Proceeding of Integrative Science Education Seminar Vol. 5 No. 1, 2025, pp. 400-412

Available online at

PISCES

Proceeding of Integrative Science Education Seminar

Beranda prosiding : https://prosiding.iainponorogo.ac.id/index.php/pisces

Article

AR-Spin Static Edusites: 3D Learning Innovation that Integrates Google Sites, Augmented Reality, and Interactive Games for Science Learning in the Era of Society 5.0

Azizah Fatwa Alamina[1]*, Martha Loviana[2]

[1,2] Universitas Islam Negeri Kiai Ageng Muhammad Besari Ponorogo, Ponorogo

** Corresponding Address: azizahfatwaa@gmail.com*

Article Info

5st AVES
Annual Virtual Conference of Education and Science 2025

Keywords:

Augmented Reality;
Google Sites;
Learning Media;
R&D;
Static Electricity.

ABSTRACT

The advancement of digital technology in the Society 5.0 era demands innovative learning media that are not only informative but also foster mindful, meaningful, and joyful learning experiences. Science learning still faces challenges in connecting abstract concepts with real experiences, especially in static electricity, which is often difficult for students to grasp, particularly in 3T (frontier, outermost, and disadvantaged) regions with limited educational access. To address this issue, AR-Spin Static Edusites was developed as a 3D technology-based innovation integrating Google Sites as a learning hub, Augmented Reality (AR) for visualizing static electricity phenomena, and interactive spin games to enhance conceptual understanding. This study aims to develop and assess the feasibility of AR-Spin Static Edusites using the Thiagarajan 3D Research and Development (R&D) model, which includes define, design, and develop stages. Validators consisted of science teachers and alumni of the PPG Science Education program. The validation instrument assessed the suitability, accuracy, efficiency, aesthetics, and safety of the material. The results indicated an average validity score of 86% (highly valid). The media is considered innovative, adaptable to technological progress, and suitable as a supporting medium to enhance students' understanding of science concepts in sustainable learning.

© 2025 Azizah Fatwa Alamina, Martha Loviana

INTRODUCTION

Education is one of the most important things to study and develop, because education is not only about the transfer of knowledge between teachers and students. The function of education is broader and deeper, namely to empower human potential to be able to pass on, develop, and build culture and civilization in the future. Through education, it is hoped that the values and excellence of past cultures can be introduced, studied, and developed into the culture of the individual, community, and nation in accordance with the era in which the students live and develop themselves (Foa, et al., 2024). Education is a deliberate and planned effort to create a learning environment and learning process so that students actively develop their own abilities. To achieve educational goals, educators have a major role in enabling students to

Copyright © 2025 Azizah Fatwa Alamina, et. Al., p-ISSN 2808-5337 e-ISSN 2808-5345

understand various concepts and applications of knowledge. Therefore, we must pay attention to the basic elements of learning, namely teaching methods and media used. The word "media" comes from the Latin word medius, which means intermediary or introducer. Meanwhile, according to the Big Indonesian Dictionary (KBBI), learning is defined as: the process, method, or act of making people or living creatures learn. This is in line with the National Education System Law No. 20 of 2003, which explains that learning is the process of interaction between educators and students and learning resources in a learning environment (Abdullah, et al., 2021).

Advances in digital technology have affected almost all aspects of human life, including education. In the era of Society 5.0, the world of education is required to combine technology with learning methods that prioritize the needs of students. Teachers are no longer just people who explain material, but also managers who can create meaningful learning processes that are appropriate to the context (Fauziyah & Arianto, 2020). In this situation, innovation in learning media is very important so that students can learn in a more effective, critical, and enjoyable way. However, in the field, it appears that some students, especially in 3T (frontier, outermost, and disadvantaged) areas, still face obstacles in gaining access to interesting and interactive digital learning resources. This situation makes the process of learning science, especially in understanding abstract concepts such as in science education, more difficult.

In essence, science is viewed as three units, which include a way of thinking, a way of investigating, and a body of knowledge. As a way of thinking, science is a mental activity (thinking) of people who are engaged in the field being studied. As a way of investigating, science provides descriptions of approaches to compiling knowledge. Meanwhile, as a body of knowledge, science is a systematic arrangement of findings made by scientists. These findings take the form of facts, concepts, principles, laws, theories, and collections of knowledge in accordance with their respective fields of study, such as biology, chemistry, physics, and so on. The main objective of science is the development of a body of knowledge. In science, the process or methods of inquiry include ways of thinking, attitudes, and steps in scientific activities to obtain scientific products or scientific knowledge, such as observation, measurement, formulating and testing hypotheses, collecting data, experimenting, and prediction. In this context, science is not just a way of working, seeing, and thinking, but "science as a way of knowing," meaning that science is a process that includes attitudes or actions, curiosity, thinking habits, and a set of procedures. Meanwhile, the values of science are related to responsibility, social moral values, the benefits of science for science and human life, as well as attitudes and actions. (Tabun, 2024).

