JPPIPA 12(7) (2026)

Jurnal Penelitian Pendidikan IPA

http://jppipa.unram.ac.id/index.php/jppipa/index

Development of Augmented Reality-Based EduTV Interactive Visual Media on Ecosystem Materials to Improve Elementary Students' Science Literacy

Rahmahtiawati Marfiyannur Rahmandita[1*], Wati Sukmawati[1]

[1] Department of Elementary School Teacher Education, Faculty of Teacher Training and Education, Universitas Muhammadiyah Prof. Dr. Hamka, Jakarta, Indonesia.

Received: May 10, 2026
Revised: June 14, 2026
Accepted: July 25, 2026
Published: July 31, 2026

Corresponding Author:
Rahmahtiawati Marfiyannur Rahmandita
rahmahtiawati@gmail.com

DOI: 10.29303/jppipa.v12i7.15972

Abstract: This study aimed to develop Augmented Reality (AR)-based EDUTV interactive visual media on ecosystem materials and evaluate its feasibility for improving elementary students' science literacy. The study employed a Research and Development (R&D) approach adapted from the 4D model, consisting of the Define, Design, Develop, and Disseminate stages. The participants were fifth-grade elementary school students. Data were analyzed using descriptive quantitative methods based on expert validation, media feasibility assessments, and student response questionnaires. The results showed that the developed media was highly feasible for classroom use. Material expert validation yielded a feasibility score of 96%, while media expert validation obtained a score of 92%, both categorized as excellent. Student responses indicated positive perceptions toward the media presentation (88.8%), science literacy-oriented content (90.0%), and learning motivation (91.7%). These findings demonstrate that the AR-based EDUTV interactive visual media is valid, feasible, and effective for supporting Science and Social Studies learning on ecosystem topics while enhancing elementary students' science literacy. The study also contributes to achieving Sustainable Development Goal 4 (Quality Education) through innovative digital learning.

Keywords: Augmented reality; EDUTV; Ecosystem; Elementary education; Science literacy

Introduction

Basic education plays an important role in developing students' scientific thinking skills from an early age. At the elementary school level, learning should not only enable students to remember concepts but also help them understand scientific concepts, relate knowledge to everyday life, and explain natural phenomena (Oktavia & Sukmawati, 2025). In elementary science learning, these competencies are closely related to science literacy because students need to understand their surrounding environment through logical and evidence-based reasoning (I. Sukmawati & Ghofur, 2023). Furthermore, science learning that integrates real-life experiences and local wisdom can improve students' science literacy by making the concepts more meaningful and relevant to their daily lives (W. Sukmawati et al., 2022). Therefore, Science and Social Studies learning at the elementary school level should be designed contextually so that students not only memorize scientific terms but also develop a deeper understanding of the concepts they learn (Sari et al., 2023).

Science literacy is one of the main skills that need to be developed in 21st century learning. This ability helps students understand scientific information, identify problems, explain phenomena, and make decisions based on their knowledge (Osborne & Allchin, 2025; Vodă et al., 2022). At the elementary school level, science literacy needs to be introduced through learning

How to cite:
Rahmandita, R. M., & Sukmawati, W. Development of Augmented Reality-Based EduTV Interactive Visual Media on Ecosystem Materials to Improve Elementary Students' Science Literacy. *Jurnal Penelitian Pendidikan IPA*, *12*(7). https://doi.org/10.29303/jppipa.v12i7.15972

activities that are simple, interesting, and in accordance with student development (Karningsih, 2022). According to Ifdaniyah et al. (2024) the increase in science literacy in grade V students can be seen from the change in students' ability to understand science material after participating in active and directed learning. This shows that science literacy does not arise automatically, but needs to be built through a learning process that gives students the opportunity to observe, discuss, ask questions, and relate the material to their own experiences (Fortus et al., 2022; Relmasira et al., 2023).

One of the Science and Social Studies learning materials that requires an in-depth understanding of concepts is the ecosystem (K. E. D. Putri et al., 2025). This material discusses the relationship between biotic and abiotic components, interactions between living things, food chains, and environmental balance. Even though the ecosystem material is close to daily life, some of the concepts in it are still difficult for students to understand if they are only conveyed through oral explanations or textbooks (Singh et al., 2024; Wennersten et al., 2023). Students are often familiar with terms such as producer, consumer, decomposer, or food chain, but do not necessarily understand the relationships between these parts in an environment (Averdunk et al., 2026). According to I. Sukmawati et al. (2023) the use of digital teaching materials that suit the needs of students has a relationship with science literacy skills because the material can be presented in a more directed, interesting, and easy to understand manner. Thus, ecosystem learning requires media that is able to display concepts in a concrete way and help students see the relationship between the material and the surrounding environment (Aprilia & Ratnasari, 2026; Zidan et al., 2023).

The limited learning media is one of the factors that can affect the low involvement of students in science learning (Febrina & Setiawan, 2024). Learning that only used package books and teacher explanations often makes students bored quickly because they do not get a varied learning experience (Liando et al., 2022). In materials that require visualization, students need media that can clarify the shape of objects, relationships between elements, and processes that occur in an ecosystem (Huang et al., 2022; Yasin et al., 2025). According to Hartomo et al. (2024), digital media such as flipbooks can help improve the science literacy of elementary school students because the material is presented visually, attractively, and more accessible. This opinion shows that technology-based media can be an alternative to improve the quality of Science and Social Studies learning, especially in materials that require visual assistance to make it easier to understand (Mushoda et al., 2026).

Despite the rapid development of digital learning technologies, many elementary schools still rely on textbooks and conventional teaching methods when teaching ecosystem concepts (Nguyen et al., 2023; Regmi, 2024). As a result, abstract concepts such as food chains, energy flow, and interactions among living organisms remain difficult for students to understand. Furthermore, there is still limited evidence regarding the effectiveness of integrating AR technology with EDUTV interactive visual media to improve elementary students' science literacy (Dewi et al., 2025). Therefore, developing innovative learning media is necessary to provide meaningful learning experiences and improve students' scientific understanding (Febrina & Setiawan, 2024; Rahim et al., 2022).

In line with technological developments, teachers need to develop learning media that is not only interesting, but also interactive and in accordance with the characteristics of elementary school students (Rachmadtullah et al., 2023; Samosir et al., 2023). Students at elementary school age tend to understand material more easily through images, colors, sounds, videos, and activities that engage them directly (Dey & Munshi, 2025; Khotimah & Hidayat, 2022; Yasin et al., 2025). One of the technologies that can be used in learning is Augmented Reality (AR), which is a technology that is able to display virtual objects into a real environment (Al-Ansi et al., 2023; Arena et al., 2022). According to Sukmawati et al. (2025) the integration of technology in learning can support the improvement of science literacy because students gain a more active learning experience and in accordance with digital developments. Therefore, the use of AR-based EduTV media is relevant to help students understand ecosystem material in a more concrete, interesting, and interactive way (Ibrahim et al., 2025).

