

Development Of Augmented Reality Using The Four-D Model In Ipas Learning For Grade 5 Elementary School

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ABSTRACT

This research aims to develop Augmented Reality (AR) learning media for the IPAS subject on the topic of Harmony in Ecosystems for 5th-grade students at SD Negeri 1 Kedungpring, Lamongan Regency. The research is motivated by low student learning outcomes, with 57% of students not meeting the Minimum Completeness Criteria (KKM), and learning activities that are monotonous with minimal use of interactive digital media. This development research employed the Four-D (4D) model (Define, Design, Develop, Disseminate). The resulting final product is an AR-based teaching module that is interactive, easily accessible, and engaging. The validation results from material experts, design experts, and media experts showed a very good category with an overall average validation score of 4.68 and a validity percentage of 94%. Product trials also indicated a positive response from peers and students. In conclusion, the developed Augmented Reality media is declared feasible/valid and effective in enhancing student motivation and understanding of the IPAS material, while also facilitating teachers in visualizing abstract concepts through interactive three-dimensional objects.

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Introduction

Education has a tremendous influence on the continuity of human life. It serves as the foundation for shaping human behavior and improving the quality of life. Essentially, humans are the most perfect of God's creations. The term *Al-Insan* attached to humans refers to their social competence and ability to master knowledge. The progress of a nation is significantly influenced by its human resources, and education becomes the key to developing these resources in order to advance and improve the nation's quality of life in line with Indonesia's national goals. Educational processes occur not only formally but also non-formally, continuing from birth throughout a person's lifetime—commonly referred to as lifelong education—and taking place both inside and outside the classroom.

From an Islamic perspective, education also holds a crucial role. As stated in Surah Al-'Alaq, the first surah revealed in the Qur'an, the command *iqra'* (read) emphasizes the importance of reading. Reading and writing are fundamental skills that every human must master to pursue education. Essentially, education is a systematic process of acquiring learning experiences that enable learners to solve various life problems. Education serves as a tool to enhance thinking skills and shape human quality, allowing individuals to think more progressively and develop. (Permadi et al., 2026)

Today, education and learning processes continue to evolve and improve. They advance alongside rapid technological development. The paradigm shift in Indonesian education has prompted continuous curriculum updates, as seen in the current national curriculum, the Merdeka Curriculum. In this curriculum, teachers are required not only to serve as information providers but to function as facilitators who meet students' learning needs. One effort to create effective learning is the utilization of learning aids, commonly known as learning media.

The use of learning media in schools, especially at the elementary level, is still relatively limited—particularly digital technology-based media. For example, at SD Negeri 1 Kedungpring in Lamongan Regency, technology-based learning media have not been optimally utilized. This is evident from the minimal use of digital devices and interactive learning applications, resulting in less varied learning activities that fail to fully accommodate students' learning needs in today's digital era. (Abdulghani & Sya'ban, 2026)

This condition is worsened by students' low learning outcomes, particularly in the IPAS subject for Grade 5. Learning results from the first semester of the 2024/2025 school year show a success rate of only 43% among 30 students indicating that more than half of the class failed to meet the school's Minimum Mastery Criteria (KKM). Therefore, efforts are needed to improve learning quality through the use of more innovative media aligned with technological advancements.

From an educational technology perspective, learning media have an appealing attractiveness that enhances students' cognitive processes and thinking skills. Learning integrated with technology is particularly crucial for elementary students, whose cognitive development is still in the concrete operational stage as described by Jean Piaget (Hasibuan et al., 2024). At this stage, learners begin to develop logical thinking based on real or directly experienced objects. Augmented Reality (AR) emerges as a technological solution in education, providing semi-real learning experiences that make learning more meaningful.

Based on this background, the researcher is interested in developing digital learning media—specifically Augmented Reality—to improve students' learning outcomes. AR serves as an effective tool for teachers because it can present material in the form of text, images, audio, 3D visuals, and videos, thus enhancing students' understanding of the material (Putra et al., 2022).

This AR media development research will be conducted in Grade 5 at SD Negeri 1 Kedungpring, Lamongan Regency. The low comprehension of learning material, the lack of media utilization, and monotonous learning activities are the main reasons for conducting this study. Teachers tend to rely on classical teaching methods using lectures and one-way communication. Although facilities exist, they are not well-utilized, and teachers' technological competence remains low. Limited technological mastery among teachers is a common problem in the digital era; teachers who are not proficient with technology are often less motivated to adopt new technology-based learning approaches.

Augmented Reality emerges as an innovative solution in education. It is relatively easy to use and does not require advanced technical skills. AR allows teachers to present material interactively, visualizing abstract concepts, increasing student engagement, and improving comprehension.

Besides benefiting the learning process, this research is relevant to technological developments in the digital age. Early exposure to technology helps students prepare for future challenges, as technological literacy is an essential skill for life and the workforce. By becoming familiar with technology from an early age, students will be better equipped to face digital-era challenges.