In the context of science education, the implementation of the Merdeka Curriculum has significant implications. Science is no longer viewed as merely factual knowledge, but rather emphasizes conceptual understanding, real-life application, and the development of scientific skills. The Merdeka Curriculum allows students to learn through a more contextual, interactive, and exploratory approach. However, there are many concepts that are considered abstract, so visual media support is needed in the learning process. Referring to the results of research by Tiara, et al. (2024), it was found that the learning resources used generally came from teachers with various sources used. The use of media in learning is still rare, especially the underutilization of laboratories and inadequate equipment. The results of the researcher's observations at the junior high school/MTs level in the Ponorogo area show that most students still find it difficult to connect the concept of electric force with everyday phenomena. Therefore, innovative learning media are needed so that students can more easily understand these concepts visually and interactively.

Digital-based learning innovations are essential to create a more adaptive, interactive, and student-centered learning process. One learning innovation that integrates various

technologies is AR-Spin Static Edusites, which combines Google Sites, Augmented Reality (AR), and interactive spin games. Google Sites serves as a digital learning center containing materials, videos, interactive links, and various learning resources that can be easily accessed through the https://sites.google.com page. Through this platform, teachers can design attractive and systematic learning pages that are integrated with other Google services such as Drive, YouTube, and Forms. Research by Arrahma (2025) emphasizes that Google Sites-based learning media is considered highly valid and practical, offering flexibility and accessibility for teachers and students in digital classrooms.

Meanwhile, Augmented Reality (AR) is used to display abstract scientific concepts—especially in the field of static electricity—in three-dimensional (3D) form that can be viewed and interacted with directly by students. This AR feature was created using the Assemblr Studio platform via the website https://studio.assemblrworld.com, which allows users to easily create educational 3D objects. According to Suaib and Sutriyani (2024), the use of the Assemblr Edu-based AR application significantly improves students' conceptual understanding and engagement in science learning. The interactive spin game functions as a means of learning through play, where students can actively participate in answering questions or conducting simple experiments. The integration of these three elements supports the principles of 3D Learning—namely, Conscious, Meaningful, and Enjoyable Learning—which helps students not only understand scientific concepts cognitively, but also experience and apply them in real-world contexts in a fun way.

As a solution, the researcher created AR-Spin Static Edusites, a 3D Learning-based learning medium that has three main components: Mindful, Meaningful, and Joyful Learning. This medium uses Google Sites as the main place to access learning materials, Augmented Reality (AR) to display static electricity phenomena in the form of 3D images, and spin games as a way of learning while playing. By combining all these elements, it is hoped that the learning process will become more interactive, collaborative, and provide a deeper learning experience. This study aims to develop and assess the feasibility of AR-Spin Static Edusites using Thiagarajan's 3D Research and Development (R&D) model, which includes the stages of definition, design, and development. The validators consist of science teachers and alumni of the PPG Science Education program. The validation instruments assess the suitability, accuracy, efficiency, aesthetics, and safety of the material.

METHOD

Research Approach

This research is a type of research and development (R&D) that aims to create and test innovative learning media products based on 3D Learning. The model used is the 3D Thiagarajan model, which is divided into three main stages, namely the definition stage, the design stage, and the development stage.

Research Design

This research was conducted through three main steps, namely Define, Design, and Development and Validation.

1. Define

This step aims to identify and analyze students' learning needs related to the concept of static electricity at the junior high school/MTs level. The activities carried out included observing the curriculum, observing through validation data with science teachers, and directly observing the learning process in the classroom. The results of the analysis showed that students had difficulty understanding the concept of electric force because the concept was abstract and there was a lack of interactive visual media that could facilitate concrete

understanding. In addition, teachers also need practical, interesting tools that can be used in both online and offline learning.