Although previous studies have reported that Augmented Reality (AR) can improve students' motivation and conceptual understanding in science learning, most of them focus only on visualization or learning outcomes (Lampropoulos, 2024; Liu et al., 2023). Limited studies have integrated AR technology with EDUTV interactive visual media specifically for ecosystem learning while simultaneously examining its contribution to elementary students' science literacy (Safitri et al., 2025). Therefore, this study offers a novel approach by developing AR-based EDUTV interactive visual media that combines educational videos, three-dimensional visualization, and interactive learning activities to enhance science literacy in elementary education and support Sustainable Development Goal 4 (Quality Education) (Billa & Restian, 2026; Islamulmuflikhun et al., 2025; Septiani, 2025; Trisanti et al., 2025).

EduTV's Augmented Reality (AR)-based interactive visual media was developed as an alternative to Science and Social Studies learning media on ecosystem materials. This media combines educational videos, visual displays, audio, and three-dimensional objects so that students can learn through more real experiences. Through this medium, students not only read or listen to the teacher's explanation, but also can see learning objects that help them understand the components of the ecosystem and the relationships between its elements (Widiasih et al., 2023). According to Septiani (2025), the use of technology in education can support the improvement of digital skills and create a learning process that is more adaptive to the needs of the times. Based on this, this research was conducted to develop AR-based EduTV interactive visual media on ecosystem materials so that Science and Social Studies learning in grade V of elementary school becomes more interesting, active, and able to support the improvement of students' science literacy (Avivah et al., 2025).

Based on the identified research gap, this study aims to develop and evaluate AR-based EDUTV interactive visual media for ecosystem learning in elementary schools. The novelty of this research lies in integrating Augmented Reality technology with EDUTV interactive visual media to support science literacy through contextual ecosystem learning. This study is expected to provide an innovative digital learning solution that contributes to improving elementary science education and supports the achievement of Sustainable Development Goal 4 (Quality Education) (W. Sukmawati & Zulherman, 2023).

Method

This study employed the Research and Development (R&D) method to produce learning products as well as test their feasibility before being applied in the learning process. The product developed is in the form of Augmented Reality (AR)-based EduTV media on ecosystem materials to improve the science literacy of grade V elementary school students. According to Barta et al. (2023) AR-based media development needs to be carried out through the stages of analysis, design, development, implementation, and evaluation, and equipped with expert validation and user trials to ensure product feasibility. In line with that, (Widiasih et al., 2023) explained that the R&D method can be used to produce AR-based digital media through needs analysis, product design, development, implementation, and evaluation so that the media produced is in accordance with the characteristics and learning needs of students (Anggraeni & Mursid, 2025).

This study adopted the 4D development model proposed by Thiagarajan, Semmel, and Semmel, consisting of four stages: Define, Design, Develop, and Disseminate (Maydiantoro, 2021). The overall research procedure adopted in this study is illustrated in Figure 1.

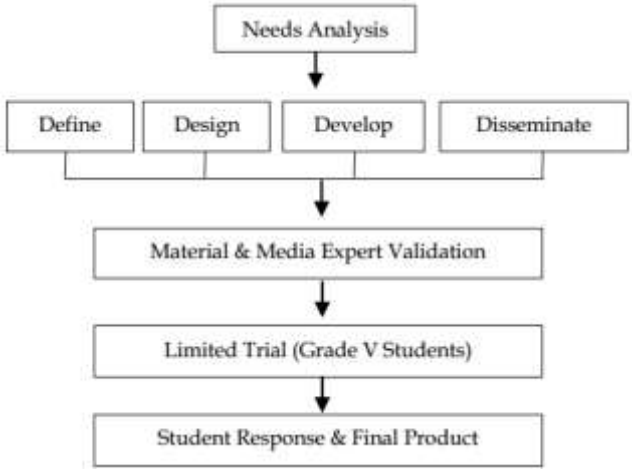

Figure 1. Flowchart

The research procedure consisted of four main stages based on the 4D development model: Define, Design, Develop, and Disseminate. Each stage was carried out systematically, beginning with a needs analysis, followed by media design and development, expert validation and product revision, and ending with a limited field trial and dissemination of the final product (Indaryanti et al., 2025).

The first stage, Define, is carried out to find out the needs and learning problems that occur in elementary schools, especially in ecosystem materials. Activities at this stage include observation, interviews with teachers, analysis of student characteristics, curriculum analysis, and analysis of the material to be developed. It is important to carry out the stages of needs analysis so that the media developed is in accordance with the learning conditions and needs of students (Indaryanti et al., 2025).

The second stage, namely Design, is carried out by designing AR-based EDUTV media. Activities at this stage include material preparation, storyboard making, media display design, preparation of research instruments, and design of three-dimensional objects used in AR applications. AR-based media design needs to pay attention to visual appearance, material clarity, and technological suitability so that media can help students understand abstract material in a more concrete way (Rauschnabel et al., 2022).

The third stage, namely Develop, is carried out by developing media according to the design that has been made. The finished product is then validated by media experts and subject matter experts to determine its level of eligibility. Input from validators is used as a basis for

product revisions until suitable media is obtained for use in learning. Expert validation and user feedback are an important part of developmental research to assess the feasibility of media before it is widely used (Izzati & Sukmawati, 2024).

The fourth stage is Dissemination or dissemination is carried out after the media is declared feasible. At this stage, AR-based EDUTV media is applied in a limited way in Science and Social Studies learning on ecosystem materials. In addition, the results of the research are also documented in the form of scientific articles as an effort to disseminate the results of development to teachers, schools, and other researchers.

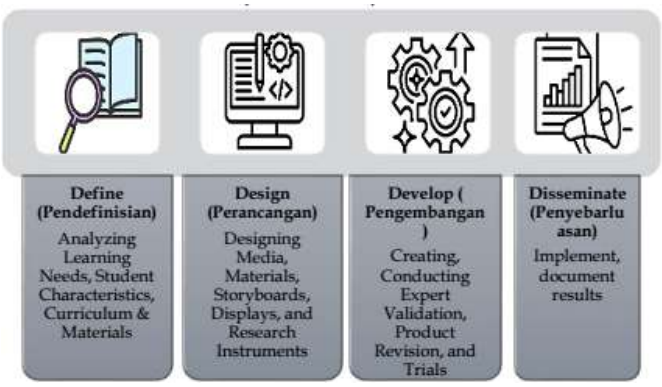

Figure 2. 4D development model

The research subjects consisted of media experts, material experts, and elementary school grade V students. The data collection technique used media expert validation sheets, material expert validation sheets, and student response questionnaires. The data obtained was analyzed using quantitative descriptive analysis techniques. The score of the student's validation and response results is calculated in the form of a percentage using the formula: Eligibility Percentage = (Score obtained/Maximum score) × 100%. The percentage of results is then interpreted based on the eligibility criteria of the learning media. Eligibility categories consisted of very feasible (81%–100%), feasible (61%–80%), moderately feasible (41%–60%), less feasible (21%–40%), and unfeasible (0%–20%). Augmented Reality (AR)-based EDUTV media is declared feasible for use if it obtains a feasible or very feasible category based on the results of expert validation and student responses.

