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DEVELOPMENT OF AUGMENTED REALITY (AR)-ASSISTED HANDOUT TEACHING MATERIALS FOR SCIENCE SUBJECTS FOR GRADE VI STUDENTS OF SD NEGERI 7 KAMPUNGDALEM TULUNGAGUNG

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Abstract*— Education in schools plays a strategic role in preparing reliable human resources for development. Thus, the educational outcomes achieved in schools are expected to help students prepare for their future lives. Education is defined as a deliberate act aimed at improving human qualities. In the ever-evolving digital era, education has undergone significant changes. Teachers seek innovative and interactive learning methods to address the challenges of understanding concepts and maintaining student interest. In this context, Augmented Reality (AR) emerges as a promising technology to enhance interactive learning. The purpose of this study is to develop Augmented Reality-assisted handout teaching materials, test the validity of the teaching material development products, and determine the applicability of Augmented Reality-assisted handout teaching materials products in the Science subject for sixth-grade students of SD Negeri 7 Kampungdalem. This research method uses the ADDIE model which consists of analysis, design, development, implementation, and evaluation. The instruments used are validation questionnaires from media experts, material experts, student response questionnaires, and teacher response questionnaires. . The criteria obtained from the validation of media expert I obtained a percentage score of 98% which was declared very valid, while for media expert II obtained a percentage score of 85% with very valid criteria. The percentage validity criteria of material expert I obtained 94% with very valid criteria, while for material expert II obtained a percentage score of 90% with very valid criteria. The student response criteria obtained 88% with very good criteria, and the teacher response questionnaire obtained a percentage score of 92% with very good criteria. So it can be concluded that the development of Augmented Reality-assisted handout teaching materials on the subject of Science for grade VI students of SD Negeri 7 Kampungdalem is very valid to be used in the learning process.

***Keywords*— Augmented Reality, Handout, Teaching Materials, IPAS, Elementary School**

I. INTRODUCTION

Education is an act that changes and determines human life, both for teachers and students. For students, education is a means that enables them to grow as human beings. Meanwhile, for teachers, educating means determining an attitude and way of life that they believe can embody the principles and human values that shape their entire lives [1]. Education plays a crucial role in enhancing human resource quality and national progress. Quality education can be achieved through optimal learning processes in schools [2].

Education in schools has a very strategic role in preparing reliable human resources for development. Thus, the results of education obtained in schools are expected to help students prepare themselves for their future lives. Education means a deliberate act to make humans better. From not knowing to knowing, from not understanding to understanding, and so on [3].

The use of learning tools can create a situation that enables students to acquire knowledge and skills. Learning tools take the form of teaching materials that contain various types of learning materials, methods, and various limitations. The development of teaching materials is currently very rapid, starting from teaching materials that only contain text to the emergence of other teaching materials of various types, such as modules, student worksheets, student books, and handouts. Interesting teaching materials can support enjoyable learning [4].

Based on interviews conducted with sixth-grade teachers at State Elementary School 7 Kampungdalem, it was found that students still face various difficulties in understanding the material taught in IPAS, especially the material on the Solar System. These difficulties may be caused by several factors, such as a lack of understanding of basic concepts and the use of uninteresting learning media. Teachers also

revealed that some students tend to be passive in the learning process, so they experience obstacles in developing a deep understanding of the material presented.

One way to overcome these problems is to innovate in the use of more interesting and interactive teaching materials to improve student understanding. The development of teaching materials is divided into four parts, namely 1) Mapping of learning indicators, 2) Learning activities, 3) Current information, and 4) Practice questions. One form of teaching material is a handout, which is a printed teaching material that is concisely compiled from a combination of several literature sources and is in line with the basic competencies, indicators, and learning objectives that have been determined. A handout is a teaching material containing material in accordance with basic competencies that is concisely compiled to make it easier for students to expand their knowledge so that they can easily achieve the desired competency objectives. The development carried out involves adding handouts based on HOTS. Handouts are chosen because they offer several benefits, including serving as supplementary materials, whether for content provided in textbooks or delivered directly [5].

