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DEVELOPMENT OF WATER CYCLE DIORAMA LEARNING MEDIA IN IPAS CLASS V SUBJECTS AT MADRASAH IBTIDAIYAH

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Abstract

The learning media for this water cycle diorama is a teaching aid, such as an aquarium, that can help students learn science in class. Material discussing the occurrence of the water cycle is included in this water cycle diorama. This media shows how the water cycle occurs on Earth, which students cannot see directly. One of the aims of this research is to evaluate the needs of teachers and students to make water cycle diorama media for class V, MI As Salam. Another objective is to determine the validity of the water cycle diorama learning media for class V MI, As Salam. Development research (R&D) is a type of research. This research uses the Richey and Klein research model, using three stages. Data collection techniques use qualitative and quantitative descriptive analysis techniques. Questionnaires that describe the needs of teachers and students are also used for validation by media experts and material experts. The research results show that the water cycle diorama learning media in science subjects for class V M is very valid to be tested on students. Media experts received a score of 98, an average of 4.9, and a validity percentage of 98%. In contrast, material experts received a score of 72, an average value of 4.8, and a validity percentage of 96%. It can be concluded that the water cycle diorama learning media is declared "very valid."

Keywords: media dioarama, IPAS subjects, madrasah Ibtidaiyah

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INTRODUCTION

Educators in learning need to develop learning media that help students understand the subject matter. (Hidayat et al., 2022). Learning media is a tool that explains part of the entire learning program that is difficult to explain verbally. (Lisnawati, 2021,Prawira et al., 2023). Learning materials will be easier and more precise if learning uses learning media. (Putra et al., 2020,Irhasyuarna et al., 2022). The function of learning media is to assist teachers in conveying abstract concepts that can be understood by students concretely.(Ninghardjanti et al., 2021,Wardhono et al., 2018)

Education is the process of shaping students' personalities and developing their potential. (Eidam, 2023). Madrasah education is an initial education to develop quality human resources so that it can affect success at the next level. Education allows people to acquire knowledge, improves their social status, and benefits the surrounding community. (Manikyam & Lakshminath, 2018).

One of the factors that determines the success of improving the quality of education is the applied learning process. (Naixin & Leong, 2024). Teachers prepare for the learning process to achieve the learning objectives that have been determined, one of which is in science lessons. Not all students master the expected scientific competencies because they often face abstract concepts, many foreign terms, and scientific names. The lack of mastery of scientific ideas is caused by students' difficulty in responding to the knowledge conveyed by their teachers.

To improve IPAS learning activities, teachers must realize that learning is a collection of processes and values that can be applied in real life. It is also caused by many factors, mainly internal and external factors. Internal factors come from within a person, such as confidence, motivation, interests, ideals, and learning habits. (Raunić, 2023). External factors come from outside, such as limited learning media, too dense material, and many foreign terms.(Laily et al., 2025).

Etymologically, the word "medium" comes from the Latin word "medium", which means "between" or "intermediary", generally used as a means of communication to describe everything that carries or transmits information between the source and the recipient of the message. To get a good quality of learning media to influence the learning process significantly, selecting and planning appropriate and good learning media is necessary. The selection of the right learning media makes learning more effective. The criteria for selecting media are derived from the concept that teaching media is part of the overall instructional system.

Teachers use learning media to communicate learning objectives so students can easily absorb the material presented, making learning more meaningful. One of the media that can be used is diorama media. A diorama is a presentation of a scene in small size (miniature), equipped with figures and details of the environment that reflect the original and combined with a natural-colored background, three-dimensional pattern, a pattern of a scene or scene made by placing

an object in front of the background with an actual perspective so that it can depict the actual situation.

Water cycle material explains how the water cycle occurs, human actions that can affect it, and how to save water. MI students need to study this material to understand how students should behave towards nature and have a caring nature for nature. Students will never see the water cycle process directly in nature, so media is needed to help them understand the material. In addition, material on the water cycle can be taught through learning resources (learning media).

Teachers still use conventional media such as books, student learning activity sheets, and lecture methods, so learning becomes boring due to the limitations of learning media. Students are more likely to use books as a learning resource. The students sitting in the back talk about things outside the material during the learning process. As a result, learners become confused by the lesson and choose not to say anything when asked. Therefore, new learning materials must be created that facilitate interaction between students and teachers, make learning fun so that it is not dull, and can arouse students' motivation and understanding.