Location and Research Participants

This research was conducted at SDN Ciracas 03, East Jakarta, Indonesia which is located in Ciracas District, East Jakarta Administrative City, Special Region of Jakarta Province. The selection of schools is based on the application of Science and Social Studies learning that has been in accordance with the applicable curriculum and student characteristics that support the development goals of learning media. In addition, SDN Ciracas 03 has adequate facilities to support the use of digital-based media, including the availability of simple technological tools and a learning environment that supports the implementation of learning innovations. The determination of the research location is also supported by the implementation of School Field Introduction (PLP) activities, so that researchers can directly observe the learning process that takes place in the classroom.

Figure 3. Learning activities

The participants in this study were 32 fifth-grade students from SDN Ciracas 03 during the 2025/2026 academic year who participated in learning activities using Augmented Reality (AR)-based EduTV media on ecosystem materials. The participants were selected using the purposive sampling technique, in which subjects were chosen based on specific characteristics that aligned with the objectives of the study. All participants were actively involved in Science and Social Studies learning and used the AR-based EduTV media developed through the Assembler Edu application. The implementation of the media enabled students to interact directly with three-dimensional visualizations of ecosystem concepts, providing a more engaging and contextual learning experience. Student participation throughout the learning activities also provided valuable feedback regarding the usability and practicality of the developed media. Therefore, the participants' involvement provided information on the feasibility of the developed media in enhancing learning motivation, active participation, understanding of ecosystem concepts, and science literacy (Ifdaniyah & Sukmawati, 2024).

AR-Based EduTV Learning Media

Augmented Reality (AR)-based contextual EduTV learning media is designed to provide a more real,

visual, and interactive learning experience for elementary school students. Through this media, ecosystem materials that were initially difficult to understand only through text or oral explanations can be displayed in the form of educational images, videos, and more concrete virtual objects. The combination of visual displays and AR technology helps students visualize abstract concepts. Al-Ansi et al. (2023) explained that AR creates an interactive and immersive learning environment that enhances student engagement and learning experiences. Especially in the abstract parts of the material such as the relationship between ecosystem components, food chains, and the interaction of living things with their environment. Thus, AR-based EduTV not only functions as a tool for delivering material, but also as a means to strengthen students' understanding through a more interesting and meaningful learning experience (Hartomo & Sukmawati, 2024).

Figure 4. Edutv

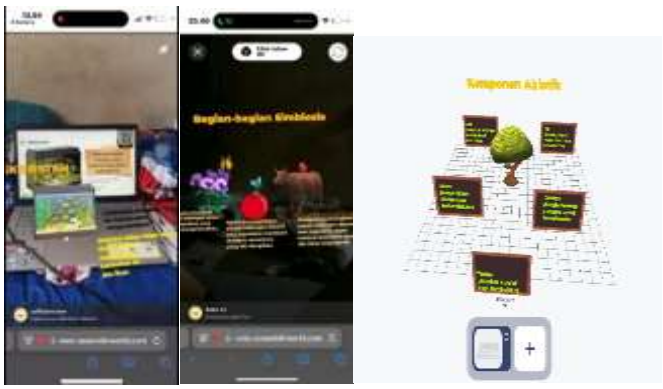

Figure 5. Augmented reality edu assembler app

In its application, the images contained in EduTV are not only presented as static media, but are developed into media that can be scanned through barcodes or AR markers. When students use devices such as tablets or smartphones, the image can display three-dimensional objects, animations, or other visual elements related to ecosystem material. According to Putri et al. (2024) this process makes students not only see pictures, but also can observe and explore learning objects directly. Learning activities become more dynamic because students are involved in the observation process, not just receiving information from the teacher. This is in line with the characteristics of elementary school students who are more likely to understand material through images, colors, movements, and concrete learning experiences (Hartomo & Sukmawati, 2024).

The contextual approach in AR-based EduTV media is also important because the learning material is associated with an environment that is close to students' lives. In ecosystem materials, the examples used can be related to the environment of homes, schools, parks, gardens, or living things that students often encounter on a daily basis. In this way, students can understand that ecosystems are not just concepts in books, but also part of the real environment they see and experience. According to Hariyadi et al. (2023), the use of visuals relevant to everyday life helps students build connections between scientific knowledge and their own experiences.

Figure 6. Students activate augmented reality-based edutv media

AR-based EduTV media also encourages students to be more active during the learning process. Students not only pay attention to the teacher's explanations, but can also interact with visual objects that appear through AR technology. These interactions can increase students' curiosity, attention, and motivation to learn because learning feels more lively and not monotonous. According to Billa et al. (2026), technology-based media provide opportunities for students to learn in a way that is more in line with the times. When students can see objects, try to scan images, and observe the results of AR visualizations, the learning process becomes more enjoyable while helping to strengthen the understanding of the concepts being learned.

Based on this description, AR-based contextual EduTV can be an alternative learning media that is suitable for Science and Social Studies learning materials in elementary schools, especially ecosystem materials. This media offers several advantages, including attractive visual presentation, interactivity, and contextual learning experiences connected to students' daily lives. Through a combination of educational

videos, images, animations, and three-dimensional objects, students can have a more concrete and immersive learning experience. However, the use of this media still requires the readiness of the device, the direction of the teacher, and adjustment to the classroom conditions so that learning runs optimally. With proper management, stating AR-based EduTV can help teachers create more interesting, active, and supportive learning of science literacy for elementary school students (Averdunk et al., 2026; Dey & Munshi, 2025; Huang et al., 2022).

Research Instruments

The main instrument of the research was a student response questionnaire to Augmented Reality (AR)-based EduTV media which contained 15 statements compiled from a grid of instruments for students. This questionnaire aims to measure students' understanding of the indicators used in the EduTV AR Media Presentation test. Assessment indicators include: (1) visual display quality and level of interactivity, (2) feasibility of contextual material presentation and integration of AR with content, and (3) benefits and learning motivation that arise from the use of AR on EduTV (W. Sukmawati et al., 2022).

To ensure the suitability of the content, validation is carried out by media experts and material experts. Each item on the validation sheet was systematically adjusted to the assessment grid of media experts (including visual clarity, quality of AR interaction, interface navigation, and aesthetic aspects) and subject matter experts (including concept suitability, content accuracy, comprehension, and relevance of local context). This process involves review by an expert panel, filling out a validity sheet, and revising items based on feedback to improve redaction and measurement focus (I. Sukmawati & Ghofur, 2023).