The conclusion from the above explanation is that the use of learning tools, including instructional materials, is crucial in supporting effective and enjoyable learning. Teaching materials come in various forms, such as modules, worksheets, supplementary books, and handouts, designed to help students acquire knowledge and skills. One effective form of teaching material is the handout, which is concisely structured based on core competencies, indicators, and learning objectives. Handouts facilitate students' understanding of the material and help them achieve learning objectives, especially when developed using a HOTS-based approach. Handouts also serve as supplementary materials that support the learning process optimally. With the advancement of technology today, handout teaching materials can be made more interesting by integrating existing technologies. One technology that can be integrated with handout teaching materials is Augmented Reality (AR) technology.

In this ever-evolving digital age, education has undergone significant changes. Teachers are seeking innovative and interactive learning methods to overcome challenges in understanding concepts and maintaining students' interest. In this context, Augmented Reality (AR) has emerged as a promising technology for enhancing interactive learning. Augmented Reality is a technology that combines real-world elements with virtual elements, creating a rich and immersive experience for users. Using hardware such as cameras, sensors, and graphic displays, AR can present additional information in real-time over physical objects. This technology allows users to see and interact with the real world enhanced by virtual elements. Therefore, IPAS learning becomes very interesting when integrated with Augmented Reality (AR) technology. Science and social studies (IPAS) learning in elementary schools often faces challenges. Abstract material and a lack of interactive learning media cause students' understanding to be less than optimal.

IPAS is a study of science that discusses living things and their interactions with the environment and the universe. For example, humans are living beings and cannot survive alone. In short, IPAS is a combination of natural science (IPA) and social science (IPS) lessons [6]. In the current independent curriculum, IPA and IPS subjects are combined into one subject called IPAS. At this level, IPA focuses on introducing basic concepts of natural science, such as understanding the environment, properties of objects, and elements of nature. Students are also taught how to conduct observations, simple experiments, and data analysis [7].

Several studies have revealed that students face difficulties in understanding solar system material. Factors such as lack of interest in the IPAS subject, limited teaching methods, and insufficient use of engaging learning media are the primary causes [8]. The development of AR-assisted handout teaching materials in IPAS subjects is expected to increase students' interest and understanding. Through interactive visualization, students can more easily understand the functions and processes occurring in the IPAS subject. Additionally, the use of AR technology can boost students' learning motivation, particularly for sixth graders who are beginning to explore the advancements in technology [2].

[9] state that the essence of the learning process in upper grades (grades 4, 5, and 6) is learning that is carried out logically and systematically to teach students concepts and generalizations so that they can apply them (solving problems, combining, connecting, separating, arranging, sequencing, folding, and dividing). Sixth-grade elementary school students who have reached the age of 11 have understood the formal operational stage of development. This means a cognitive development that indicates that students already have the ability to think critically or scientifically. The development of scientific attitudes in upper-grade elementary school students can be done by creating learning experiences where students dare to argue and ask questions, encouraging them to have a desire to know, and to have an honest attitude towards themselves and others [10].

Based on the background described above, the expected outcome of this research is the creation of Augmented Reality-assisted handout teaching materials for IPAS learning. Therefore, research was conducted with the title “Development of Augmented Reality-assisted Handout Teaching Materials for IPAS Subjects for Sixth Grade Students at SD Negeri 7 Kampungdalem Tulungagung.”

II. METHODS

This research is a type of research and development (R&D) that uses the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. In the analysis stage, needs are identified through interviews and observations of students and teachers. The

design stage involves the preparation of handout structures and content sketches to be displayed. Next, in the development stage, the product is created using Canva for handout design and Assemblr Studio for AR technology integration. The product is then tested on sixth-grade students at SD Negeri 7 Kampungdalem. Validation is conducted by two media experts, two subject matter experts, and through survey responses from students and teachers. Data is analyzed using descriptive quantitative methods to determine the product's validity and applicability.

