of 0.000. If t count < t table, then there is a difference in the average value of students before using PBL-based SIAR diorama media. Based on the data, the significance value (sig. 2-tailed) from the large-scale trial was 0.000, which is less than 0.05. Therefore, it can be concluded that H_0 is rejected and H_a is accepted. Based on the formulation of the hypothesis, it can be concluded that there are differences in the learning outcomes of class V when using PBL-based SIAR diorama media. Furthermore, researchers conducted the N-Gain test.

In the usage trial or large-scale study, involving 20 fifth-grade students from Kutowinangun 08 Salatiga Elementary School, there was an increase in learning outcomes, with an N-gain of 0.64 in the medium category. From the calculation results, the researcher obtained an average difference of 25.5 between the pretest and posttest. Based on the N-gain calculation, the PBL-based SIAR diorama media is effectively used in the IPAS learning process.

The advantages of diorama media are: (1) materials are affordable and easy to obtain; (2) can be used more than once or many times; (3) able to present real conditions; (4) able to display situations that are difficult to observe directly (Aris & Afina, 2022). Supporting research indicates that the implementation of learning using diorama media meets very good criteria, with an average percentage of 88.1% among teachers and 90.6% among students. The results of the independent sample t-test show that the t-count of 3.218 is greater than the t-table value of 1.991. The significance value (2-tailed) of 0.002 is smaller than 0.05, so that H0 is rejected and Ha is accepted. The average N-gain value of the experimental class of 0.70 is categorized as high, and the control class of 0.47 is categorized as medium. In conclusion, the PBL model, combined with diorama media, has a positive effect on the science learning outcomes of animal life cycle material for fourth-grade students (Fitria & Suryanti, 2023).

Conclusion

Researchers have developed PBL-based SIAR diorama media that is very feasible to be applied in learning. The assessment of media expert validators and material expert validators proves the validity. Media experts assessed 82% which has very feasible criteria. Material experts provided an assessment of 90.67%, which meets very feasible criteria. Learning IPAS water cycle material using PBL-based SIAR diorama media proved to be effective. Based on the results of the paired sample t-test obtained, the significance value (2-tailed) of 0.000 <0.05, it can be concluded that H0 is rejected and Ha is accepted, so that the results are effective and supported by the results of the N-Gain calculation, which is 0.64 (medium). It is expected that PBL-based SIAR diorama media can serve as an alternative learning medium. In addition to facilitating teachers in enhancing the motivation and learning outcomes of IPAS water cycle material, introducing new insights and experiences to students, and serving as a reference source for further learning.

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