Design of Augmented Reality Interactive Learning Media for PISAV Subjects

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Abstract – Advances in technology and communication have changed every aspect of contemporary life. Today, technological advancements are rapidly developing towards a global digital era, including in the field of education. However, despite the widespread spread of technology such as smartphones, students often use them more to play online games and engage in social media, leading to reduced effectiveness in the learning process. This research aims to develop Augmented Reality (AR) interactive learning media for the Audio Video System Installation Planning Course (PISAV) and validate the validation of the developed media. Media validation was carried out by four validators. The research method used in this article is the Multimedia Development Life Cycle (MDLC). The results of this study are Android-based AR applications that can display the 3D form of equipment and learning materials from PISAV. The media developed is valid in the material category with a value of 89.35% and valid in the media category with a value of 98%. This application is presented as support in the implementation of audio video learning and in the future will continue to be improved.

Keywords – Learning Media, Augmented Reality, PISAV, MDLC.

I. INTRODUCTION

The pervasive influence of globalization across global communities has given rise to various new perspectives on education and technology. Looking ahead, education will continue to be optimized through information networks and technology that enable communication and collaboration. Consequently, the impact of globalization has made our education system more open, interactive, flexible, and oriented towards workforce productivity, timeliness, and competitiveness.

Education encompasses all processes that occur over time in learning or acquiring new knowledge to realize a dynamic educational experience, developing potential within oneself and others. In the current era of globalization, the utilization of technology in education can be actualized through instructional media planning. Careful use of instructional media has the potential to enhance the quality of interaction in the learning process [1].

In the context of vocational education learning, the role of teachers is significant in guiding the learning process for students. However, not all teachers are capable of effectively - delivering course materials, thus requiring the assistance of instructional media to enhance effectiveness and efficiency in learning implementation. Changes in learning patterns undoubtedly present new challenges for both teachers and students [2].

To achieve effective learning objectives, vocational high school students must actively select and implement suitable learning methods. Good instructional media meet several criteria, including being engaging, easy to use, providing learning experiences for students, and enhancing the quality and outcomes of learning in line with the intended learning objectives [3].

Interactive learning is an approach that utilizes technology to optimize the learning process for students. Interactive media is a description of learning media that can create a connection between individuals and learning media which in the process will influence each other in conveying learning material. [4].

Based on experiences and observations conducted in the Audio-Video Engineering (TAV) department at SVHC 1 Batipuh during the implementation of the Field Education Experience Program (PPLK) from July to December 2022, researchers found that conventional learning processes and less varied and monotonous. The monotonous media and systematic learning system contribute to the establishment of boredom, resulting in a lack of conducive and effective learning environments [5]. Therefore, researchers aim to develop interactive instructional media based on Augmented Reality technology using the Assembly Edu application for the Audio-Video System Installation Planning subject, focusing on the topics of Pre-Amp and Power Amp as supporting means for more interactive and engaging instructional media.

Augmented Reality technology is capable of integrating computer-generated objects, both two-dimensional and three-

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dimensional, into the real environment [6]. This includes utilizing graphic technology and sensors to modify the positioning, orientation, and illumination of virtual objects, creating the illusion of their integration into the actual surroundings. Augmented Reality has advantages, namely a more attractive visual appearance, because it can display 3D objects so that it appears to exist in the real world. Apart from that, AR also has advantages on the interactive side because it uses markers to display 3D objects directed by Android so that it can help increase power the learner's reasoning and imagination [7].

Assembly Edu is a platform for creating 3D models interactively, easily using various types of objects, images, and sounds. With its ease of use and high level of flexibility, this application supports students in enhancing their understanding of 3D design concepts more effectively and entertainingly [8].

II. METHODS

The method applied in this research is the Multimedia Development Life Cycle (MDLC). The MDLC method is an approach suitable for designing and developing media applications that combine elements such as visuals, audio, animation movements, and its stages can interchange positions [9]. The MDLC method comprises six stages: concept, design, material collecting, assembly, testing, and distribution [10].

