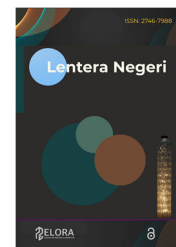




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Development of interactive solar system diorama media to improve fifth-grade students' critical thinking skills in elementary islamic school

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ABSTRACT

This study focuses on the lack of critical thinking skills and the low interest of students in class VA at Elementary Islamic School Darun Najah Srobyong, where the learning methods used still rely on static images. The purpose of this study is to design solar system diorama learning media that meet the standards of validity, practicality, and effectiveness in improving students' critical thinking abilities in Elementary Islamic School. The methodology applied in this study is Research and Development (R&D), which follows the ADDIE model, namely Analysis, Design, Development, Implementation, and Evaluation. Data were collected through interviews, observations, and pretest and posttest measurement instruments. The results show that this medium has a high level of validity, with scores reaching 87% from media experts and 90% from material experts. Statistical analysis conducted using a paired-sample T-test showed a significance value of 0,000, indicating a significant difference in students' critical thinking abilities before and after using the media. In addition, The N-Gain score analysis shows an average value of 0.3326 (33.26%), which categorizes the effectiveness of the media in the "moderate" group approaching low but relevant for use in learning. Therefore, it is concluded that the interactive solar system diorama is an appropriate and efficient tool for improving critical thinking abilities in Natural and Social Sciences (IPAS) learning at the elementary school level.



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Introduction

Learning in Elementary Islamic School requires teachers to be able to provide and create a learning atmosphere that is active, enjoyable, and in accordance with the needs of students in the classroom. The current curriculum emphasizes the importance of mastering 21st-century skills that must be instilled from an early age, as changes in the education system aim to produce graduates who not only master knowledge, but are also required to master the essential skills known as the 4Cs: critical thinking, creativity, communication, and collaboration (Zain & Muhammad Sonhaji Akbar, 2025). Piaget emphasized that the learning process is an active activity in which individuals interact with the surrounding environment to build knowledge through schemas, accommodation, assimilation, and equilibrium (Abdillah et al., 2025). The selection of appropriate learning media is one of the determining factors for the success of the teaching and learning process. Attractive and interactive media are believed to increase motivation while also developing students' critical thinking skills. This background became the basis for conducting observations and interviews in class VA of Elementary Islamic School Darun Najah Srobyong. These observations were carried out to determine the actual learning conditions in the classroom and the obstacles faced by both teachers and students.

Interviews with the homeroom teacher also provided an overview of the need for more innovative learning media. Thus, this study is expected to provide a solution for improving the quality of learning in accordance with curriculum demands. The results of observations and interviews with the class VA homeroom teacher, Mrs. Lailah Faiqoh, S.Pd., showed that the actual conditions in class VA of Elementary Islamic School Darun Najah Srobyong indicated that students tended to be passive, less enthusiastic, and were not yet accustomed to developing critical thinking skills.

The problem in education is a weak learning process. Because classroom learning focuses solely on memorization, children are less motivated to develop their thinking skills. As a result, they tend to be forced to memorize and retain various information without requiring a deep understanding of it. (Barokah et al., 2024). The learning media used are still limited to static images and verbal explanations, causing students to become bored quickly and not actively involved in the learning process. In the topic of the Solar System, this is reflected in the large number of students who are unable to explain planetary motion, interactions among celestial bodies, and their impact on life on Earth. This problem is important to address immediately because the low quality of students' competency mastery can directly affect the critical thinking skills that should be developed from an early age (Annisyah Arifah & Rahmaini, 2025). If this condition is allowed to continue, students' learning motivation will decline further, the learning process will become ineffective, and curriculum achievements will not be met. Thus, the use of appropriate media plays an important role in making the classroom more active, encouraging enthusiasm for learning, and developing students' knowledge and critical thinking skills (Lail & Julianto, 2025).

Critical thinking skills are a process of reasoning and reflection focused on what is believed and done, in which, according to Ennis, there are five indicators of critical thinking ability, namely building basic skills, providing simple explanations, making determinations, providing further explanations, and organizing schemes and tactics (Chotimah, 2025). In addition, the use of HOTS (Higher Order Thinking Skills) questions in evaluation has also been proven to encourage students not only to memorize, but to think more deeply, compare, and provide logical reasons for their answers (Insani et al., 2025). Therefore, critical thinking in elementary school students is an important ability that must be developed from an early age because it becomes the foundation for higher-order thinking skills.