III. DISCUSSION

The development of Augmented Reality (AR)-assisted handout teaching materials for IPAS subjects was carried out with the aim of improving the quality of learning, particularly in understanding Solar System material for sixth grade students. Learning Solar System material is often considered abstract and difficult to understand due to the lack of interactive visual media. Therefore, the integration of AR technology into the handout teaching materials was designed to address this issue by presenting celestial objects in three-dimensional form that can be observed in real-time through digital devices.

The product development process followed the ADDIE model, which includes five stages: analysis, design, development, implementation, and evaluation. The analysis stage revealed that teachers and students at SD Negeri 7 Kampungdalem faced difficulties in understanding and conveying Solar System material. This was evident from interview results indicating that the media used were limited to textbooks, and students often felt bored and less active in learning. This situation underscored the need for the development of technology-based learning media to enhance student engagement and understanding.

In the design stage, the researcher designed the structure of the handout teaching materials in accordance with the learning outcomes of the Merdeka Curriculum. The handout was designed with an attractive layout, containing concise material, illustrations, practice questions, and links to AR visualizations developed using the Assemblr Studio application. The use of this technology allows students to point their device's camera at a specific QR code and view celestial objects such as planets, asteroids, and satellites in 3D form that can be rotated and zoomed in on, thereby enhancing visual understanding.

The development phase continued with a validation process conducted by two media experts and two subject matter experts. Media expert I assigned a validity score of 98%, while media expert II assigned a score of 85%, both of which fall within the highly valid category. Similarly, subject matter expert I assigned a score of 94%, and subject matter expert II assigned a score of 90%. These scores indicate that the developed teaching materials meet the criteria for content, presentation, language, and technology used. Some suggestions from the validators were also used to make revisions before testing the materials with students.

The implementation stage was carried out through a limited trial in the sixth grade of SD Negeri 7 Kampungdalem. This pilot test involved the responses of students and teachers to the use of the teaching materials. The survey results showed that students gave a positive response with a score of 88%, indicating an excellent category. Meanwhile, teachers gave a response score of 92%, which is also excellent. This reinforces that the AR-assisted handout developed is suitable for use and has a positive impact on the learning process.

The integration of AR in handouts has been proven to increase students' interest in learning. The visualization of the Solar System material, which was previously only in the form of static images in textbooks, can now be observed dynamically. This creates a more enjoyable learning experience, as students feel interested and want to explore further. This ability also helps students build conceptual understanding independently and reduces their dependence on teacher explanations.

In addition to increasing interest in learning, the use of AR-assisted handouts also supports the development of higher-order thinking skills (HOTS). The material presented in 3D not only helps students understand concepts but also encourages them to analyze the differences in the characteristics of each celestial object, understand the processes of rotation and revolution, and relate them to everyday life. Students are also given conceptual understanding-based exercises that challenge their reasoning and scientific thinking.

Teachers state that the use of AR handouts helps in conveying material that was previously considered difficult to explain. 3D visual media serves as an extremely effective tool in explaining concepts such as orbital paths, planetary positions, and interplanetary relationships. Additionally, students become more active in asking questions and participating in discussions because they feel more confident after seeing the objects visualized directly through their devices.

In terms of implementation, some challenges were also identified, particularly regarding device availability. Not all students have mobile devices compatible with AR applications. However, this can be addressed through group activities, where students share devices and learn together. Teachers also play a crucial role in guiding the use of technology to ensure it remains focused on learning objectives and does not become a distraction.

Overall, the development of AR-assisted handouts in IPAS learning has a significant impact on the quality of learning. Not only does it improve students' understanding and motivation to learn, but it also strengthens the application of technology in the learning process in elementary schools. Thus, similar developments can be recommended for other subjects that are highly visual and require interactive media support.

IV. CONCLUSION

Based on the results of research and development, it can be concluded that the Augmented Reality (AR)-assisted handout teaching materials developed are highly valid and effective for use in teaching IPAS material on the Solar System in sixth grade elementary school. This product not only enhances conceptual understanding but also increases students' interest in learning and their engagement in the learning process. The integration of AR technology into the handout teaching materials represents a relevant and innovative approach to addressing the challenges of 21st-century learning, particularly in visually presenting abstract concepts in an interactive and engaging manner.

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