IPAS learning at MI has the following objectives: Fostering belief in God Almighty based on his creations' existence, beauty, and order.2) Increasing knowledge and understanding of IPAS concepts that have benefits and can be applied to daily life. 3) Developing curiosity, positive attitudes, and having awareness about the interdependent relationship between IPAS, environment, technology, and society. 4) Develop a skill or process to investigate the state of the environment, be able to solve problems, and be able to make decisions. 5) Increase the sense of awareness to have a role in maintaining and preserving the natural environment. 6) Increase awareness to appreciate nature and its phenomena of order as one of God's creations. 7) Obtain knowledge of IPAS concepts and skills to continue junior high school education. The learning media in social studies lessons greatly influence teaching and learning activities, because social studies lessons present a more actual and contextual learning in daily activities, one of which is the material on the day and night process.

Based on the results of observations made by researchers at MI As Salam, there are several problems, one of which is the lack of learning resources or learning media, especially in science lessons in class V, causing students to become bored and look unfocused when learning begins. Learning tools or resources as an introduction to subject matter can make learning science more interesting and compelling. By using this learning tool or media, students can see an overview of the existing material and understand the material easily, especially in science subjects.

This learning media can also make learning more enjoyable for students. In this study, the learning media that will be developed is the Water Cycle Diorama. The water cycle diorama media developed will help students understand the water cycle process. This is because the press

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developed includes illustrations of objects in the water cycle process. Like the illustration of the ocean, the water in the sea will evaporate, then condense to form water droplets, and drip as rain. In addition, water cycle diorama media can help students in carrying out scientific activities, namely activities contained in the water cycle diorama media student worksheet, including observing, reasoning, conducting experiments, and communicating.

The expected result of this study is that water cycle diorama media can be effectively used to study water cycle process material in science subjects in grade V at MI As Salam school. Students are also expected to be more active, innovative, and independent in finding the concepts of the material studied. They are also likely to be highly interested in social studies and enjoy taking lessons.

METHODS

This research uses the Research and Development (R&D) approach, which is a research method that focuses on developing and testing the effectiveness of a product.(Umarin et al., 2023,Bartel, 2006). This approach not only aims to produce an innovation or media.(Dieterich et al., 2023,Ali & Ateeq, 2025), but also to ensure that the product developed has real benefits and can be effectively applied in the context of its use (Rodrigues & Delfim, 2022, Ramot & Bialik, 2023). In the context of this research, the product developed is a learning medium in the form of a diorama, which is designed to support a more interactive and engaging learning process.

In the development of the diorama media, the researcher adopted the learning media development model from Richey and Klein, which consists of three main stages: Planning, Production, and Evaluation.(Vongtathum & Chaijaroen, 2019). The Planning stage includes identifying needs, analyzing materials, and formulating learning objectives.(Qu & Chaijaroen, 2025). The Production stage involves creating diorama media based on the results of previous planning. (Nurhayati et al., 2023). Meanwhile, the Evaluation stage is carried out to assess the quality and effectiveness of the media that has been developed. (Sosa et al., 2020, Anwar et al., 2021)Both through limited trials and evaluations from experts. These three stages are the basis for designing innovative media that is relevant and effective in supporting the learning process.

The needs analysis in this study was carried out through two approaches, namely field research and literature study. Field research aims to explore the real needs of educators and learners as potential media users. At the same time, literature studies are used to strengthen theoretical foundations and compare findings with relevant references. Once the data obtained is considered valid and represents the needs in the field, the next step is to design and produce learning media based on the analysis results. The collected data is then processed into an initial design or product draft.

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The media draft that has been prepared is then tested for validity by media experts and material experts to ensure that its content, appearance, and function are per the standards of good learning media development. The results of this validation test are the basis for revising and perfecting the product before it is applied in the field. This research was carried out at MI As Salam, the location of the trial of the developed media. The researcher has compiled a general grid containing the indicators and aspects observed to support the data collection process, as presented in Table 1.