Table 1. Media Expert Validation Instrument Grid

Aspects	Indicator	Item
Visual Display	Attractive and suitable for elementary school students	1
	Neatly arranged layout of AR text and AR images	2
	Color combinations and layouts are easy to see	3
AR Quality	The display of the AR object corresponds to the learning material	4
	AR objects help students remotely understand the material	5
Interactivity	Media encourages active student interaction	6
Ease of Use	Users can switch pages/media easily	7
	Instructions for use are clear and easy to understand	8
	Practical media used in learning	9
Media Suitability	Aligned with learning objectives	10
	Supports the Improvement of Students' Science Literacy	11
	Contains innovative features and innovation	12
	Suitable for science learning	13
Language Feasibility	The language used is in accordance with the rules of the Indonesian Language Standard (KBBI)	14
	The language used in the media is easily understood by elementary school students.	15

Table 2. Material Expert Validation Instrument Grid

Aspects	Indicator	Item Number
Material Suitability	According to the Competencies and Learning Objectives	1
	Neatly arranged and consistent curriculum	2
Truth of the Concept	The concept of the material is presented scientifically	3
	No misconceptions	4
Material Completeness	Includes abiotic and biotic components	5
	The depth of the material according to the student's characteristics	6
Presentation of Materials	Examples given Help with the understanding of the material	7
	The order of the material is presented in a material is presented systematically	8
	Material related to daily life	9
Compatibility with Edutv AR Media	Material is compatible with EduTV and AR features	10
	Materials support learning achievement	11
Language and display	Language according to the level of student development and in accordance with Indonesian language standards	12
	Illustrations (images) are able to express the meaning/meaning of the object clearly	13
	Spacing, font size is clearly visible and legible	14
	Color combinations in the content of AR and edu tv materials Interactive and interesting	15

In addition to content validation, the questionnaire was piloted on a small group of students representing the study population to evaluate language clarity, response to AR features, and filling time. The trial data was analyzed descriptively to find less sensitive items; Problematic items are then revised or eliminated. Next, the internal consistency of the instrument is assessed (e.g. by calculating Cronbach's alpha) from the test results; this reliability value is the final consideration before the questionnaire is used in the main data collection (Al-Ansi et al., 2023).

The reliability of the instrument used a Likert scale with percentage-based eligibility criteria. Percentages of 0%–20% are categorized as unfeasible, 21%–40% are less feasible, 41%–60% are moderately feasible, 61%–80% are feasible, and 81%–100% are very feasible. These criteria are used to determine the feasibility level of Augmented Reality (AR)-based EduTV media developed. The higher the percentage obtained from the validation results, the higher the level of feasibility of media to be used in the Science and Social Studies learning process, especially in ecosystem materials in elementary schools. Media validation is carried out by media experts and material experts who assess various aspects, such as the suitability of the material content, the quality of the display, the level of interactivity, and the feasibility of media as an effective learning tool and in accordance with the characteristics of elementary school students. (Istiqomah & Sukmawati, 2023).

Data Collection Procedure

This study employed the Research and Development (R&D) method with a 4D development model consisting of the Define stage, Design (Design), Develop (Development), and Disseminate (Dissemination). The 4D model was chosen because it has systematic, structured, and suitable stages for use in the development of technology-based learning media, especially those that require an ongoing product validation and revision process (Indaryanti et al., 2025).

Each stage in the 4D model is carried out in stages from the analysis of needs to the dissemination of the products that have been developed. According to Nurjanah, with these clear stages, the development process of AR-based EDUTV learning media can run more in a more directional manner and produce products that are suitable for use in the learning process.

The research was conducted through several stages. It began with a needs analysis involving classroom observations, teacher interviews, curriculum analysis, student characteristics analysis, and ecosystem material analysis. The next stage involved media planning through storyboard development, AR-based EduTV design, and preparation of research instruments. Subsequently, the media was developed and validated by material and media experts, followed by product revision. The revised media was then implemented in a limited trial involving fifth-grade students. Finally, data were collected through student response questionnaires to evaluate Media Presentation and students' learning motivation.(Arrauyani & Sukmawati, 2025).

Data Analysis Techniques

The data were analyzed using quantitative descriptive analysis to determine the feasibility of the Augmented Reality (AR)-based EduTV learning media based on the validation results from media experts, material experts, and students' response questionnaires. The feasibility score was calculated using the percentage formula, which is commonly applied in learning media development research (Muhaimin & Zumrotun, 2023).

$$p = \frac{f}{N} \times 100\% \quad (1)$$

Description:
P = Percentage Score (%)
f = Total Score Obtained
N = Maximum Possible Score

The questionnaire employed a five-point Likert scale consisting of Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4), and Strongly Agree (5). The percentage scores obtained from the validation process were interpreted using the following feasibility criteria: 0.00–20.00% (not feasible), 21.00–40.00% (less feasible), 41.00–60.00% (moderately feasible), 61.00–80.00% (feasible), and 81.00–100.00% (very feasible). The developed media was considered suitable for implementation if it achieved a minimum score within the feasible category (≥ 61.00%).

The sustainability phase of EduTV media development based on Augmented Reality (AR) is focused on efforts to maintain the sustainable use of media in Science and Social Studies learning, especially in ecosystem materials. Media that has been declared feasible can be reused by teachers as an interactive, interesting, and in accordance with the characteristics of elementary school students. To strengthen the impact of its use, this media can be disseminated through classroom learning activities, discussions between teachers, and documentation of research results in the form of scientific reports or articles. The success of the use of AR-based EduTV media depends on the readiness of teachers, student involvement, and school support in implementing innovative learning media (A. Z. Septiani & Sukmawati, 2025).

Result and Discussion

The developed AR-based EduTV media was produced through the four stages of the 4D development model. In the Define stage, an analysis of learning needs, student characteristics, curriculum, and ecosystem materials was carried out as the basis for the development of Augmented Reality (AR)-based EduTV media. At the Design stage, learning materials, media interfaces, three-dimensional objects, and research instruments were designed. During the Develop stage, the prototype was developed and validated by media and material experts to determine its feasibility and obtain suggestions for revision. Finally, the Disseminate stage involved implementing the developed media with 32 fifth-grade students. The research data was obtained through the results of media expert validation, material expert validation, and student response questionnaire which was used to determine the feasibility of the developed media. The use of AR technology in learning media can provide a more interactive learning experience through the presentation of visual and virtual objects that help students understand learning concepts more concretely (AlGerafi et al., 2023).