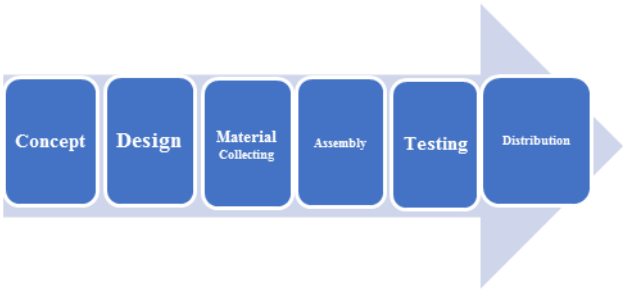

Figure 1. MDLC Method Stages

1. Concept Stage

This stage is intended to obtain relevant information regarding the media to be created, starting from the type of media, the applications to be developed, and the target users [11]. In this stage, various aspects underlying the significance of the development process of instructional media content are identified, namely Interactive Learning Media based on Augmented Reality in the Subject of Planning and Installation of Audio-Video Systems.

Based on the description of the conditions in the introduction, it is necessary to create an interactive learning media that can enable students to learn independently, be engaging and interactive, and motivate students to understand the learning material. The selected media is interactive learning media based on Augmented Reality in the subject of Planning and Installation of Audio-Video Systems, which contains material with a 3D display of pre-amp and power amp circuits that are interesting and inspiring for students to learn with full initiative, interact actively, and enjoy every moment of learning, thus stimulating their interest in learning.

2. Design Stage

The designed media is an interactive learning multimedia relying on Augmented Reality technology using the Assembly Edu application. This design stage is carried out to outline the overall development of the application [12]. The system design to be created is as outlined below.

TABLE 1.

PISAV LEARNING ACHIEVEMENTS

Element 3	Learning Outcomes
Audio Video System Planning and Installation	At the end of Phase F, students are able to understand: Sound waves and room acoustic systems, psychoacoustics, anatomy of the human ear, various types of microphones in acoustic systems and their working principles, universal pre amplifier circuits, tone control circuits.) audio amplifier, mixing circuit (mixer), audio amplifier circuit (power amplifier), measuring the frequency response of power amplifiers.

The subject of Audio Video System Installation Planning in the Merdeka Curriculum is taught to second-year students or eleventh graders. The material that the researcher will focus on is the one that discusses pre-amp and power amplifiers. The reason the researcher chose this topic is that this material can be implemented into interactive AR learning media, has relevance to the industry, potential for innovation, and relates to the personal interests of students.

a. Research Conceptual Framework

The conceptual framework of the research is a graphical representation or abstract structure used to illustrate the relationships between key ideas in a study. The conceptual framework helps clarify and organize understanding of the research subject, as well as assisting researchers in identifying important variables and their interrelationships.

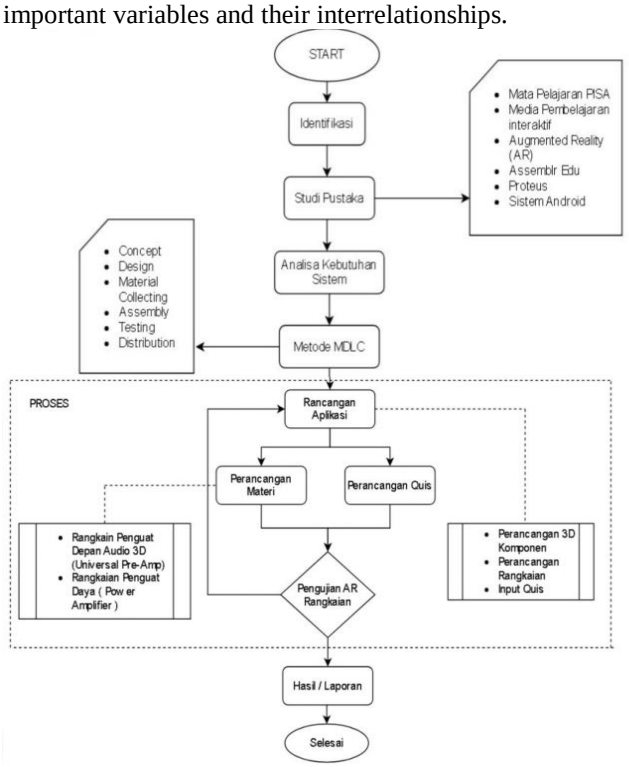

Figure 2. Research Conceptual Framework

In addition to illustrating the relationship or interconnectedness between various concepts within the context of an issue to be investigated, a conceptual framework also plays a crucial role in providing comprehensive and detailed explanations of the topic under discussion, thus facilitating the smooth and easy implementation of research activities.

b. The Design Application Flowchart

The flowchart serves as an overview of the workflow system and serves as a reference in the application design [13].