2. Design

In the development of the media product Assemblr Studio-based AR and web-hub platform Google Sites, the design is grounded in cognitive and constructivist learning theories to ensure pedagogical robustness. According to the Cognitive Theory of Multimedia Learning (Macedo et al., 2023), learners process visual and verbal channels in parallel; therefore, the integration of 3D objects (via AR) with explanatory text and interactive spin games helps reduce extraneous cognitive load and fosters meaningful schema construction (Macedo et al., 2023). Moreover, Constructivist Learning Theory posits that the learner actively builds knowledge through experience and reflection (Romdhon et al., 2024; Zin et al., 2024); accordingly, the media design embeds student-centered tasks, exploration via AR, and game-based interaction to allow learners to be the agents of their own understanding. The web-based hub (via Google Sites) functions as both an anchor and scaffold for the learning experience, creating an environment where students navigate content, engage in spin-game challenges, and explore AR models in a self-paced manner—aligning with the scaffolding and zone of proximal development concept (Vygotsky, 1978, as elaborated in Kurniawan et al., 2024). Furthermore, systematic reviews show that AR integrated with cognitive-constructivist frameworks significantly increases student engagement, motivation, and conceptual understanding (Mohamad et al., 2024; Heydemans & Elmunsyah, 2024). In this light, the development of AR-Spin Static Edusites adheres to the ADDIE model—analysis, design, development, implementation, evaluation—while ensuring that each phase is underpinned by theory and empirical evidence.

At this stage, the AR-Spin Static Edusites learning media was designed using Google Sites as the center for managing and integrating various digital features. This media has eight main menus, namely: Home Page, Learning Materials, Augmented Reality (AR), Learning Videos, Simulations, Games, Evaluation, and Attendance. In designing the initial media, the researcher integrated visual learning and IT learning, where the IT media development process included Google Sites and Augmented Reality (AR). For visual learning, a physical spin game was also created, equipped with an electrical circuit using aluminum foil and an AR barcode so that students could learn directly through visual interaction. Each part was designed with the principles of 3D Learning in mind, namely Mindful, Meaningful, and Joyful, so that the students' learning experience would be more profound and meaningful.

3. Development The development stage includes media content creation and review by experts. Interactive visual elements were created using Metaverse AR technology, PhET simulations, and Wordwall to help students learn exploratively. The review was conducted by three science subject experts who evaluated the media based on six main aspects: material suitability, tool durability, accuracy, efficiency, aesthetics, and safety. The assessment is carried out using a Likert scale of 1 to 5. Based on the experts' suggestions, improvements are made to several parts, such as increasing the durability of the tools against weather and adding battery and dynamo protectors to make the media safer to use in the school environment. After the prototype is completed, it is validated by media and material experts to assess the quality of the product based on specific criteria.

   1. Media expert validation assessed six aspects: effectiveness, ease of use, suitability, completeness, communicative interaction, and tool safety for students.
   2. Material expert validation assessed four aspects: content suitability, material completeness, ease of understanding, and clarity of concepts.

However, in the validity test, material experts and media experts used six aspects, namely material suitability, tool durability, tool accuracy, tool efficiency, aesthetics, and tool safety. In calculating the average rating scale, validators used the following formula:

Average Rating per Validator

$$P = \frac{Score\ obtained}{\text{Maximum score}} \times 100\%$$

Then, the final scores of the three validators were calculated using the following formula:

Final Value of Validation Test

$$\text{Final Value of Validation Test} = \frac{\sum validator\ final\ value}{\sum validator\ final\ value\ item}$$

Data Collection Techniques

In this study, the data used was collected through validation instruments given to media experts and material experts. The instruments were closed questionnaires with measurable indicators. These indicators covered six aspects of assessment, namely: material suitability, tool durability, accuracy, efficiency, aesthetics, and safety. Each aspect was further broken down into several indicators, and each indicator was assessed using a five-point Likert scale to quantitatively measure the suitability of AR-Spin Static Edusites learning media.

Data analysis was conducted using a descriptive quantitative approach, namely by calculating the percentage of media suitability based on the scores given by the validators.
The formula used refers to Arikunto (2019), as follows:

Table 1. Media Analysis Percentage Criteria

Interval Percentage	Category
$85 \leq P \leq 100$	Very suitable
$70 \leq P < 85$	Acceptable
$50 \leq P < 70$	Fairly acceptable
$25 \leq P < 50$	Less acceptable
$P < 25$	Very inadequate

Thiagarajan's 3D stages were adapted because they were considered more suitable for the development of learning media that intensively uses digital technology. This model emphasizes a regular, systematic, and time-efficient testing process, making it suitable for use in research on the development of Augmented Reality-based media and interactive websites. In practice, many modern R&D researchers choose to adapt Thiagarajan's four-stage (4-D) model into a 3D model (Define–Design–Develop), as it allows them to focus on design quality and initial validation without having to conduct extensive field trials in the early stages of development (Ramadhani, 2023; Arnidah, 2023).

Furthermore, the 3D model facilitates a faster development process. In the Define stage, researchers can clearly determine learning needs and objectives. The Design stage focuses on creating prototypes that take user needs into account. Meanwhile, the Develop stage leads to product completion through expert review and gradual refinement (Indaryanti, 2025). This approach has proven effective for technology-based projects because it allows developers to evaluate technical aspects, such as AR integration and PhET simulations, pedagogical aspects, such as the suitability of 3D learning materials and activities, and practical aspects, such as tool

durability and safety, in a sequential and controlled manner (Journal of Educational Sciences, 2025).