Figure 7. Development process of AR-based EduTV media

Table 3. Bar Chart of Media Expert Assessment Results

Aspects	Question Item	Score	Maximum Score	Percentage	Overall Percentage
Visual Appearance	1	5	5	86%	92%
Aspect	2	4	5		
	3	4	5		
AR Quality Aspects	4	4	5	90%	
	5	5	5		
Interactivity	6	5	5	100%	
Ease of Use Aspect	7	5	5	93%	
	8	4	5		
	9	5	5		
Media Compatibility	10	4	5	95%	
Aspects	11	5	5		
	12	5	5		
	13	5	5		
Language Eligibility	14	5	5	90%	
Aspects	15	4	5		

Table 4. Material Expert Assessment Results

Aspects	Question Item	Value	Max	Percentage	Overall
Material Suitability	1	5	5	100%	90%
Aspects	2	5	5		
Aspects of Concept	3	5	5	100%	
Diversity	4	5	5		
Material	5	5	5	90%	
Completeness	6	4	5		
	7	5	5		
Aspects of Material	8	4	5	93%	
Presentation	9	5	5		
Aspects of	10	5	5	100%	
Compatibility with	11	5	5		
EduTV AR Media					
Aspect of Display	12	5	5	95%	
Language	13	5	5		
	14	4	5		
	15	5	5		

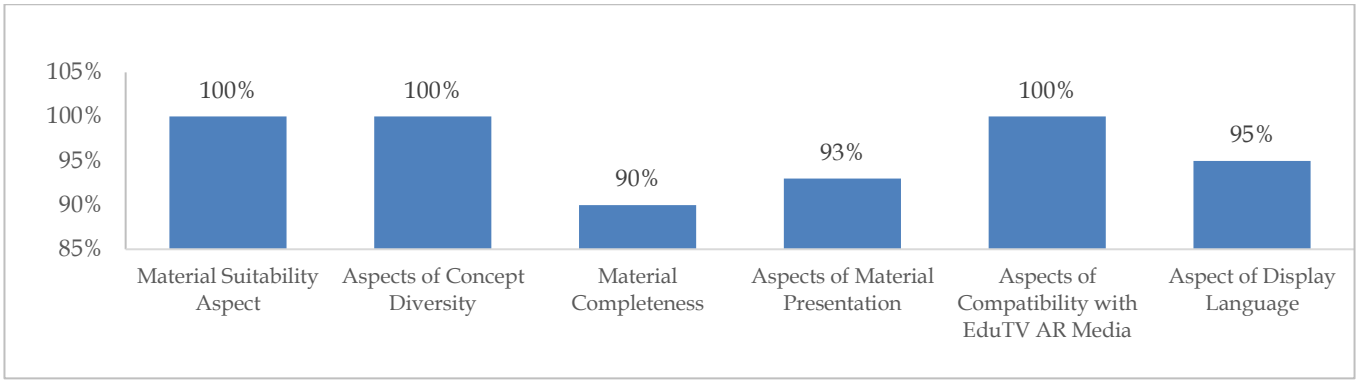

Figure 8. Bar diagram of material expert assessment results

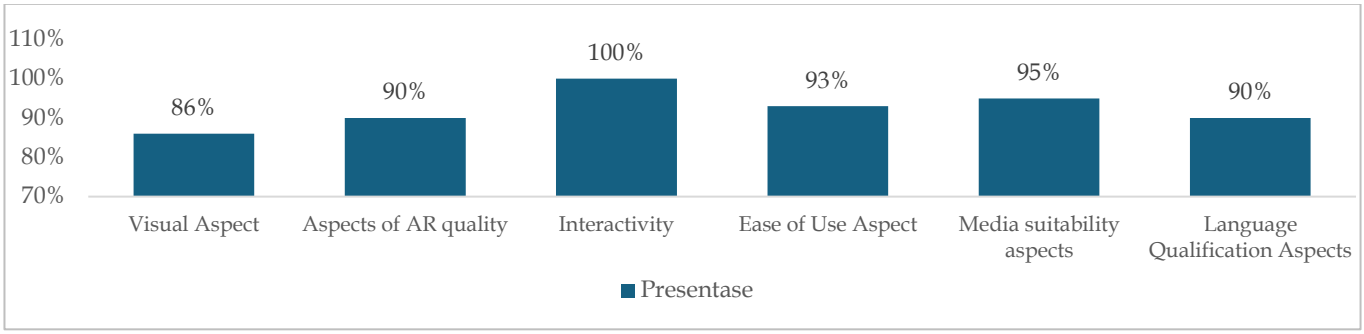

Figure 9. Bar diagram of media expert assessment results

Figure 7 illustrates the major stages of the media development process, beginning with the needs analysis conducted through teacher interviews and classroom observations, followed by media development using the Assembler Edu application. The figure also presents the expert validation process and product revision conducted before classroom implementation. These activities ensured that the developed media met both pedagogical and technical requirements prior to student trials.

Based on Table 3, the overall validation results from the media experts reached 92%, indicating that the developed AR-based EduTV media falls into the highly feasible category for use in elementary Science and Social Studies learning. The assessment covered visual appearance, AR quality, interactivity, ease of use, media suitability, and language appropriateness (Ismail et al., 2025).

As presented in Figure 9 and Table 3, the media expert validation results showed that the visual appearance aspect obtained 86%, AR quality 90%, interactivity 100%, ease of use 93%, media suitability 95%, and language appropriateness 90%. All assessed aspects were categorized as highly feasible, indicating that the developed AR-based EduTV media is visually attractive, interactive, easy to use, and appropriate for elementary Science and Social Studies learning (Huang et al., 2022; Ibrahim et al., 2025).

As shown in Figure 10 and Table 4, the material expert validation produced an overall score of 96%, which falls into the highly feasible category. The evaluation covered material suitability, conceptual accuracy, content completeness, material presentation, compatibility with the AR-based EduTV media, and language appropriateness. These findings indicate that the ecosystem content is scientifically accurate, appropriate for the learning objectives, and suitable for fifth-grade elementary students.

Student Respondent Questionnaire

The student response to the Visual Edutv Media based on Augumented reality was carried out by grade V B students at SDN Ciracas 03. The following presents student respondent data on Edutv visual media based on Augumented reality.

Based on Table 5, students gave positive responses toward the developed media, with an overall percentage of 90%, indicating that the media was highly feasible. The highest score was obtained in the learning motivation aspect (91.7%), followed by science literacy-oriented content (90.0%) and media presentation (88.8%). These findings indicate that students perceived the developed media as engaging, easy to use, and supportive of classroom learning.

The findings of this study are consistent with those reported by Azhari et al. (2026), who found that AR-based learning media significantly improved students' behavioral, emotional, and cognitive engagement, leading to better conceptual understanding in primary science learning. Similarly, Sattar et al. (2025) reported

that AR-enhanced instruction significantly increased students' learning achievement, motivation, and classroom participation compared to conventional instruction (Fitria & Sukmawati, 2024).

Table 5. Student Response Questionnaire Results

Assessment Aspects	Number of Question Items	Obtained Score	Max Score	Percentage
Media Presentation	5	711	800	88.8
Science Literacy	7	1.108	1120	90.0
Learning Motivation	3	445	480	91.7
Category	Very Feasible	Very Feasible	Very Feasible	Very Feasible
Overall		90%		

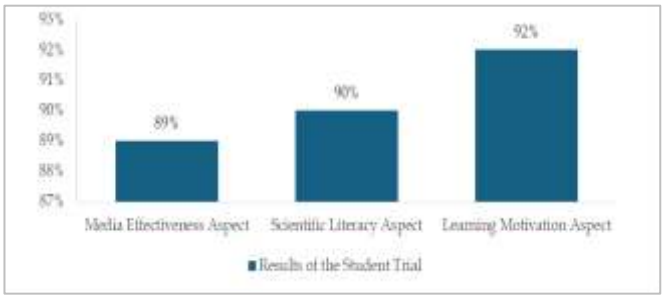

Figure 10. Trial results for class V B students

These findings also support the constructivist perspective proposed by Afnan et al. (2024), which suggests that AR facilitates meaningful learning through interactive visualization of abstract concepts. Therefore, the present study further confirms that integrating AR technology with EduTV interactive visual media can support science literacy and create more engaging learning experiences for elementary school students.