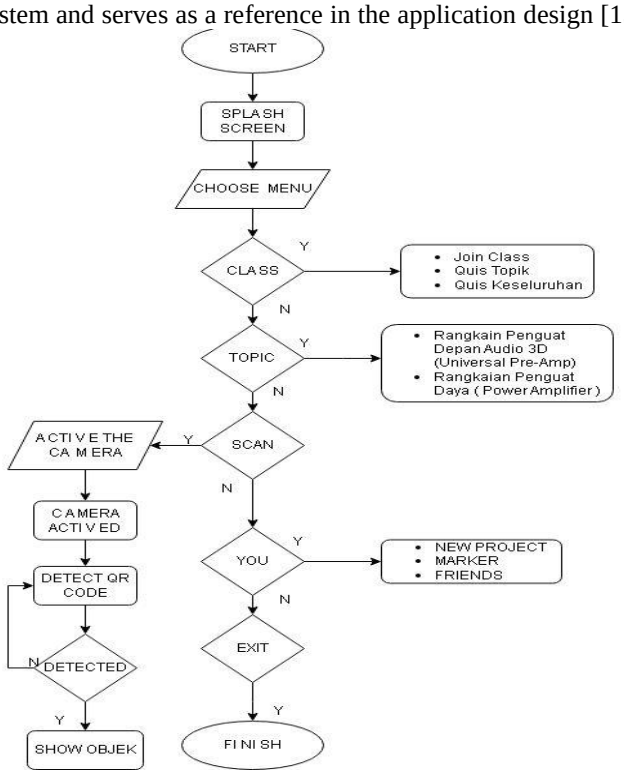

Figure 3. Application Design Flowchart

When opening the Assembly Edu application after the user installs the application, the application's splash screen will appear. After that, users will be immediately provided with a simple tutorial on how to use the application, and after that, users will go directly to the main menu page. On the initial display, there are various options that can be accessed, such as options to access classes, topics, perform scans with markers, and also menus related to you as a developer.

c. Circuit Scheme and Simulation

At this stage, the researcher designs the circuit that will be created and simultaneously performs simulation of the preamp and power amp circuit design using the Proteus application to ensure that the preamp and power amp circuits created are valid and can function properly. Some features of Proteus include: VSM simulation, PCB design creation, and visual design. [14].

3. Material Collection Phase

During this phase, all materials to be used in this process are collected for the creation of multimedia, including images, videos, audios, texts, and also 3D models needed to develop high-quality multimedia products.

The materials or data to be used to develop the Assembly Edu application for preamp and power amp materials are 3D circuit paths along with the necessary components, instructional videos, buttons, learning materials, and sounds that will later be imported into Assembly Edu.

4. Assembly Phase

This process involves the integration of collected components that meet the processing requirements [15]. At this step, animations are also applied to all access menus in its user interface and to all components used so that the final result of this interactive learning media becomes more attractive and motivates students in learning.

5. Testing Phase

After the learning media is created, the next stage is the testing phase. Media testing is carried out by running the created media to check for errors [16]. During the testing phase, it's essential to rigorously assess the functionality, usability, and effectiveness of the learning media. This process involves evaluating its compatibility across different devices and platforms to ensure seamless accessibility for users. Additionally, gathering feedback from target audiences and stakeholders helps identify areas for improvement and refinement. By conducting thorough testing, any potential technical glitches, navigational issues, or content inaccuracies can be identified and rectified before the final deployment of the learning media. This iterative approach ensures that the learning experience meets the desired objectives and enhances user engagement and comprehension.