Therefore, the use of Thiagarajan's 3D model in this study was not only chosen because of its methodological practicality, but also supported by the latest empirical evidence showing that this model is effective in the development of technology-based learning media. The 3D model allows the development team to create products that are appropriate, easy to use, and can be adapted to the needs of schools—especially in places with limited resources—using less time and energy compared to R&D methods that require large-scale trials in the early stages (Ramadhani, 2023).

RESULT AND DISCUSSION

The development of integrated learning media in the form of AR-Spin Static Edusites is an innovative effort to overcome the limitations of conventional learning methods in schools, especially in science topics that are often delivered through lecture-based (teacher-centered) methods. These conventional methods, which are still dominant in many Indonesian educational institutions, tend to make students passive and less actively involved in the learning process. As a result, students' understanding of static electricity concepts is limited to theoretical aspects without holistic integration involving observation, exploration, and practical application (Sari et al., 2024). This research was conducted using a 3D development model (define, design, and development) to produce an innovative learning media development product in the form of integrated visual and IT media as a form of cross-material representation of science learning in the field of physics as well as a support for the learning activities of junior high school/MTs students in Ponorogo Regency.

The results of the analysis in the Define stage have determined the initial requirements and specifications for the development of AR-SPIN STATIC EDUSITES digital learning media focused on Static Electricity material. The initial analysis (needs analysis) shows a significant gap, where science learning is still dominated by lecture and textbook methods, causing students to have difficulty understanding abstract concepts due to the lack of interactive visual media. Therefore, digital media capable of presenting the concept of Static Electricity in a concrete manner is urgently needed. Analysis of junior high school/MTs students in Ponorogo Regency reinforces this need, as the majority of students are accustomed to actively using technology and have a visual learning style; around 80% of students find it easier to understand concepts through simulations and interactive videos. In line with this, the analysis of the concept of Static Electricity determined that visualization of processes, such as charge interaction or electron transfer, is essential for students to achieve a deep understanding (rather than just memorization). Based on these findings, the learning objectives were formulated so that students would be able to explain the concepts of electric charge and static electricity phenomena, as well as show examples of their application using interactive digital media. The final result of the Define stage is the design of the AR-SPIN STATIC EDUSITES media prototype, which will integrate Augmented Reality (AR) elements for concrete visualization, Google Sites as a navigation platform, and Game Spin as an interactive assessment tool.

Design Stage

1. Media Structure Design through Google Sites

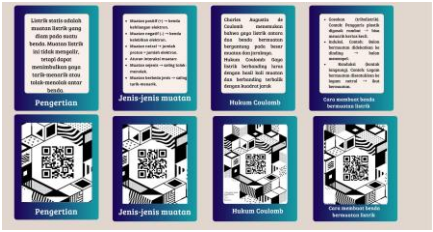
   Google Sites is used as a learning hub that contains all digital components. This site is designed so that students can access various learning resources such as text materials, learning videos, PhET simulations, and links to AR features and interactive games. Google Sites was chosen because it is easy to operate, compatible with various devices, and allows

direct integration with other Google services such as Drive, Forms, and YouTube. The page design is simple and responsive, consisting of eight main menus: Home Page, Learning Materials, Augmented Reality, Educational Videos, Games, Attendance, and Closing. The display can be seen in Table 1.

Table 1. AR-Spin Static Media Specifications Edusites

Figure 1. AR Media - Spin Static Edusites

Figure 2. Google Sites Barcode



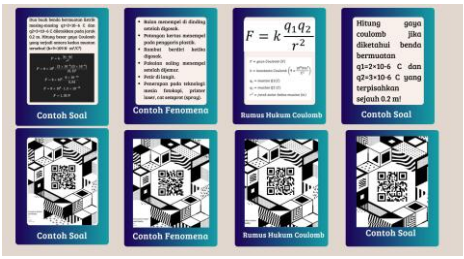


Figure 3. AR/Augmented Reality Flash Card

Figure 4. Google Sites Home Page Display

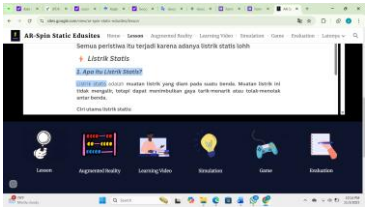


Figure 5. Google Sites Menu Display

This structure allows students to learn independently or in groups with a more enjoyable and focused learning experience.