Conclusion

This study developed Augmented Reality (AR)-based EduTV interactive visual media on ecosystem materials using the 4D development model, consisting of the Define, Design, Develop, and Disseminate stages. The validation results showed that the developed media achieved a score of 92% from media experts and 96% from material experts, indicating that it is highly feasible for use in elementary Science and Social Studies learning. The assessments confirmed that the media met the criteria for visual quality, AR functionality, interactivity, ease of use, content suitability, and language appropriateness. The limited trial involving 32 fifth-grade students showed highly positive responses, with an overall average score of 90%. Students also gave favorable evaluations regarding the media presentation, science literacy-oriented content, and learning motivation. These findings indicate that the AR-based EduTV media is appropriate and well accepted as an innovative learning medium for ecosystem materials. Further studies using experimental designs, such as pre-test and post-test measurements, are recommended to examine its effectiveness in improving students' science literacy and learning outcomes.

Acknowledgments

The author expressed his gratitude to the supervisor for the direction and input given during the research process and article preparation. Gratitude was also conveyed to SDN Ciracas 03, VB class teachers, media expert validators and material experts, as well as all VB class students who have participated in the implementation of the research. This research does not receive grants or special funding support from government, private, or other organizations.

Author Contributions

Conceptualization, R.M.R. and W.S.; methodology, R.M.R.; software, R.M.R.; validation, R.M.R. and W.S.; formal analysis, R.M.R.; investigation, R.M.R.; resources, R.M.R.; data curation, R.M.R.; writing—preparation of original drafts, R.M.R.; writing—review and editing, W.S.; Visualization, R.M.R.; supervision, W.S.; project administration, R.M.R.; acquisition of funding, does not apply. All authors have read and approved the published version of the manuscript.

Funding

This research was funded by private funds.

Conflict of Interest

The author states that there is no conflict of interest.

References

Afnan, M. Z., & Puspitawati, R. P. (2024). Exploration of biological concept understanding through augmented reality: A constructivism theory approach. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *10*(3), 1139–1147. https://doi.org/10.22219/jpbi.v10i3.36896

Al-Ansi, A. M., Jaboob, M., Garad, A., & Al-Ansi, A. (2023). Analyzing augmented reality (AR) and virtual reality (VR) recent development in education. *Social Sciences and Humanities Open*, *8*(1), 100532. https://doi.org/10.1016/j.ssaho.2023.100532

AlGerafi, M. A. M., Zhou, Y., Oubibi, M., & Wijaya, T. T. (2023). Unlocking the Potential: A Comprehensive Evaluation of Augmented Reality and Virtual Reality in Education. *Electronics (Switzerland)*,

12(18). https://doi.org/10.3390/electronics12183953

Anggraeni, M. A. P., & Mursid. (2025). Historical Islamic TV as Storytelling-Based Educational Media for Early Childhood Cognitive Development. *TEMATIK: Jurnal Pemikiran Dan Penelitian Pendidikan Anak Usia Dini*, *11*(2), 227–235. https://doi.org/10.26858/tematik.v11i2.11022

Aprilia, S., & Ratnasari, J. (2026). Integration of Local Wisdom in CTL Learning to Improve Conceptual Understanding of Plant Diversity in Junior High School Students. *Bioilmi: Jurnal Pendidikan*, *XII*(1), 26–38. https://doi.org/10.19109/bioilmi.v12i1.36559

Arena, F., Collotta, M., Pau, G., & Termine, F. (2022). An Overview of Augmented Reality. *Computers*, *11*(2). https://doi.org/10.3390/computers11020028

Arrauyani, S., & Sukmawati, W. (2025). The Effect of the Use of HBA Media (Human Body Anatomy) on the Understanding of the Human Body Skeleton Concept in Grade VI Elementary School Students. *Jurnal Penelitian Pendidikan IPA*, *11*(9), 926–933. https://doi.org/10.29303/jppipa.v11i9.11690

Averdunk, C., Zabel, J., & Bergmann-Gering, A. (2026). From individuals to populations to cyclic interactions: investigating secondary students' descriptions of food web interactions. *Journal of Biological Education*, *60*(3), 402–428. https://doi.org/10.1080/00219266.2025.2502381

Avivah, N. A., Suttrisno, & Yulia, N. M. (2025). Development of Ar Interactive Learning Media on Ecosystem Material to Improve Critical Thinking Abilities in Grade V Students. *Journal of Primary Education and Learning Development (JPELD)*, *5*(4), 1509–1518. https://doi.org/10.58737/jpled.v5i4.663

Azhari, N. P., & Nugraha, F. A. (2026). Biofun AR : Enhancing Primary Student' s Engagement in Science Learning through Augmented Reality A . Introduction Education is widely recognized as one of the fundamental pillars of individual development and societal progress. Through education. *Jurnal Didaktika Pendidikan Dasar: Direktorat Guru Pendidikan Dasar, Kemendikdasmen RI*, *10*(1), 19–40. https://doi.org/10.26811/didaktika.v10i1.2085

Barta, S., Gurrea, R., & Flavián, C. (2023). Using augmented reality to reduce cognitive dissonance and increase purchase intention. *Computers in Human Behavior*, *140*(August). https://doi.org/10.1016/j.chb.2022.107564

Billa, Y. S., & Restian, A. (2026). Development of Augmented Reality-Based Scansmart Card Media to Improve Elementary Students' Understanding of Photosynthesis in Support of SDG 4 (Quality Education). *Jurnal Penelitian Pendidikan IPA*, *12*(1), 797–805. https://doi.org/10.29303/jppipa.v12i1.14281

Dewi, M., Apriza, B., & Dinata, K. B. (2025). The Effectiveness of Wordwall Interactive Media in Teaching Mathematics in Elementary School: A Systematic Literature Review. *Mimbar PGSD Undiksha*, *13*(1), 127–137. https://doi.org/10.23887/jjpgsd.v13i1.92352

Dey, A., & Munshi, S. A. (2025). Fun with Images: An Analysis of the Role of Visual Literacy in Facilitating Easy and Enjoyable Learning with a Focus on Future Prospects. *Libri*, *75*(2), 109–127. https://doi.org/10.1515/libri-2024-0143

Febrina, V., & Setiawan, D. (2024). Analysis of the Use of Learning Media on the Learning Interest of Learning Science Students and Environmental Themes. *Jurnal Penelitian Pendidikan IPA*, *10*(8), 5702–5709. https://doi.org/10.29303/jppipa.v10i8.7497