Table 1

Research Data Collection

Data	Data Source	Instrumen
To analyze the need for water cycle diorama media in science learning in class V MI As Salam	Class VI students	1. Needs Questionnaire 2. Interview Guidelines
Identifying the validity of water cycle diorama learning media in science class V MI, As Salam	1. Learning Media Expert 2. Learning Material Expert	1. Product Evaluation Sheet

The test subjects in this study were students of class V A MI As. The selection of this class is adjusted to the competency standards and basic competencies listed in the subject syllabus. The trial was carried out to assess the extent to which the learning media developed followed the needs and characteristics of students. This research aims to ensure that the diorama media created can support the learning process effectively under the expected competency achievement.

In the development of Water Cycle Diorama learning media, the data used consists of two types, namely quantitative data and qualitative data. Quantitative data were obtained from the results of questionnaires given to students and used as the primary data in evaluating the effectiveness of the media. Meanwhile, qualitative data is in the form of suggestions, criticisms, and input from learning experts, which helps assess the feasibility of media content and display. The instruments used in the data collection process include questionnaires, interviews, and observations, which are designed to obtain comprehensive information from various parties involved.

RESULTS AND DISCUSSION

Based on the study's results, using learning media helps make it easier for students to understand the material. (Tal et al., 2021). Diorama media, which has been successfully developed, is one of the media that can be used in science subjects. Diorama media can develop

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students' abilities more optimally. (Scheersoi & Tunnicliffe, 2019). The use of diorama media can certainly develop students' understanding. (Guedes et al., 2023). According to the interview results, before using diorama media, teachers still used conventional media, such as Student Worksheet books only, and lecture methods, so learning became boring due to the limitations of learning media. Students are more likely to use books as a learning resource. The obstacles experienced at MI As Salam are the limited learning media facilities provided by the Madrasah, as well as the problems encountered by students with low interest in reading, so that students cannot think abstractly, and it isn't easy to imagine material about the stages of the water cycle. This is an obstacle for classroom teachers. Teachers only use Student Worksheets and package books, so that students tend to get bored easily, feel less interested in the existing material, and experience a decrease in concentration in following the learning process.

Based on the observations and interviews in the field, the researcher determined the need to produce a medium that could help the learning process, so that the learning process became easier. The product made by the researcher in this study is the Water Cycle Diorama Media class V, which has been adjusted to the needs of educators and students at MI As Salam, providing an understanding of Water Cycle material to students and fostering students' interest in IPAS subjects, so that they can help students in understanding IPAS subject matter.

The results of the research analysis of the development of water cycle diorama learning media in class V science subjects can be seen from the analysis of media needs of educators and students, and through the results of media validity analysis. This stage of analysis can be a reference in producing learning media. There are two stages of this needs analysis, namely the needs of educators and students. Looking at the results of the needs of educators and students, the researcher will develop a 3-dimensional media, namely the water cycle diorama where the media is critical and valuable for teaching and learning activities, so that students can more easily grasp the material that has been learned and seen by students through the water cycle diorama learning media that illustrates the original form. The form of media desired by educators and students is a 3D water cycle diorama media, made of acrylic primary material, with a size of 40x20, as well as icons to form the original shape, and plants in the media.

Design validation is an activity process to assess whether the product design, in this case the new teaching method, will rationally be more effective than the old one. The validity test in this development research was carried out to determine the validity of a learning medium that was successfully produced. This development research obtained two product validation datasets: media expert and material expert validation data. Validation determines the validity of a product.

Design validation is done to determine the weaknesses and advantages of the media that the researcher has successfully developed. Design validation is an activity to assess whether the product design, in this case, the new teaching method, will be more effective than the old

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one. It is said to be rational because the validation here is still an assessment based on logical thinking, not yet a field fact. Product validation can be done by presenting several experts in their fields to assess the new product being designed.

The validity test in this study was carried out by two competent parties, namely media experts and material experts, to ensure that the learning media developed meets quality standards in terms of visual appearance, functionality, and suitability of the content of the material with the curriculum. Media experts are tasked with evaluating technical aspects such as design, attractiveness, clarity of visual information, and ease of use of media by students. Meanwhile, material experts focus on the accuracy of content, the accuracy of concepts, the relevance to competency standards, and the usefulness of the material in supporting the learning process. The evaluation results from these two experts are used as a basis for revising and perfecting the media before testing it on students.