Diorama media is one form of learning media that presents three-dimensional objects realistically and contextually. The presence of a diorama in the classroom can bridge the gap between abstract concepts and concrete experiences that students can observe directly (Jannah et al., 2023). In science learning, especially in the topic of the solar system, a diorama helps students understand the positions, sizes, and movements of planets. The use of such concrete learning media will become more optimal when integrated with student-centered learning (Febriant et al., 2026). In addition, a diorama also provides a more interesting learning experience because it combines visual and kinesthetic aspects. Thus, this medium becomes an effective alternative for improving the quality of learning in elementary schools. It can be stated that interactive diorama teaching materials are highly suitable for use as learning media that attract students (Farhanto & Setiani, 2025). This shows that dioramas play an important role in creating a more lively and meaningful learning atmosphere.

The use of solar system diorama media has strong relevance in improving the critical thinking abilities of elementary Islamic school students. Through observing the diorama, students can examine relationships among planets, understand the concepts of rotation and revolution, and relate astronomical phenomena to everyday life. Diorama media is effective in delivering solar system material and is considered attractive because it can foster students' curiosity (Nurhaswinda. & Parisu, 2025). This activity encourages students to ask questions, conduct simple analyses, and draw conclusions based on observations. This process is in line with the goals of basic education, which emphasize the development of critical and analytical thinking skills. Thus, a solar system diorama is not merely a visual medium, but also a learning tool that fosters curiosity and higher-order thinking skills. One effort is to apply interactive learning media that can develop students' critical thinking, in which students construct their own understanding by using diorama learning media (Fatimah et al., 2025). Furthermore, this diorama can strengthen problem-solving skills that are an important foundation for students at the next level.

Interactive dioramas incorporate elements of manipulation, participation, or digital augmentation. They allow learners to explore content actively, which can foster engagement and collaboration. Studies suggest that interactive dioramas enhance motivation and may contribute to the development of critical thinking skills (Sefhira, Setiawati, & Dewi, 2025). Nevertheless, evidence of their superiority over static dioramas in cultivating critical thinking remains inconclusive. Sintarani et al. (2024) emphasize that while interactive media can support collaboration and problem-solving, comparative studies are still limited. Although solar

system dioramas have been used previously, there are significant differences between conventional media and the innovation developed in this study. Previous dioramas tended to be static, displaying only the shapes of planets without interaction or movement dynamics, and focused only on improving cognitive learning outcomes. In contrast, the diorama created in this study is more interactive because it can rotate, move, and is equipped with lights, thereby presenting a more vivid learning experience. This innovation is a solution to the real conditions at Elementary Islamic School Darun Najah, where fifth-grade students are less interested when learning uses only textbooks. With the interactive diorama, students become more actively involved, learning feels enjoyable, and learning motivation increases significantly. Diorama media is not only a visual aid, but also a tool for developing critical and creative thinking skills through project-based learning (A. Khanafi et al., 2025). The practical benefits of this research are expected to serve as a reference for teachers in using more innovative learning media, improving the quality of the learning process, and encouraging the strengthening of students' critical thinking competencies from the lower grades (Sari & Widiyono, 2026). In addition, this interactive diorama can foster students' curiosity while strengthening conceptual understanding through deeper learning experiences in improving critical thinking.

Method

This study uses Research and Development, which aims to produce solar system diorama-based learning media that are valid, practical, and effective in improving the critical thinking abilities of class VA students at Elementary Islamic School Darun Najah Srobyong, Mlonggo District, Jepara Regency. In the context of education and the social sciences, the Research and Development method is an important foundation for developing learning tools, media, and educational technologies that are relevant to the needs of learners and the wider community (Ade Rahayu, 2025). This study refers to the systematic ADDIE approach, which consists of five main stages, namely: Analysis (analysis of needs and learning conditions), Design (design of media and evaluation instruments), Development (product development and validation), Implementation (application of media in learning), and Evaluation (assessment of media effectiveness in improving students' critical thinking abilities). Each stage is carried out sequentially and continuously to ensure that the media developed are suitable for the characteristics of madrasah ibtidaiyah students, support IPAS learning outcomes, and can be implemented realistically in classroom contexts with limited resources. This approach was chosen because it can accommodate the media development process comprehensively, from problem identification to product effectiveness testing.