1. Development of Augmented Reality (AR) Components through Assemblr Studio
   Augmented Reality (AR) components were developed using the Assemblr Studio platform. This platform is used to display 3D visualizations of static electricity phenomena. Students can see how positive and negative charges interact and observe the attractive force between charges. In addition, students can also understand the application of static electricity concepts in everyday life through these visualizations. This AR feature helps transform abstract concepts into visual experiences that are easier to understand.
   This AR content is linked to barcodes or QR codes that are integrated into Google Sites pages and Spin Game physical media. When the barcode or QR code is scanned, students are immediately directed to a 3D object display in the Assemblr studio. This strengthens the connection between digital media and interactive visual experiences.
2. Designing Electrical Circuits Using Aluminum Foil
   As part of a simple experiment-based learning method, this media uses physical electrical circuits that utilize aluminum foil as a current conductor. Aluminum foil was chosen because it is easy to find, safe to use, and can replace ordinary cables in simple learning activities.
   This circuit aims to demonstrate how electric charges move in real life, such as through induction and electrostatic force. In addition, the activity of building and observing the

reactions of this tool also helps train students' motor skills and builds their curiosity about the scientific phenomena around them.

Development Stage

The Develop stage is the final step in the R&D method using the 3D model, namely Define, Design, and Develop. At this stage, the AR-Spin Static Edusites product was developed and refined according to the design that had been made previously. The goal was to ensure that the media was suitable for use in science learning, especially static electricity material at the junior high school/MTs level. The development was carried out by compiling visual and interactive elements based on Google Sites that combine Augmented Reality (AR), PhET simulations, learning videos, Wordwall games, and AR Spin physical games.

Each part of the media was examined in terms of material integration, clarity of display, and ease of supporting student learning activities.

The feasibility of the media and material was tested by three validators, namely science teachers from junior high schools/MTs in Ponorogo Regency who served as media and material experts. The validation was carried out by filling out a digital questionnaire using Google Form which covered six aspects, namely material suitability, tool durability, accuracy, efficiency, aesthetics, and safety. Each aspect was assessed using a five-point Likert scale, where 1 = very unsuitable and 5 = very suitable. Furthermore, the results of the evaluation and validation by the experts also included comments or suggestions and recommendations for product revisions, which were then described by the researcher to be used as a basis for improving the media or product. The validation test results are presented in the following diagram.

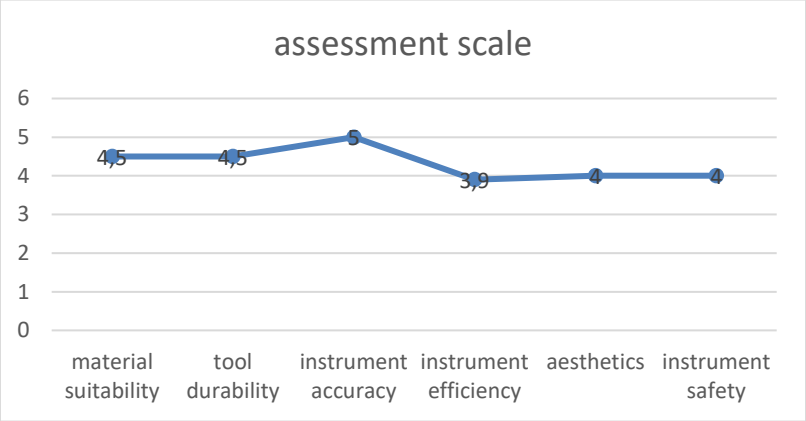


Figure 1. Results of Validation Test I

The results of media expert validation from one of the science teachers at Ponorogo State Junior High School show six assessment indicators, namely Material Suitability, Tool Durability, Tool Accuracy, Tool Efficiency, Aesthetics, and Tool Safety. Each indicator received a high score, with an average score of 4.0, which is considered acceptable. Some input from media experts stated that the AR-Spin Static Edusites media should be made more interesting by adding illustrative images to the material section. This resulted in a score percentage of:

$$P = \frac{4{,}0}{5} \times 100\% = 80\%$$

Overall, AR-Spin Static Edusites is considered good and suitable for use in science learning that bridges visual media and IT.