The expert validation stage, using instruments that media expert research instruments have approved, has 20 indicators with eight aspects, namely aspects of student involvement, media presentation, color, size, neatness, graphics, use, and media effectiveness. Meanwhile, the research for subject matter experts has 15 indicators with seven aspects, namely aspects of material suitability, material presentation, truth and accuracy, clarity of topics, adequacy of aspects, actualization, and involvement.

Table 2

Material Expert Validation Results

Indicators	**Score Obtained**	**Maximum Score**
Comformity	50	50
Servingg	50	50
Accuracy	46	50
Clarity	50	50
Aspect Coverage	40	50
Actualization	40	50
Involvement	50	50
Number of Screws	**326**	**350**
Present Criteria	**96% Highly Valid**	

Table 2 is the result of validation obtained from the assessment of subject matter experts reviewed from several aspects, namely aspects of material suitability, material presentation, truth and accuracy, topic clarity, adequacy of aspects, actualization, and involvement. Showing the indicators assessed in this aspect is very good. The material validation produced a score of 72, and the average score obtained was 4.8. After converting with the media validity criteria in table 2 by considering the results through the validity criteria table, the percentage of 96% with very valid criteria and no revision from the validator.

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The development of water cycle diorama learning media was developed by looking at the results of questionnaire data on the needs of educators and students, which stated that the learning media uses acrylic materials as a framework. To look livelier, this medium is also given blue stickers as a replica of the sky. Then, the media is also given the impression of blue color as a replica of the sea using blue stereophotography. The water cycle diorama media is designed with a 3-dimensional model and uses the replicas or icons needed for each material, so that students not only see and read, but can also apply directly and clearly according to the material presented.

Table 3

Media Expert Validation Results

Indicator	**Score Obtained**	**Maximum Score**
Involvement	50	50
Serving	46	50
Color	50	50
Size	50	50
Neatness	50	50
Graphic	50	50
Use	50	50
Effectiveness	50	50
Total Scores	**396**	**400**
Present Criteria	**98% Highly Valid**	

Table 3 is a validation result obtained from the assessment of media expert validators, which is reviewed from several aspects, namely, aspects of student involvement, media presentation, color, size, neatness, graphics, use, and effectiveness of media. Showing the indicators assessed in this aspect is very good. The validation of learning media produced a score, with the number of scores obtained being 98, and the average score was 4.9. After converting to the media validity criteria in Table 4.3 by considering the results through the validity criteria table in Table 3.8, a percentage of 98 % with very valid criteria was obtained.

The development of water cycle diorama learning media was developed by looking at the results of questionnaire data on the needs of educators and students, which stated that the learning media uses acrylic materials as a framework. This medium is also given blue stickers as a replica of the sky to look livelier. Then, the media is also given the impression of blue color as a replica of the sea using blue stereophotography cycle diorama media is designed with a 3-dimensional model and uses the replicas or icons needed for each material, so that students not only see and read, but can also apply directly and clearly according to the material presented.

The water cycle diorama media was also created as an evaluation material, namely a snake and ladder, which is equipped with smart cards and contains questions about the water cycle. The water cycle diorama learning media was also tested for media validity with validators

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and material validity tests with validators for Class V MI As Salam teachers. Furthermore, after the media is tested, the results of the validity of the media experts and the material are declared very valid. The media can be used in learning, especially in teaching science class V material on the occurrence of the water cycle.

The material and characteristics make the media selection stage for students. Then, the tools and materials used to manufacture the media will be collected. These materials include acrylic to make aquariums, stickers to give color to the sky, Styrofoam, glue, ping pong balls, Dakron, bulbs/LED lights, aquarium sponges, switches, water pumps, plants, magnets, and steam USB machines. Meanwhile, the tools used include scissors, syringes, solder, solation, grenda, cutter, meter, and tools for drilling acrylic (drill). The following are the stages of making a water cycle diorama learning media for science subjects on water cycle material.