Previous AR-related research has been conducted in various schools. For example, at SD Negeri Gambaran, Wonosobo, Central Java (Novianti & Nisa, 2023), the use of the Assembler Studio app in two cycles of Classroom Action Research enhanced learning outcomes and motivation. Another study at SMA Negeri 1 Gowa (Thahir & Kamaruddin, 2021) also showed improved learning outcomes in Biology.

A third study in SDN 2 Lakarsantri Surabaya (Untari et al., 2022) involved 43 Grade 5 students and demonstrated that AR significantly enhanced problem-solving abilities in Mathematics, particularly in geometry. Similarly, research in SDN 065015 Medan (Ginting & Tambunan, 2023) found that AR using Assemble Edu improved learning outcomes in thematic subjects.

Another study (Nurdiana Agustin et al., 2024) showed that AR positively influenced students' conceptual understanding of the human circulatory system in Grade 5. In SD Muhammadiyah Karangwaru Yogyakarta (Rahmawati, 2022), AR improved English vocabulary mastery. Meanwhile, Putro & Yugopuspito (2024) found that AR increased writing and speaking skills in Bahasa Indonesia but had no significant effect on critical thinking.

Despite these findings, several gaps remain. Most existing AR studies focus only on 3D visualization, whereas the current study aims to develop more interactive media, including labeling, short explanatory texts, simple questions, and audio elements to enhance student engagement and comprehension. Learning media must also align with the technological development of the era in which they are created.

Additionally, AR development research has rarely been conducted in rural areas. This study, conducted in Kedungpring District, Lamongan, addresses the gap, as most previous studies were conducted in urban schools where students are more familiar with technology. Implementing AR in rural schools is crucial to reducing educational disparities and identifying specific challenges such as limited infrastructure and insufficient teacher training.

Method

The research method employed is Research and Development (R&D), adopting the Four-D (4D) model which encompasses the stages of Define, Design, Develop, and Disseminate. The *Define* stage commences with an initial needs analysis, learner analysis, concept analysis, and learning objective analysis to identify both problems and media requirements. Subsequently, the *Design* stage focuses on the product creation, specifically an Augmented Reality (AR)-based teaching module complete with a *barcode*, and the preparation of assessment instruments (questionnaires). The *Develop* stage involves the AR media development process using applications like Assemblr Edu and rigorous validation by three experts (material, design, and media) to ascertain product feasibility. This is followed by limited trials conducted on 2 peer teachers and 30 5th-grade students at SD Negeri 1 Kedungpring. Finally, the *Disseminate* stage is carried out on a limited basis to users at the research location. The collected data is qualitative in nature, obtained through questionnaires utilizing a Likert scale, and analyzed using qualitative descriptive techniques to ensure the developed product is both feasible and effective for use.

Result

The augmented reality (AR) learning media developed for Grade 5 IPAS underwent a comprehensive validation and testing process involving material experts, design experts, media experts, peer reviewers, and student user groups. The validation aimed to ensure accuracy, feasibility, usability, and overall quality of the product before classroom implementation.

1. Expert Validation Analysis

The material expert assessed relevance, accuracy, clarity, organization, and suitability for Grade 5 learners. The AR product obtained an average score of 4.50 (90%), categorized as *very good*. The highest rating appeared in the media quality aspect, showing that AR effectively supports conceptual understanding and aligns with students' developmental needs. The expert concluded that the product is accurate, comprehensive, systematically structured, and able to increase learning motivation.

Design validation focused on visual appeal, layout consistency, readability, navigation, technological standards, and accessibility. The AR media received an exceptionally high average score of 4.87 (97%), categorized as *very good*. Visualization, technological functions, and accessibility achieved excellent ratings. The expert highlighted the AR media as highly feasible while suggesting enhancements such as adding references and institutional logos.

Media validation evaluated technical performance, interactivity, compatibility, clarity of visuals and audio, and responsiveness. The AR product achieved an average score of 4.60 (92%), categorized as *very good*. Technical aspects reached 94%, while presentation quality reached 89%. The validator emphasized the need to improve print quality, add references, and refine the cover design.

Across all expert validators, the product consistently demonstrated strong feasibility, high accuracy, and suitability for Grade 5 IPAS learning.

2. Field Testing

Field testing was conducted in three stages—small group, medium group, and large group—along with peer evaluation by teachers.

Peer Evaluation involved two senior teachers. The AR media scored an average of 4.75 (95%), classified as *very good*. Teachers confirmed that the media supports content delivery, enhances student engagement, and serves as an innovative alternative to conventional teaching tools. They recommended implementing the media across other subjects as well.

Small-Group Trial with two students yielded an average score of 4.60 (92%). Students found the media interesting, easy to use, and helpful in understanding the material. They expressed the desire to use AR for other subjects.