Fitria, A., & Sukmawati, W. (2024). The Influence of Magnetic Media Usage on Improving Reading Literacy Skills in Material Understanding of Objects in Second Grade Elementary School. *Jurnal Penelitian Pendidikan IPA*, *10*(9), 6426–6433. https://doi.org/10.29303/jppipa.v10i9.7991

Fortus, D., Lin, J., Neumann, K., & Sadler, T. D. (2022). The role of affect in science literacy for all. *International Journal of Science Education*, *44*(4), 535–555. https://doi.org/10.1080/09500693.2022.2036384

Hartomo, R. M., & Sukmawati, W. (2024). The Effect of Digital Flipbook Media on Improving Science Literacy on Human Digestive System Materials Among Elementary School Students. *Jurnal Penelitian Pendidikan IPA*, *10*(9), 6260–6270. https://doi.org/10.29303/jppipa.v10i9.7994

Huang, C. Y., Chou, Y. Y., Chen, C. H., & Tsai, Y. H. (2022). Applying Activity System-Based Process Model in Augmented Reality-Based Learning for Natural Science Course in Elementary School. *Mobile Information Systems*, *2022*. https://doi.org/10.1155/2022/9579766

Ibrahim, M. B., Pramono, S. E., Fakhruddin, F., & Subali, B. (2025). Implementation of Augmented Reality-Based Pop-Up Books to Enhance Elementary Students' Understanding of Ecosystem Concepts. *Unnes Science Education Journal*, *14*(3), 535–544. https://doi.org/10.15294/usej.v14i3.36081

Ifdaniyah, N., & Sukmawati, W. (2024). Analysis of Changes in Students' Science Literacy Ability in Class V Elementary School Science Learning Using the RADEC Model. *Jurnal Penelitian Pendidikan IPA*, *10*(2), 681–688. https://doi.org/10.29303/jppipa.v10i2.3952

Indaryanti, R. B., Harsono, H., Sutama, S., Murtiyasa, B., & Soemardjoko, B. (2025). 4D Research and Development Model: Trends, Challenges, and Opportunities Review. *Jurnal Kajian Ilmiah*, *25*(1), 91–98. https://doi.org/10.31599/na7deq07

Islamulmuflikhun, A., Rochmah, E., & Putra, N. P. (2025). Development of E-Learning Materials Assisted by Augmented Reality in the Science Subject of Water Cycle Material for Grade V Elementary Schools. *Jurnal Penelitian Pendidikan IPA*, *11*(2), 1157–1168. https://doi.org/10.29303/jppipa.v11i2.10346

Istiqomah, N., & Sukmawati, W. (2023). Stacking Analysis of the Mastery of Science Concepts in the RADEC Learning Model for Grade IV Elementary Students. *Jurnal Penelitian Pendidikan IPA*, *9*(10), 7993–8000. https://doi.org/10.29303/jppipa.v9i10.3999

Izzati, T. G., & Sukmawati, W. (2024). Increasing Science Literacy through Make a Match Learning Media on Human Growth Materials in Class V of Elementary School. *Jurnal Penelitian Pendidikan IPA*, *10*(9), 6541–6551. https://doi.org/10.29303/jppipa.v10i9.7995

Karningsih, K. (2022). Improving Students' Social Skills Using Literacy-Based Learning on Social Science. *Proceedings of the International Conference on Madrasah Reform 2021 (ICMR 2021)*, *633*, 147–153. https://doi.org/10.2991/assehr.k.220104.022

Khairi, H. I., & Sukmawati, W. (2025). The Influence of Comic Media in the Team Games Tournament (TGT) Model to Improve Science Literacy in Elementary School Class III Animal Life Cycle Materials. *Jurnal Penelitian Pendidikan IPA*, *11*(8), 622–628. https://doi.org/10.29303/jppipa.v11i8.11538

Khotimah, H., & Hidayat, N. (2022). Interactive Digital Comic Teaching Materials to Increase Student Engagement and Learning Outcomes. *International Journal of Elementary Education*, *6*(2), 245–258. https://doi.org/10.23887/ijee.v6i2.46038

Lampropoulos, G. (2024). Teaching and learning natural sciences using augmented reality in preschool and primary education: A literature review. *Advances in Mobile Learning Educational Research*, *4*(1), 1021–1037. https://doi.org/10.25082/amler.2024.01.013

Liando, N. V. F., Tatipang, D. P., Tamboto, G., Poluan, M., & Manuas, M. (2022). Pictures as a Learning Media in Teaching Vocabulary. *Jurnal Ilmiah Universitas Batanghari Jambi*, *22*(3), 1944. https://doi.org/10.33087/jiubj.v22i3.2832

Liu, Q., Ma, J., Yu, S., Wang, Q., & Xu, S. (2023). Effects of an Augmented Reality-Based Chemistry Experiential Application on Student Knowledge Gains, Learning Motivation, and Technology Perception. *Journal of Science Education and Technology*, *32*(2), 153–167. https://doi.org/10.1007/s10956-022-10014-z

Mushoda, E., Haq, E. D., & Adiningsih, S. (2026). The Use of Visual Learning Materials to Improve Learning Outcomes in Natural and Social Sciences (IPAS) in Elementary Schools. *The Prime*, *2*(1), 88–101. https://doi.org/10.37459/theprime.v2i1.561

Nguyen, L. T., Kanjug, I., Lowatcharin, G., Manakul, T., Poonpon, K., Sarakorn, W., Somabut, A., Srisawasdi, N., Traiyarach, S., & Tuamsuk, K. (2023). Digital Learning Ecosystem for Classroom Teaching in Thailand High Schools. *SAGE Open*, *13*(1), 1–14. https://doi.org/10.1177/21582440231158303

Oktavia, N., & Sukmawati, W. (2025). STEM Learning Using the RADEC Model on Elementary School Students' Electrical Materials in Improving Students' Science Literacy Skills. *Jurnal Penelitian Pendidikan IPA*, *11*(8), 636–643. https://doi.org/10.29303/jppipa.v11i8.11541

Osborne, J., & Allchin, D. (2025). Science literacy in the twenty-first century: informed trust and the competent outsider. *International Journal of Science Education*, *47*(15–16), 2134–2155. https://doi.org/10.1080/09500693.2024.2331980

Putri, K. E. D., Agung, A. A. G., & Sutyaningsih, A. A. A. D. (2025). Problem-Based Learning Video on Ecosystem Harmony for Social Science Subject (IPAS) in Grade 5 Elementary School Students. *Jurnal Ilmiah Sekolah Dasar*, *9*(1), 78–89. https://doi.org/10.23887/jisd.v9i1.91565

Putri, N. T., & Sukmawati, W. (2024). Improving Science Literacy in Elementary Schools Through the Application of the RADEC Model. *Jurnal Penelitian Pendidikan IPA*, *10*(8), 6230–6238. https://doi.org/10.29303/jppipa.v10i8.7993