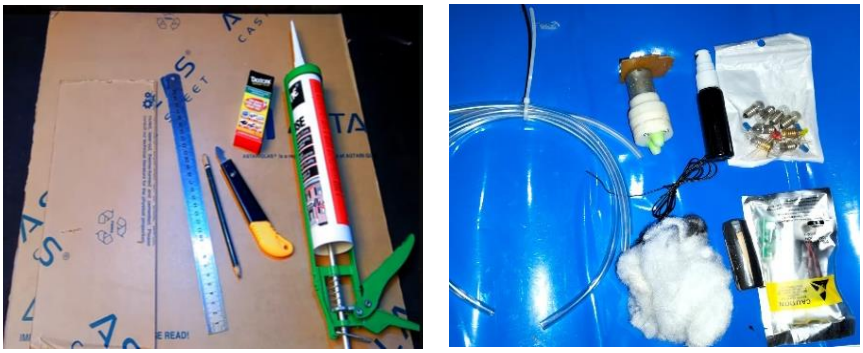

Figure 1: Tools and Materials

The image above shows the various materials used by the researcher in creating diorama-based learning media with the theme of the Water Cycle. The primary material used is acrylic, which serves as the basic framework of the medium due to its strong and transparent properties. In addition, various supporting materials such as dakron, black ink, blue stickers, and black foam are also used to form visual elements that represent clouds, rain, and water currents. Streptomyces are used as the base of the landscape, while synthetic grass, miniature plants, and ping pong balls reinforce the diorama's natural look. To add to the interactive and visual aspects, lights, cables, steam engines, and water pumps are added, which depict the evaporation process and movement of water in cycles.

Researchers use various tools to shape, cut, and arrange these materials in the media assembly process. The tools used include a ruler and pencil to sketch out the initial design and glue, shot, injection, and soldering to hold small parts together with precision. Hangers and grinders are used to cut and tidy up complex parts such as acrylics and sterophome, while small drills make holes for cable paths and water flows. Combining these materials and tools, the diorama is designed as an engaging visual medium and an interactive and functional learning aid.

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Figure 2 Media Frame Design

Acrylic that has been cut according to size. Next, assemble the media using injection glue and coat it with silicon glass glue so it does not leak, then assemble it to form a rectangle like an aquarium. The highest part of the acrylic is coated with blue stickers, and the base is coated with blue sterophome. Perforation of high acrylic wall parts by drilling or up to a hole. These holes in acrylic are used for rain hoses, sunlight, cloud lights, and water vapor. then, IPAS according to the illustrations.



Figure 3: Electrical Networking

At this stage, on the back, there is a box in which an electrical circuit connects the adapter with the cable, then connected with a switch. Four switches can operate according to their function: switch 1 to turn on LED lights in the sun, switch 2 to turn on water vapor, switch 3 to turn on LED lights for clouds, and switch 4 to lower rainwater.

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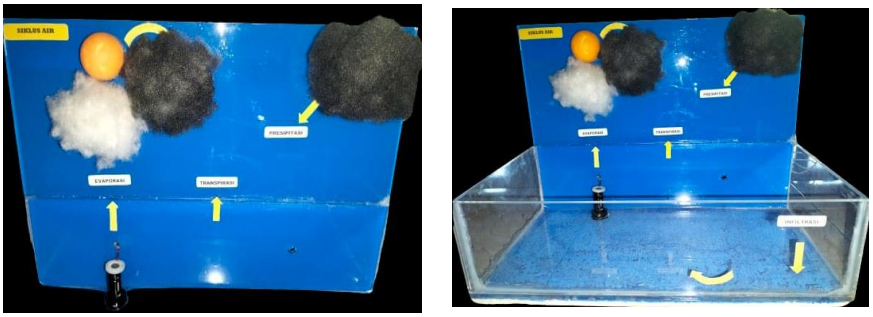

Figure 4: Illustration of the Front of the Water Cycle Diorama

The creation of water cycle diorama learning media using existing materials such as sun illustrations made from yellow ping pong balls, formed in a semicircle with bulbs/LEDs. The white cloud is made of delineated Dakron, and LED lights are given in the center to clarify the actual visualization of the cloud. The black cloud is made of Dakron, the water vapor USB machine, which is described and then colored with black ink. There is a hose to drip water so it rains, while the black cloud that can walk in is given a front and rear magnet. The arrow marks and names are given to explain their function and use. This design aims to visualize ideas in developing water cycle diorama media.