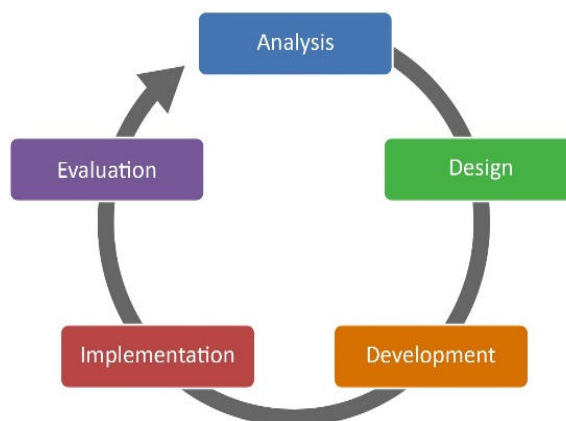


Figure 1 <ADDIE Research Model>

The population in this study consisted of all fifth-grade students of Darun Najah Srobyong State Elementary School, Mlonggo District, who participated in Natural and Social Sciences (IPAS) learning with the topic of the Solar System during the research semester. The population includes all fifth-grade students from all existing study groups. The main characteristics of the population are students whose average age corresponds to the Madrasah Ibtidaiyah level, following the IPAS curriculum, and have received initial learning about the Solar System. The sample used was class VA, because class V has two study groups, so one was used as an experimental class and one as a control class, namely class VB.

Meanwhile, to determine media feasibility, the percentage formula that can be used is as follows (Fitri, 2025). The validity test data results can be calculated using the formula described above to obtain quantitative data, which can then be summarized as a percentage (%). To determine the validity of the developed product,

refer to The validity assessment criteria in this study were classified into five categories based on percentage scores. A score ranging Very Valid, Valid, Fairly Valid, Less Valid, and Not Valid. These classifications were adapted from (Hutabri, 2022). To determine the feasibility of the developed product, the achievement levels were classified into four categories based on percentage scores. A percentage ranging from Highly Feasible, Feasible, Fairly Feasible, and Less Feasible. These criteria were adapted from Himmah & Sulaikho (2022).

The data analysis technique used to test the effectiveness of the development of solar system diorama media employed a quantitative descriptive method in the form of a paired sample T-test and an N-Gain test. The categories for interpreting values in the N-Gain test (Muna et al., 2025).

Results and Discussions

Analysis of Solar System Diorama Media Development

The result of this study is an interactive solar system diorama medium that can be used as a teaching aid for IPAS material in elementary schools or madrasah ibtidaiyah. The use of interactive diorama media can significantly increase learners' engagement, conceptual understanding, and critical thinking abilities. The development process of interactive solar system diorama media for IPAS material used the ADDIE model, which has five steps: analyze, design, develop, implement, and evaluate.

The first stage is analysis, a step carried out by analyzing the needs of teachers and students. This study was conducted through interviews with the class VA homeroom teacher, who also teaches the IPAS subject, Mrs. Lailah Faiqoh, S.Pd., as well as direct observation in class V of Elementary Islamic School Darun Najah Srobayong Mlonggo.

Table 1 <Results of Teacher Interviews>

Dimension	Indicator
Teacher needs	Teachers experience limitations in using or creating interactive media
Media needs	Teachers show strong interest and high expectations for innovative media
Critical Thinking Skills	Assessment is still simple, but teachers recognize the importance of critical thinking skills for students
School support	Facilities are available, but have not been used optimally

Based on the table above, the indicator with the lowest percentage is teachers' limitations in using interactive media. This indicates an urgent need to provide more varied learning media, such as an interactive solar system diorama, in order to help teachers deliver IPAS material more effectively while also training students' critical thinking skills.

Table 2 <Results of Class V Observations>

Dimension	Indicator
Teacher activities	The teacher explains the material, but media use is not yet optimal
Student activities	Students are fairly active, but enthusiasm is not evenly distributed among all students
Learning media	Media are available, but are still limited to conventional media (images)
Critical Thinking Skills	Students show enthusiasm for learning, but are lacking when asked to think more deeply or critically
Facilities and infrastructure	Facilities such as projectors are available, but have not been used optimally; digital TV

The observation results show that the indicator with the lowest percentage is students' learning motivation. This is due to the lack of variety in the learning media used by teachers, so students are not yet fully actively involved in the learning process and are not yet trained to think critically in understanding the concept of the solar system. Based on the results of interviews and observations, it can be concluded that the development of more innovative IPAS learning media is highly necessary. Elements in learning media have a very important role in creating learning situations, thereby influencing success in achieving learning objectives (Habib et al., 2020).. Interactive solar system diorama media can be an effective solution for improving understanding of solar system concepts while also fostering students' motivation and involvement in learning.