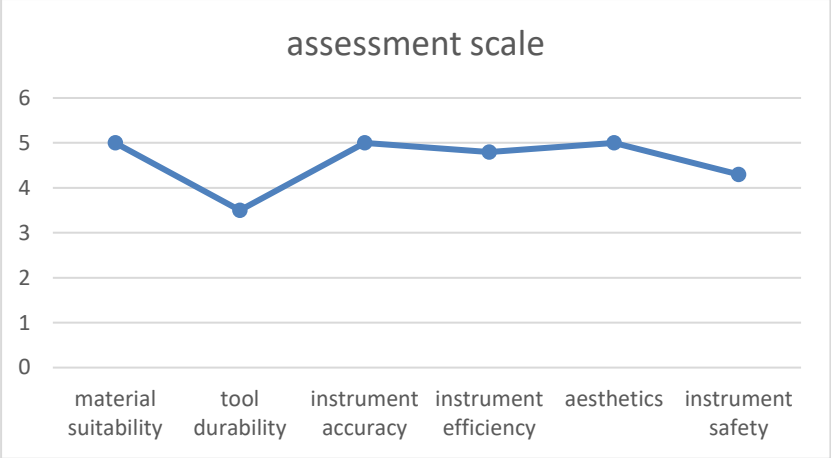


Figure 2. Results of Validation Test II

The results of media expert validation from one of the science teachers at a public junior high school in Pacitan Regency showed six assessment indicators, namely Material Suitability, Tool Durability, Tool Accuracy, Tool Efficiency, Aesthetics, and Tool Safety. Each indicator received a high score, with an average score of 4.5, which is considered very good. Some input from media experts stated that the AR-Spin Static Edusites media could be modified to make the equipment more waterproof and weatherproof, and that the aluminum foil could be simplified by using cables. However, using aluminum foil is also fine. The batteries should be placed in a box. The same applies to the dynamo to make it neater. This resulted in a score percentage of:

$$P = \frac{4{,}5}{5} \times 100\% = 90\%$$

Overall, AR-Spin Static Edusites is deemed excellent and suitable for use in science education, bridging visual media and IT.

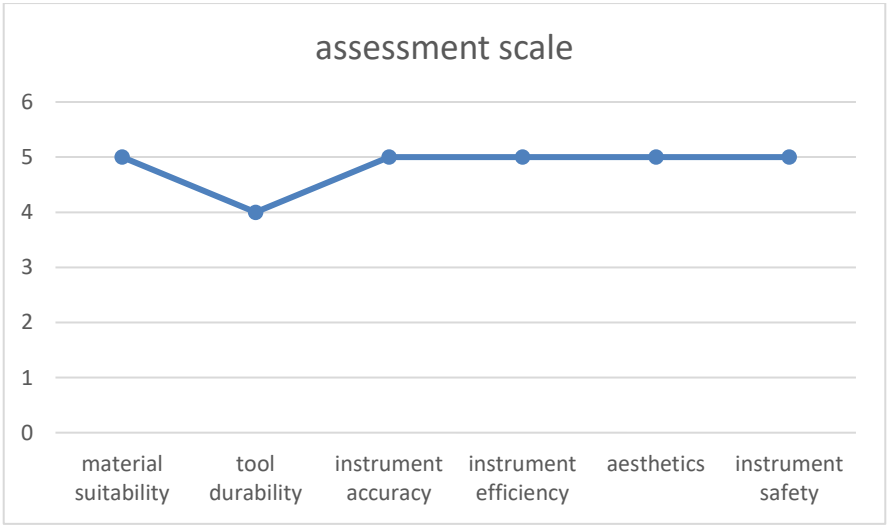


Figure 3. Results of Validation Test III

The results of media expert validation from one of the science teachers at a public junior high school in Pacitan Regency showed six assessment indicators, namely Material Suitability, Tool Durability, Tool Accuracy, Tool Efficiency, Aesthetics, and Tool Safety. Each indicator received a high score, with an average score of 4.8, which is classified as very good. Some

input from media experts stated that the AR-Spin Static Edusites media was appropriate in its choice of materials so that when moving classes, for example in rainy weather, the tools were still safe and could be used properly. This resulted in a score percentage of:

$$P = \frac{4,8}{5} \times 100\% = 96\%$$

Overall, AR-Spin Static Edusites is considered very good and suitable for use in science learning, bridging visual media and IT.

Based on the results of checks carried out by three validators, the overall average score was 4.0+4.5+4.8= 13.3 with 3 validator indicators, resulting in a Final Value of Validation Test using the formula:

$$\text{Final Value of Validation Test} = \frac{4,0 + 4,5 + 4,8}{3} = \frac{13,3}{3} = 4,43$$

This figure shows that the learning media created is included in the "very good" category based on the assessment criteria listed in Table 1. The assessment criteria include the percentage of media analysis. These results indicate that in general, the AR-Spin Static Edusites media can be used in the teaching and learning process because it has met several important aspects in the assessment, namely effectiveness, ease of use, material suitability, completeness of components, interactivity, and safety for students.