Figure 5: Installation of Land and Sea Illustrations

The image above shows the installation stage of the illustration of the land and ocean on the Water Cycle diorama media. On the front of the media, the researcher added a visual element like a black aquarium filter depicting the soil layer. The dark color of the filter gives a deep impression and strengthens the illustration of the contours of the Earth's surface. This element becomes an essential basis for distinguishing between land and ocean areas in dioramas.

On top of the surface of the filter, synthetic grass is installed that represents a green and fertile area of the soil surface. The researcher also attached mini ornamental plants on the artificial grass to create a natural impression and beautify the visual appearance. The

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arrangement of the plants is done proportionally to make it look realistic and aesthetically appealing. All these components are structured in such a way as to create illustrations that are not only informative but also capable of capturing students' attention and improving students' understanding of the water cycle process.



Figure 6: Water Cycle Diorama Learning Outcomes

The image above results from a water cycle diorama media developed by the researcher. The illustrations in the water cycle diorama media are based on reality, such as in terms of the appearance of the media, colors, and emphasized elements. The color in the diorama media is appropriate as the illustrations of the ocean, river, infiltration, and land (highlands, mountains, and lowlands). Based on the production results of the Water Cycle Diorama learning media development above, it is a learning material instead of a book. The press is presented concretely according to the material in IPAS learning and on the worksheet of IPAS students in class V. Educators first explain the material presented. Students are divided into four groups to show the media to their friends, so they will find it easier to understand the material.

Water cycle diorama learning media was also carried out, a media validity test, and a material validity test with a material validator. Furthermore, after the media is tested, the results of the validity of the media experts and the material are declared very valid. The media can be used in learning, especially in the teaching of science class V material on the occurrence of the water cycle. In line with previous research, it is stated that when natural science learning media, such as weather materials, have been declared valid, they can be applied in the learning process. The water cycle diorama that has been developed is seen from the function of use, namely: (1) The water cycle diorama media has an attention function, namely attractiveness, (2) The water cycle diorama media has an affective function, namely improvement, (3) The water cycle diorama media has a cognitive function, namely achievement. (Harrington, 2020,Cools et al., 2018)(4) Water cycle diorama media has a compensatory function, which means that the presence of images or elements of materials used in learning media can help students in organizing information in the media(Trowbridge, 2019,Hoekstra, 2019).

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Water cycle dioramas have been successfully developed and proven suitable for use as a learning medium in the classroom. This media is very appropriate to be applied to science learning in class V of MI, As Salam, especially in the material on the water cycle process. A diorama as a visual medium provides an additional alternative to textbooks.(Poli et al., 2018)So that it can clarify concepts and help students understand the material more easily.

Using this media is expected to provide tangible benefits for students, adding insight and increasing interest in learning. With engaging and interactive presentations, learning becomes more effective and fun. This certainly supports the achievement of optimal learning goals in the classroom.

CONCLUSION

Based on the results of research and development that have been carried out by researchers on the development of water cycle diorama learning media in science class V, MI As Salam, it can be concluded that water cycle diorama learning media was developed by looking at the results of questionnaire data on the needs of educators and students. Educators and students want acrylic as the primary material, measuring 40 x 20 cm, using colors to clarify the material, and icons/plants as illustrations in the media. The water cycle diorama media is designed with a 3-dimensional model and uses the replicas or icons needed for each material, so that students not only see and read, but can also apply the media directly and according to the material presented.

This research produced a water cycle diorama learning media product that obtained the following validity: The validation results obtained from the assessment of media experts received a total score of 98, with an average score of 4.9. After converting with the media feasibility criteria in Table 4.3, a total percentage of 98% was obtained with very valid criteria. The validation results obtained from the assessment of material experts obtained a total score of 72, with an average score of 4.8. After being converted with the media eligibility criteria, it gets a total percentage of 96% with very valid criteria. The limitation of the research lies in the limited location of the study, which is only one school. Recommendations for further research include developing learning media in a broader scope of locations.