An interactive diorama allows students to see the arrangement of planets realistically in three-dimensional form, interact with the model, and understand solar system movements more concretely. With direct interaction, students do not merely receive information passively, but are also invited to analyze, compare, and draw conclusions, so that their critical thinking skills can develop and their enthusiasm for participating in learning activities also increases, making the classroom atmosphere more enjoyable (Budianti et al., 2023). Thus, interactive solar system diorama media not only meets teachers' needs in delivering material more attractively, but is also able to create interactive and meaningful learning that can increase elementary school students' learning motivation and critical thinking skills.

Development of Solar System Diorama Media

The design stage began by designing learning media capable of visualizing the abstract concept of the solar system concretely. Based on the needs analysis of class VA students, the researcher chose a three-dimensional diorama form because it was considered the most appropriate for displaying the arrangement of planets and their orbits realistically. The main material used was plywood, chosen because it is more durable, not easily damaged, and allows for a neat and sturdy design. The researcher also added sparkling light elements so that the diorama display would be more attractive and able to capture students' attention. At this stage, in addition to preparing the physical design of the media, the researcher also prepared material and media validation instruments, as well as student response questionnaires to measure acceptance of the solar system diorama.

The develop stage was carried out by realizing the design into a real product in the form of an interactive diorama. The planets were arranged according to the order of the solar system, from Mercury to Neptune, with sizes and colors adjusted to resemble actual conditions. Each planet was equipped with brief information about its characteristics, such as its distance from the sun, rotation period, and revolution. To add interactivity, the diorama was designed to rotate with the help of an electrical connection, so students could observe a simulation of planetary motion around the sun. The combination of three-dimensional visuals, lighting, and mechanical movement makes this medium more lifelike and able to provide a learning experience that is both enjoyable and meaningful.

The initial implementation stage was carried out by testing the solar system diorama in class VA of Elementary Islamic School Darun Najah Srobyong. Students were invited to observe the arrangement of planets, compare their characteristics, and discuss the phenomena displayed through the diorama. This activity encouraged them to ask questions, provide reasons, and draw conclusions based on direct observation, so that their critical thinking skills could be sharpened. Questionnaire results showed that students felt helped in understanding solar system material that was previously difficult to visualize. Diorama media not only increased learning interest, but also provided opportunities for students to develop analytical and problem-solving abilities through interactive and contextual learning.

Validation and Feasibility of Solar System Diorama Media

At the product validation stage, the researcher involved one media validator and one material validator to assess the feasibility of the developed solar system diorama. The media validator gave a score of 87%, which is included in the valid category, while the material validator gave a score of 92%, also in the valid category. These results indicate that the solar system diorama media have a high level of validity in terms of both appearance and material content. The feasibility of learning media is an important requirement so that the media developed can truly be used effectively in teaching and learning activities (Learning & Air, 2026). Validation was carried out using assessment instruments that included aspects of content suitability, clarity of information, neatness of design, and the usefulness of the media in supporting the learning process.

Based on these validation results, it can be concluded that the solar system diorama is feasible for use as learning media in elementary schools. The high level of validity shows that this medium is able to present the concept of the solar system clearly, attractively, and interactively. The advantage of the diorama lies in the combination of three-dimensional visuals, lighting, and a planet-rotation feature that provides students with a more realistic learning experience. The use of diorama media as a learning resource shows an increase in teacher activity or the implementation of learning. Thus, this medium not only meets academic feasibility standards, but also has the potential to improve students' critical thinking skills through more in-depth observation, analysis, and discussion of solar system phenomena.

Effectiveness of Diorama Media in Improving Students' Critical Thinking Skills

The next stage then entered the implementation stage in the classroom. After all solar system diorama media components passed the validation process by media experts and material experts and were declared to meet the feasible criteria, the researcher began applying them in instructional activities. Before the treatment was given, the researcher first conducted a pre-test to map the initial critical thinking abilities of class VA students.

The learning process was then carried out by intensively using solar system diorama media to provide concrete visualization of space phenomena. At the end of the meeting, a post-test was conducted to see the development of students' competencies after interacting with the media. To measure the degree of effectiveness of using solar system diorama media in improving critical thinking skills, statistical analysis was carried out through a paired sample T-test with the following results:

Table 3 <Paired Samples Test>

		Paired Differences		95% Confidence Interval of the Difference		t	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Lower		
Pair 1	Pretest - Posttest	-12.241	5.276	.980	-14.248	-10.235	.000
						12.495	

The initial stage of effectiveness analysis was carried out through a normality test to validate the data distribution in the class VA student group. Based on the table above, the significance value of the pretest was 0,135 and that of the posttest was 0,114 using the Shapiro-Wilk calculation method. Both results were above the 0,05 threshold, confirming that the research data were statistically normally distributed. This evenly distributed data condition allowed the researcher to continue the analysis using parametric statistical procedures with a good level of confidence. Thus, these initial data fulfilled the basic prerequisite for testing the impact of developing solar system diorama media on students' abilities.