The discussion of the development results shows that AR-Spin Static Edusites successfully addresses the main problem, namely the lack of holistic understanding among students due to conventional learning methods. With a student-centered approach, this media allows students to interact directly in learning, such as operating and learning with Google Sites, scanning AR, and playing spinner media that encourages active exploration and enjoyable experience-based learning. This is in line with Piaget's theory of knowledge construction through interaction, where students build holistic understanding by connecting theoretical concepts, such as evaporation, with physical demonstrations. Compared to lectures, this diorama increases student engagement, as seen in the initial trial where students were able to explain the water cycle completely after using the media. Additionally, the use of recycled materials not only reduces production costs but also integrates environmental education, allowing students to learn about sustainability alongside science. This is supported by the results of research by Indayana, S. A., & Indrapangastuti, D. (2025). Which states that Augmented Reality (AR) based learning media is proven to be effective in improving elementary school students' science learning outcomes, because it helps them understand abstract concepts more realistically and interactively, encourages motivation and active participation, and shows significant improvements compared to methods without AR, with students feeling easier to understand, not bored, and challenged. The implications emphasize the integration of innovative technology in learning and teacher training for optimal implementation. Further research is suggested to focus on developing AR models tailored to student characteristics and the latest science curriculum, through experimental studies in various school contexts.

The combination of 3D visuals, games, and digital elements of AR-Spin Static Edusites is an innovative effort to overcome the limitations of conventional learning methods in schools, particularly in science topics that are often delivered through teacher-centered lectures. This conventional method, which is still dominant in many Indonesian educational institutions, tends to make students passive and less actively involved in the learning process. As a result, students' understanding of concepts such as static electricity is limited to theoretical aspects alone, without a holistic integration involving observation, exploration, and practical

application. This integrated media can increase student engagement through interactive simulations, thereby facilitating deeper understanding. (Sari et al., 2024)

The advantages of this media lie in its multifunctional integration as a visual, audio-visual tool that applies AR and web technology, which is interactive and educational. Technically, AR-Spin Static Edusites is capable of delivering static electricity material cyclically without excess electricity due to the use of aluminum foil as a substitute for cables, with simple components that are safe for teachers and students to use. The process of making and using it is practical for schools and can even reach 3T areas. However, there are limitations to digital media that require an internet connection and sufficient device storage space. The implications of this research for the world of education are its potential to be replicated in other science topics, such as dynamic electricity. With a validity of 86%, this media is ready for wider field testing, which is expected to improve the quality of science learning in Indonesia. Overall, this development shows that innovation in media based on recycled materials can be an effective solution to change the learning paradigm from teacher-centered to student-centered. Thus, students gain a more in-depth and meaningful holistic understanding.

In the context of related literature, this study is in line with previous studies such as that conducted by Arsyad (2013) on the development of interactive learning media, which emphasizes the importance of expert validation to ensure effectiveness. However, this study is limited to a small scale, so recommendations for further research include testing effectiveness on a larger sample and analyzing the long-term impact on student achievement. Thus, this water cycle diorama not only solves conventional learning problems but also contributes to inclusive and environmentally friendly educational innovation. The researchers hope that these findings will encourage schools to adopt similar media, making science learning more interesting and effective for the younger generation. Theoretically, this study reinforces the argument that learning media must be adaptive to student needs. With a focus on holistic understanding, this diorama integrates cognitive, affective, and psychomotor aspects that are often overlooked in lectures. The high validation results confirm that the R&D approach with a 3D model is effective for producing quality educational products. Further research could explore media variations for other topics, such as using recycled materials for ecosystem models.

CONCLUSION

Development of innovative AR-Spin Static Edusites learning media This media is a 3D Learning innovation that combines three main components: Google Sites as the material center, Augmented Reality (AR) for 3D visualization, and interactive spin games. The development method used is the Thiagarajan 3D R&D model, which includes the define, design, and develop stages. Validation by experts (science teachers) showed that AR-Spin Static Edusites has very high feasibility, with an overall average score of 4.43. This figure is equivalent to a percentage above 85% and places this media in the “Highly Feasible” category for use in the teaching and learning process. This development successfully overcomes the problems of conventional (teacher-centered) learning by providing a student-centered approach that encourages students to interact actively through AR scanning, the use of PhET simulations, and Wordwall games. This success proves that media that integrates visuals, AR technology, and simple physical tools can transform abstract concepts into a more concrete, in-depth, and enjoyable learning experience that is safe for both students and teachers to use.

With a high level of validity, AR-Spin Static Edusites has great potential to be replicated in other science topics and is ready to be tested for effectiveness in the field further. Suggestions for further research include conducting effectiveness trials on larger samples and analyzing the long-term impact on student academic achievement.