REFERENCES

Ali, S. A., & Ateeq, A. (2025). *The Role of the Knowledge Economy and Its Impact on Achieving Sustainable Development According to the Lofty Vision 2030* (pp. 269–276). https://doi.org/10.1007/978-3-031-71318-7_25

Anwar, M., Alimin, & Munawwarah. (2021). An interactive e-book development based on green chemistry study on Hydrocarbon. *Journal of Physics: Conference Series*, *1899*(1), 012161. https://doi.org/10.1088/1742-6596/1899/1/012161

Copyright © 2019 | JMIE | p-ISSN: 2580-0868, e-ISSN: 2580-2739

Bartel, L. R. (2006). Trends in Data Acquisition and Knowledge Development. In *Menc Handbook Of Research Methodologies* (pp. 343–386). Oxford University PressNew York, NY. https://doi.org/10.1093/oso/9780195189452.003.0009

Cools, S., Conradie, P., Ciocci, M.-C., & Saldien, J. (2018). *The Diorama Project: Development of a Tangible Medium to Foster STEAM Education Using Storytelling and Electronics* (pp. 169–178). https://doi.org/10.1007/978-3-319-61322-2_17

Dieterich, K., Kaschub, V. L., & Ohlhausen, P. (2023). *Interorganizational New Product Development: A Future Vision of Project Team Support on an Organizational, Relational, and Content-Related Collaboration Level* (pp. 757–766). https://doi.org/10.1007/978-3-031-18641-7_70

Eidam, H. (2023). FORMAÇÃO NA ESCOLA: ONDE MAIS O SERIA SENÃO? *Educação & Sociedade*, *44*. https://doi.org/10.1590/es.273563

Guedes, L. S., Zanardi, I., Span, S., & Landoni, M. (2023). *Multisensory Diorama: Enhancing Accessibility and Engagement in Museums* (pp. 628–637). https://doi.org/10.1007/978-3-031-42283-6_34

Harrington, M. C. R. (2020). Connecting User Experience to Learning in an Evaluation of an Immersive, Interactive, Multimodal Augmented Reality Virtual Diorama in a Natural History Museum & the Importance of Story. *2020 6th International Conference of the Immersive Learning Research Network (iLRN)*, 70–78. https://doi.org/10.23919/iLRN47897.2020.9155202

Hidayat, W. N., Patmanthara, S., Sutikno, T. A., Soraya, D. U., Bin Mahamad, A. K., Anwar, A. S., & Meriatami, A. Z. (2022). Mobile Live Coding Development as a Disruptive Learning Media in Programming Course. *2022 8th International Conference on Education and Technology (ICET)*, 281–287. https://doi.org/10.1109/ICET56879.2022.9990671

Hoekstra, M. (2019). A Place for Stupidity: Investigating Democratic Learning Spaces in the Diorama. *International Journal of Art & Design Education*, *38*(3), 649–658. https://doi.org/10.1111/jade.12240

Irhasyuarna, Y., Hafizah, E., Sari, M. M., Nurhaliza, S., & Fajar, I. N. (2022). *The development of interactive media in the context of wetland local wisdom on science materials for junior high schools to practice science literacy*. 060009. https://doi.org/10.1063/5.0117913

Laily, I. F., Setiawan, D., & Arifuddin, A. (2025). The Effectiveness Of Digital Media-Assisted Reciprocal Teaching On Elementary Student's Reading Comprehension Skills. *JMIE (Journal of Madrasah Ibtidaiyah Education)*, *9*(1), 134. https://doi.org/10.32934/jmie.v9i1.760

Lisnawati, I. (2021). Speaking learning based on multimedia. *Journal of Language and Linguistic Studies*, *17*(4), 2046–2056. https://doi.org/10.52462/jlls.147

Manikyam, K. S., & Lakshminath, A. (2018). Legal Education: Ideological and Institutional Perspectives. In *Contemporary Issues in International Law* (pp. 513–525). Springer Singapore. https://doi.org/10.1007/978-981-10-6277-3_36

Naixin, Z., & Leong, W. Y. (2024). Integrating artificial intelligence into pedagogy: theoretical framework and application model of I-TPACK in intelligent education. In *Industry 5.0* (pp. 335–371). The Institution of Engineering and Technology. https://doi.org/10.1049/PBME026E_ch17

Ninghardjanti, P., Indrawati, C. D. S., Dirgatama, C. H. A., & Wirawan, A. W. (2021). An Analysis on the Need for Mobile Learning-Based Interactive Learning Media in Vocational High School. *Journal of Physics: Conference Series*, *1737*(1), 012017. https://doi.org/10.1088/1742-6596/1737/1/012017

Nurhayati, E., Scristia, & Araiku, J. (2023). *Development of realistic mathematics education (RME) based*