Medium-Group Trial with ten students produced an average score of 4.75 (95%). Students reported increased enjoyment, better comprehension, and improved memory retention. The media encouraged active learning and offered interactive learning experiences.

Large-Group Trial with thirty Grade 5 students resulted in an average score of 4.72 (94%). Students consistently rated the AR product high in attractiveness and accessibility. The media was perceived as engaging, easy to navigate, and helpful in comprehending IPAS concepts.

Across all trial stages, students showed strong enthusiasm, improved participation, and higher motivation to learn using AR media.

3. Data Analysis Summary

Combined validation and trial results across all subjects produced an overall average validation score of 4.68 (94%), indicating that the AR product is *highly feasible* and suitable for classroom use.

The validation process showed strong results across all subjects, with a score of 4.50 from the material expert, 4.87 from the design expert, and 4.60 from the media expert. The peer reviewers provided a score of 4.75, while the small group trial yielded 4.60, the medium group trial 4.75, and the large group trial 4.72. Overall, the product achieved an average score of 4.68, equivalent to 94%, and was categorized as Very Good.

The combined data confirm that the AR learning media significantly enhances understanding, engagement, and accessibility for Grade 5 learners

C. PRODUCT REVISION SUMMARY

Product revisions were made based on feedback from experts, peer reviewers, and student users. Key improvements include:

- Material Expert Suggestions: Expand AR development for other subjects requiring concrete visualization.
- Design Expert Suggestions: Add references, include a preface, and place the university logo on the front cover.
- Media Expert Suggestions: Improve print quality, enhance image clarity, add more references, and ensure high-quality materials.

- Peer Reviewer Feedback: Consider developing AR for lower-grade subjects and producing larger, library-friendly editions.
- Student Feedback: Students reported increased interest and preferred using AR media for other topics and subjects.

Revisions were applied to improve accuracy, readability, visual quality, layout, and technical functionality. The final version of the product showed enhanced design consistency and improved overall usability.

The augmented reality-based learning product developed in this study underwent a complete Four-D development process—Define, Design, Develop, and Disseminate. The final product review aimed to examine its characteristics, strengths, validity, and its impact on IPAS learning for Grade 5 students at SD Negeri 1 Kedungpring, Lamongan.

Discussion

1. Characteristics of the Final Product

The final product is an interactive AR-based teaching module aligned with the Grade 5 topic *Harmony in Ecosystems*. The module integrates images, barcodes, and 3D elements accessible through the Assemblr Edu application. It is designed with engaging visuals, supportive color schemes, readable fonts, and a systematic layout appropriate for Grade 5 learners. The product is available in printed form and can be readily used by both teachers and students.

2. Product Trial Results

The AR module successfully passed expert validation involving a material expert, design expert, and media expert. All experts provided high validation scores: **4.50 (90%)** for material, **4.87 (97%)** for design, and **4.60 (92%)** for media—classified as very good. Field implementation included peer reviews and student trials in small, medium, and large groups. Each stage produced mean scores above **4.60** with validation percentages over **92%**, indicating highly positive responses. Teachers and students highlighted the module's visual appeal, ease of use, ability to enhance conceptual understanding, and its motivational impact during IPAS learning.

3. Impact on Learning

The AR product significantly improved teaching effectiveness and classroom engagement. It made learning more interactive and enjoyable, strengthened students' understanding of ecosystem concepts, and increased their creativity and active participation. Many students expressed interest in using similar AR-based media for other subjects.

4. Recommendations for Further Development

Revisions have been incorporated based on expert and user feedback, including adding the Universitas PGRI Adi Buana Surabaya logo, improving print quality, enriching references, and enhancing paper quality. Overall, the product is considered feasible for wider implementation in IPAS learning and has strong potential to be adapted for other subjects and educational levels with appropriate content and design adjustments.

Conclusion

Based on the results of the development research on augmented reality using the Four-D model in IPAS learning for Grade 5 elementary school students, the following conclusions can be drawn:

1. The product developed is an augmented reality learning media created using the Assemblr Edu platform supported by Canva, containing Grade 5 material for Chapter 2: *Harmony in Ecosystems*.

2. The augmented reality product has been validated by experts, including a material expert, design expert, and media expert. The results of these validations indicate that the AR product for IPAS learning in Grade 5 is highly feasible for use, with an overall feasibility percentage of 94%.
3. The product is considered effective for classroom learning, as shown by positive user responses. The small-group, medium-group, and large-group trials all produced scores above 4.60, demonstrating strong acceptance and usability.
4. Product revisions based on feedback from experts and users have successfully improved the quality of the AR media, making it suitable for implementation in elementary school learning environments.
5. This research contributes significantly to the use of digital technology as an innovative learning medium aligned with the Merdeka Curriculum and Deep Learning approaches.

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