ACKNOWLEDGMENTS

The author would like to express his gratitude to Allah SWT for His abundant blessings and grace so that this research could be completed successfully. The author would also like to express his sincere appreciation and gratitude to his parents, who have always provided moral support and valuable advice throughout the research process. The author would also like to thank Mrs. Rahmi Faradisya Ekapti, S.Pd., M.Pd. as the supervising lecturer who has provided direction, guidance, and constructive input in the preparation of this research

REFERENCE

Abdullah, A., Achmad, A., & Sahibu, S. (2021). Media pembelajaran interaktif mata kuliah pemrograman web berbasis android. *Inspiration: Jurnal Teknologi Informasi dan Komunikasi*, *11*(1), 45-54.

Arnidah, A. (2023). *Pengembangan media video mengajar dengan menerapkan model 3D (Define–Design–Develop).* Jurnal Ilmiah Pengembangan Pendidikan, 7(2), 45–58.

Arrahma, A. (2025). *Google Sites Innovation as a Web-Based Learning Media*. *Jurnal Sains Edukasi dan Riset*.

Arsyad, A. (2013). Media pembelajaran edisi revisi. *Jakarta: Rajawali Pers*, *24*(4).

Fauziyah, & Arianto. (2020). Pemanfaatan teknologi digital dalam pembelajaran di era Society 5.0. (Catatan dikutip dalam teks).

Heydemans, C., & Elmunsyah, H. (2024). Systematic literature review: Use of augmented reality as a learning media: Trends, applications, challenges, and future potential. *Jurnal Nasional Pendidikan Teknik Informatika: JANAPATI, 13*(3). https://doi.org/10.23887/janapati.v13i3.78825

Indaryanti, R. B. (2025). *4D research and development model: A systematic review and applications in educational innovation.* Jurnal Kebijakan dan Inovasi Pendidikan, 2(1), 30–49.

Indayana, S. A., & Indrapangastuti, D. (2025). Inovasi Penggunaan Media Pembelajaran Berbasis Augmented Reality (AR) Untuk Meningkatkan Hasil Belajar IPAS Siswa Sekolah Dasar. In *Social, Humanities, and Educational Studies (SHES): Conference Series* (Vol. 8, No. 3, pp. 1762-1772).

Journal of Educational Sciences. (2025). *Application of the 3D model (Define–Design–Develop) in R&D for educational resources.* Journal of Educational Sciences, 14(3), 102–119.

Macedo, H. d. S., Felix d. S., I. T., & Oliveira d. S., E. L. (2023). *The power of attention: Bridging cognitive load, multimedia learning, and AI*. arXiv. https://doi.org/10.48550/arXiv.2311.06586

Mohamad, S. A., Zaharudin, R., Kamin, Y., & Md Noor, N. H. (2024). Integrating augmented reality with cognitive constructivist theory: A systematic review of enhancing learning in education. *Journal of Contemporary Social Science & Education Studies (JOCSSES), 4*(3 Special Issue), 124–132. https://doi.org/10.5281/zenodo.14048799

Ramadhani, I. K. (2023). *The development of augmented reality (AR) based learning media: Procedures and feasibility*. Journal of Pedagogical Innovation, 5(1), 12–27.

Romdhon, J., Masrifah, M., Shiyama, N. M., & Suharyati, H. (2024). Applying constructivist learning theory to enhance student learning outcomes in elementary schools. *International Journal of Sustainable Development & Future Society, 2*(2), 62–69. https://doi.org/10.62157/ijsdfs.v2i2.73

Sari, M., Sari Yunilarosi, E., Laili, U. F., & Yulita, N. (2024). Pengembangan Media Diaroma Terhadap Hasil Belajar Siswa Pada Materi Siklus Air Di SMP Negeri 4 Kota Bengkulu. *Indonesian Journal of Computer Science and Engineering*, *1*(02), 7–12. https://doi.org/https://doi.org/10.70656/ijcse.v1i02.116

Suaib, M., & Sutriyani, W. (2024). *The Effectiveness of Using Assemblr Edu Application Media Based on AR (Augmented Reality) on Understanding the Concept of Elementary School Geometry 3D*. *Indonesian Journal of Education and Mathematical Science*, 5(3), 190–196.

Tiara Putri, D., Umah, A. M., & Ahsanunadya, A. N. (2024). Kajian Penerapan Kurikulum Merdeka Dalam Pembelajaran IPA Di Salah Satu SMP di Kabupaten Ponorogo. *Jurnal Konatif: Jurnal Ilmiah Pendidikan*, *2*(1), 15-29.

Zin, Z. M., Abdullah, A. S., Ahmad, H., & Sahib, F. H. (2024). The constructivist learning theory: Exploring key technological advancements in learning management systems. *International Journal of Modern Education (IJMOE)*, *6*(23). https://doi.org/10.35631/IJMOE.623040