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teaching materials with the context of fortress of pendem to facilitate mathematical concepts understanding. 020031. https://doi.org/10.1063/5.0142760

Poli, A., Gambini, A., Pezzotti, A., Broglia, A., Mazzola, A., Muschiato, S., Standoli, C. E., Zambarbieri, D., & Costa, F. (2018). *Digital Diorama* (pp. 52–82). https://doi.org/10.4018/978-1-5225-2616-2.ch003

Prawira, I., Rizkiansyah, M., Ahdareni, R. J., Ariestyani, A., & Mettadewi, A. (2023). The Impact of Interactive Features on Broadcasting Virtual Laboratory on Vocational Students' Learning Motivation; Study at SMKN 1 Bangil and SMKN 1 Sragen, East Java, Indonesia. *E3S Web of Conferences*, *388*, 04042. https://doi.org/10.1051/e3sconf/202338804042

Putra, I., Rajibussalim, R., Irwandi, I., & Muhammad, S. (2020). Utilizing LoRa for IoT based mini weather station as STEM learning media to support industrial revolution 4.0. *Journal of Physics: Conference Series*, *1470*(1), 012042. https://doi.org/10.1088/1742-6596/1470/1/012042

Qu, X., & Chaijaroen, S. (2025). Theoretical Retrospectives for Developing a Constructivist Learning Environment Model to Enhance Metacognitive Regulation in Authentic Writing. *Forum for Linguistic Studies*. https://doi.org/10.30564/fls.v7i3.8452

Ramot, R., & Bialik, G. (2023). Toward a consensual definition of educational research and development: a Delphi study. *Higher Education Research & Development*, *42*(2), 427–441. https://doi.org/10.1080/07294360.2022.2052814

Raunić, R. (2023). O naravi, smislu i ciljevima nastave filozofije. *Nova Prisutnost*, *XXI*(1), 43–58. https://doi.org/10.31192/np.21.1.3

Rodrigues, J. C., & Delfim, V. (2022). *Technology Foresight to Enable New R&D Collaboration Partnerships: The Case of a Forestry Company* (pp. 155–163). https://doi.org/10.1007/978-3-030-79165-0_15

Scheersoi, A., & Tunnicliffe, S. D. (2019). Introduction: Natural History Dioramas and Science Educational Aspects. In *Natural History Dioramas – Traditional Exhibits for Current Educational Themes* (pp. 1–8). Springer International Publishing. https://doi.org/10.1007/978-3-030-00175-9_1

Sosa, G. R., Aripriharta, Putranto, H., Andajani, K., Parlan, & Dasna, I. W. (2020). DC Generator Didactic Tools Development for the Study of Electrical Machine. *2020 4th International Conference on Vocational Education and Training (ICOVET)*, 107–110. https://doi.org/10.1109/ICOVET50258.2020.9230282

Tal, I., Zou, L., Farren, M., & Muntean, G.-M. (2021). *Improving Learner Experience, Motivation and Knowledge Gain When Using Mulsemedia-Based Technology Enhanced Learning* (pp. 146–161). https://doi.org/10.1007/978-3-030-86439-2_8

Trowbridge, C. A. (2019). Dioramas and Teachers: Looking, Thinking, Drawing, and Talking. In *Natural History Dioramas – Traditional Exhibits for Current Educational Themes* (pp. 159–170). Springer International Publishing. https://doi.org/10.1007/978-3-030-00175-9_11

Umarin, S., Hashimoto, T., Chinda, T., & Nakamori, Y. (2023). *Exploring Knowledge Synthesis Enablers for Successful Research Projects* (pp. 136–149). https://doi.org/10.1007/978-981-99-8318-6_10

Vongtathum, P., & Chaijaroen, S. (2019). *Design and Development of Interactive Learning Environment Model to Enhance the Creative Problem Solving Thinking for Computer Education Students* (pp. 703–712). https://doi.org/10.1007/978-3-030-35343-8_74

Wardhono, W. S., Arwani, I., & Wijaya, H. (2018). Learning Media Development for Basic Arithmetic Concept with Interactive Augmented Reality. *Proceedings of the 2nd International*

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Conference on Digital Technology in Education, 49–52. https://doi.org/10.1145/3284497.3284511

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