Rachmadtullah, R., Setiawan, B., Wasesa, A. J. A., & Wicaksono, J. W. (2023). Elementary school teachers' perceptions of the potential of metaverse technology as a transformation of interactive learning media in Indonesia. *International Journal of Innovative Research and Scientific Studies*, *6*(1), 128–136. https://doi.org/10.53894/ijirss.v6i1.1119

Rahim, F. R., Sari, S. Y., Sundari, P. D., Aulia, F., & Fauza, N. (2022). Interactive design of physics learning media: The role of teachers and students in a teaching innovation. *Journal of Physics: Conference Series*, *2309*(1). https://doi.org/10.1088/1742-6596/2309/1/012075

Rauschnabel, P. A., Felix, R., Hinsch, C., Shahab, H., & Alt, F. (2022). What is XR? Towards a Framework for Augmented and Virtual Reality. *Computers in Human Behavior*, *133*(May), 107289. https://doi.org/10.1016/j.chb.2022.107289

Regmi, B. N. (2024). Interdisciplinary Issues in Education Comprehensive Teaching Strategies : Learning Ecosystems for Twenty- first Century. *Interdisciplinary Issues in Education*, *2*(2), 61–71. https://doi.org/10.3126/iie.v2i2.71767

Relmasira, S. C., Lai, Y. C., & Donaldson, J. P. (2023). Fostering AI Literacy in Elementary Science, Technology, Engineering, Art, and Mathematics (STEAM) Education in the Age of Generative AI. *Sustainability (Switzerland)*, *15*(18). https://doi.org/10.3390/su151813595

Safitri, D., Marini, A., Irwansyah, P., & Sudrajat, A. (2025). Transforming environmental education with augmented reality: A model for learning outcome. *Social Sciences and Humanities Open*, *12*(December), 101796. https://doi.org/10.1016/j.ssaho.2025.101796

Samosir, E. D. B., Agung, A. A. G., & Suartama, I. K. (2023). Interactive Learning Media Based on Character Education in Indonesian Subjects for Grade 1 Elementary Schools. *Indonesian Values and Character Education Journal*, *6*(1), 12–23. https://doi.org/10.23887/ivcej.v6i1.57720

Sari, G. S., Mustadi, A., Nugroho, I. A., & Limiansih, K. (2023). Optimizing the Science Literacy Abilities of Elementary School Teacher Education Students Through Electrical Material Practicum. *Jurnal Penelitian Pendidikan IPA*, *9*(12), 12213–12220. https://doi.org/10.29303/jppipa.v9i12.5726

Sattar, M. A., Maqbool, M. U., Zakir, F., & Billah, M. (2025). Enhancing student engagement through augmented reality in secondary biology education. *Frontiers in Education*, *10*(September), 1–11. https://doi.org/10.3389/feduc.2025.1628004

Septiani, A. Z., & Sukmawati, W. (2025). The Effectiveness of Digital Learning with the Application of Solar System Scope on the Understanding of Solar System Material Concepts in Grade VI Elementary School Students. *Jurnal Penelitian Pendidikan IPA*, *11*(9), 275–283. https://doi.org/10.29303/jppipa.v11i9.11687

Septiani, M. (2025). Utilizing Interactive Learning Media Based on Augmented Reality to Improve Concept Understanding in Science Learning. *Indonesian Journal of Teachingand Learning for Education*, *01*(01), 15–22. Retrieved from https://e-journal.berrymediaresearc.com/ijtle/article/view/4

Singh, D. S., Pratap Singh, D. D., & Chandra, M. K. (2024). Enhancing Transparency and Interpretability in Deep Learning Models: A Comprehensive Study on Explainable AI Techniques. *Interantional Journal of Scientific Research in Engineering and Management*, *08*(02), 1–13. https://doi.org/10.55041/ijsrem28675

Sukmawati, F., Qodr, T. S., & Rutambuka, T. (2025). Integrating Digital Games into Project-Based Learning to Enhance Student Achievement in STEM Education. *IJORER : International Journal of Recent Educational Research*, *6*(2), 294–315. https://doi.org/10.46245/ijorer.v6i2.744

Sukmawati, I., & Ghofur, M. A. (2023). Pengembangan E-LKPD Berbasis Problem Based Learning Terintegrasi Keterampilan 4C untuk Meningkatkan Kemampuan Berpikir Kritis Peserta Didik pada Mata Pelajaran Ekonomi. *Jurnal Paedagogy: Jurnal Penelitian Dan Pengembangan Pendidikan*, *9*(1), 2022. https://doi.org/10.33394/jp.v10i4.8626

Sukmawati, W., Sari, P. M., & Yatri, I. (2022). Online Application of Science Practicum Video Based on Local Wisdom to Improve Student's Science Literacy. *Jurnal Penelitian Pendidikan IPA*, *8*(4), 2238–2244. https://doi.org/10.29303/jppipa.v8i4.1940

Sukmawati, W., & Zulherman, Z. (2023). Analysis of Changes in Students' Scientific Literacy Ability After Attending Lectures Using the RADEC Model. *Jurnal Penelitian Pendidikan IPA*, *9*(3), 1039–1044. https://doi.org/10.29303/jppipa.v9i3.2846

Trisanti, N., Rahayu, Y. S., & Sunarti, T. (2025). Analysis of Junior High School Students' Scientific Literacy Skills in Supporting the Achievement of Sustainable Development Goals (SDGs). *Jurnal Penelitian Pendidikan IPA*, *11*(9), 113–119. https://doi.org/10.29303/jppipa.v11i9.12193

Vodă, A. I., Cautisanu, C., Grădinaru, C., Tănăsescu, C., & de Moraes, G. H. S. M. (2022). Exploring Digital Literacy Skills in Economics and Social Sciences and Humanities Students. *Sustainability (Switzerland)*, *14*(5), 1–31. https://doi.org/10.3390/su14052483

Wennersten, L., Wanselin, H., Wikman, S., & Lindahl, M. (2023). Interpreting students' ideas on the availability of energy and matter in food webs. *Journal of Biological Education*, *57*(1), 3–23. https://doi.org/10.1080/00219266.2020.1858935

Widiasih, W., Zakirman, Z., & Ekawati, R. (2023). Development of Augmented Reality Media to Improve Student Understanding of Optical Eyes System Materials. *Jurnal Penelitian Pendidikan IPA*, *9*(2), 912–919. https://doi.org/10.29303/jppipa.v9i2.2858

Yasin, R., Zibar, C., & Parisu, L. (2025). Visual Media as a Driver of Interest in Learning Natural Science In Elementary Schools. *International Journal of Management and Education in Human Development*, *5*(1), 1553–1557. Retrieved from http://www.ijmehd.com/

Zidan, Z., Maftuhah, M., Yusti, D., Rahmat, A. A. R., Riandi, R., & Kusnadi, K. (2023). Learning strategies on ecosystem concepts and environmental change: A pedagogical study analysis. *Assimilation: Indonesian Journal of Biology Education*, *6*(2), 141–152. https://doi.org/10.17509/aijbe.v6i2.59777