6. Distribution Phase

Distributing the media content during this phase is not undertaken due to the nature of the research, which primarily focuses on the development and feasibility testing of the media itself. The emphasis lies in assessing the effectiveness, usability, and potential impact of the media rather than its widespread dissemination. As such, resources and efforts are concentrated on refining the media product and evaluating its suitability for the intended audience, laying the groundwork for future distribution strategies. Additionally, postponing distribution allows for comprehensive refinement based on research findings before reaching a broader audience, ensuring the highest quality and relevance of the media content upon release.

III. RESULTS AND DISCUSSIONS

1. Application Development

The development of interactive Augmented Reality media for Planning and Installing Audio Video Systems for preamp and power amp materials starts with creating 3D assets of the required circuit components, speakers, and 3D circuit paths. In addition to 3D assets, buttons are also needed to access menus in the application, learning materials, and instructional videos according to Learning Objectives (LO).

a. Learning Media Assets

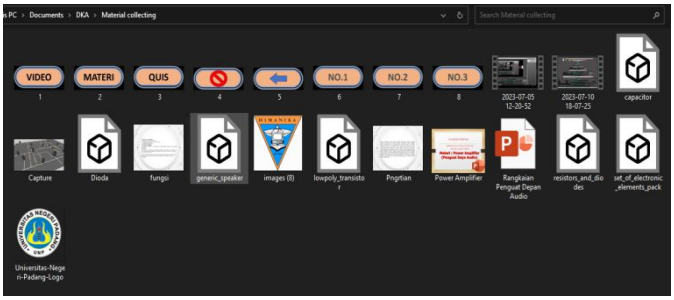

Figure 4. Learning Media Assets

b. Interface Display (User Interface)

1) Main Menu

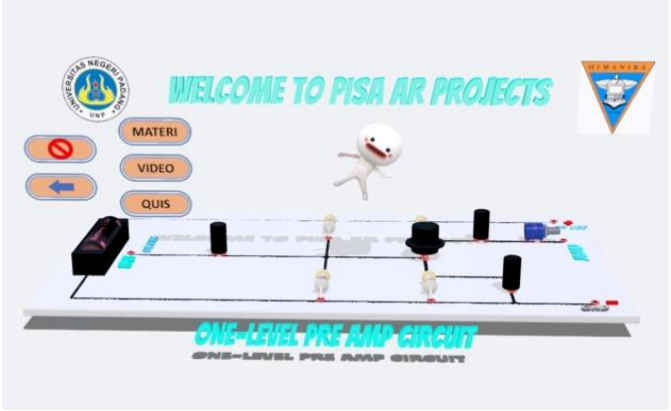

Figure 5. Main Menu for Pre Amp Material

Figure 6. Main Menu for Power Amp Material

On the first page that opens the application, there are various interesting menu selection buttons and a mascot from Assembly Edu, starting from the material menu which contains short learning material, the video menu which contains learning videos and series simulation videos, the quiz menu which contains interactive quiz questions related to the material, back button, and a button to remove all access to the previous button menu if you want to focus on the 3D series only.

2) Guide

This page contains a tutorial on how to use the application correctly.

Figure 7. Tutorial

3) Material

This page will display interactive learning material in the form of 3D circuits along with explanations of the material according to CP.

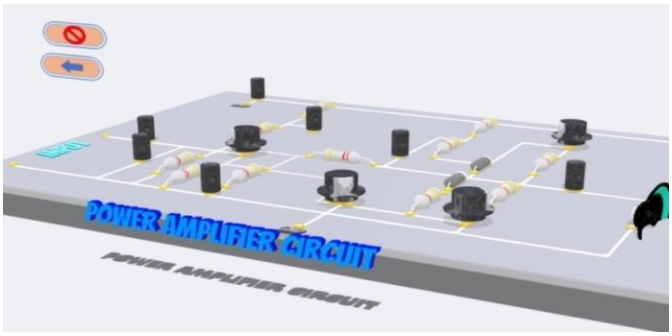

Figure 8. 3D Power Amp Circuit

Figure 9. Power Amplifier Material

4) Videos

On this page, users will be shown a short learning video related to pre amp and power amp material along with a circuit simulation video.