Table 4 <Test of Homogeneity of Variance>

		Levene Statistic	df1	df2	Sig.
Result	Based on Mean	.450	1	56	.505
	Based on Median	.387	1	56	.536
	Based on Median and with adjusted df	.387	1	55.999	.536
	Based on trimmed mean	.456	1	56	.502

After ensuring the normality of the data, the next step was to verify the homogeneity of variance to ensure the equality of the conditions of the research subjects in class VA. Referring to the Levene test results table above, the significance value obtained was 0,505, which is far above the 0,05 standard. This proves that the variance of critical thinking skills data before and after treatment was homogeneous or did not have striking variance differences. The similarity of variance characteristics ensures that any changes that appear later truly originate from the use of solar system diorama media. The validity of this prerequisite is an important indicator that comparisons of learning outcomes in this study can be conducted objectively and accurately.

Table 5 <Descriptive Statistics>

	N	Minimum	Maximum	Mean	Std. Deviation
Ngain_Score	29	.11	.60	.3326	.12912
Ngain_Percentage	29	11.11	60.00	33.2643	12.91193
Valid N (listwise)	29				

The analysis of the effectiveness of the solar system diorama media through the N-gain score calculation, which reached an average of 0,3326 or 33,26%, showed that this medium was in the medium category. Nevertheless, this achievement still reflects a consistent positive contribution to improving students' critical thinking skills in Madrasah Ibtidaiyah. This confirms that the use of a diorama as learning media can provide a more meaningful learning experience, especially in the context of IPAS learning that requires exploration, analysis, and in-depth conceptual understanding.

The advantages of solar system diorama media can be seen from several aspects. First, the diorama presents concrete visualization that helps students understand abstract concepts about the solar system, making the learning process more accessible. Second, this medium encourages students' active involvement through direct observation, discussion, and reflection, which are important parts of developing critical thinking skills. Third, the diorama provides opportunities for students to learn collaboratively, because its use often involves group work that fosters communication skills and shared problem-solving. Based on these data, it can be concluded that diorama media not only meet validity criteria from technical and content aspects, but are also considered practical in classroom implementation and have strong prospects for broader

adaptation in Natural and Social Sciences (IPAS) learning (Pendidikan & Sapitri, 2025). In addition, the diorama also fosters curiosity and learning motivation, because its attractive and interactive form can create an enjoyable learning atmosphere.

Thus, effectiveness in the medium category still has strategic value in supporting learning. Solar system diorama media do not only function as visual aids, but also as pedagogical tools that are relevant for developing critical thinking skills, strengthening conceptual understanding, and improving the quality of students' learning interactions. The effectiveness level of solar system diorama media in improving students' critical thinking skills was further analyzed through the N-gain score calculation. Based on the table above, the average N-gain obtained by class VA students reached 0,3326, or 33,26% when expressed as a percentage. This achievement placed the developed learning media in the medium effectiveness category according to the gain interpretation standard. Although it was in the medium category, these results show a stable positive contribution in supporting critical thinking skills in Madrasah Ibtidaiyah. This effectiveness proves that the diorama is a relevant media solution for supporting more challenging and exploratory IPAS learning activities.

Conclusions

Based on the results of the study and discussion regarding the development of solar system diorama learning media in class VA of Elementary Islamic School Darun Najah Srobyong, it can be concluded that this medium is declared feasible and effective for use. Validation results from media experts and material experts showed very high achievement percentages, so the media met quality standards both in terms of visual aesthetics and the depth of IPAS material content. Statistically, the use of diorama media was proven to have a significant impact on improving students' critical thinking skills, as shown by a significance value of 0,000 in the paired sample T-test.

The improvement in students' abilities was also strengthened by the average N-gain score of 0,3326, which placed the media's effectiveness in the medium category. This indicates that three-dimensional visualization in the diorama can help students analyze, evaluate, and understand solar system concepts that were previously abstract so that they become more concrete. Thus, the development of this solar system diorama media is an innovative solution that successfully addresses the challenge of low student critical thinking skills in science learning at the elementary school or elementary Islamic school level.

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