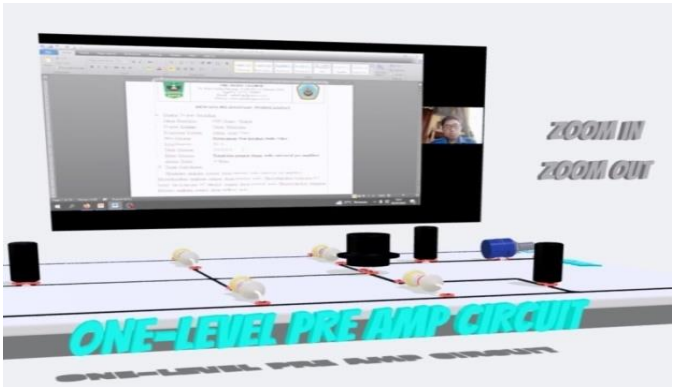

Figure 10. Learning Video Display

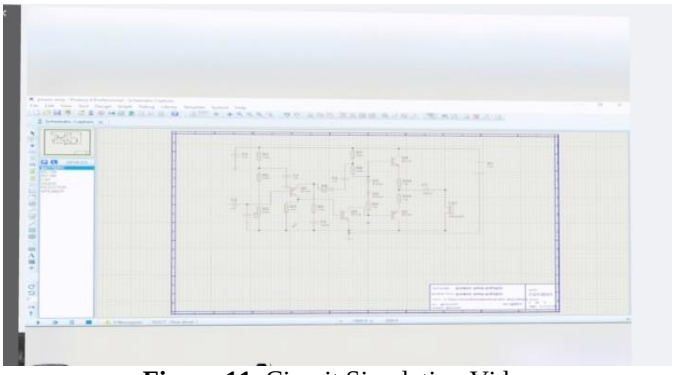

Figure 11. Circuit Simulation Video

5) Quiz

On this page, there is an interactive quiz regarding pre amp and power amp material.

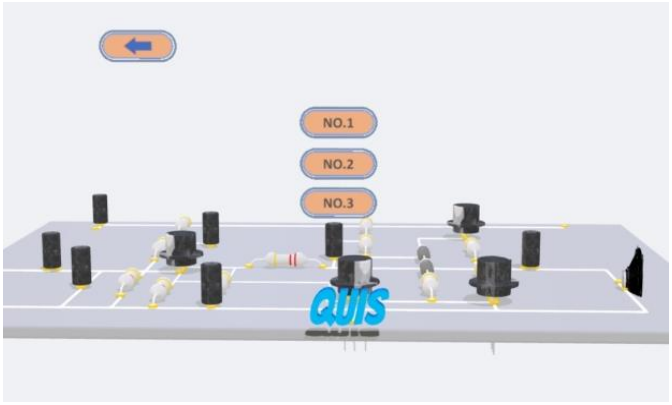

Figure 12. Quiz Menu Display

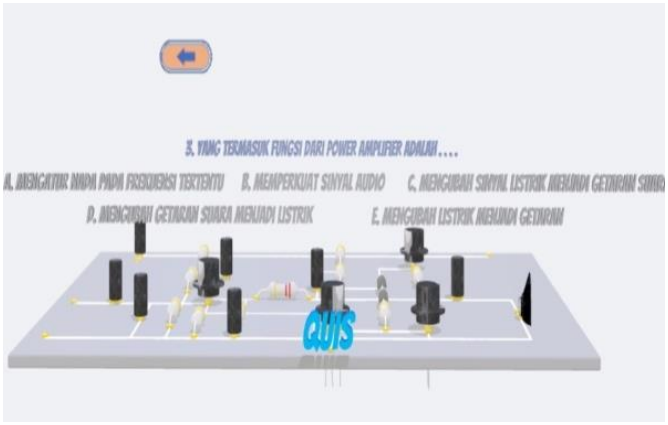

Figure 13. Example of an interactive quiz

6) Get to know the main components of the circuit

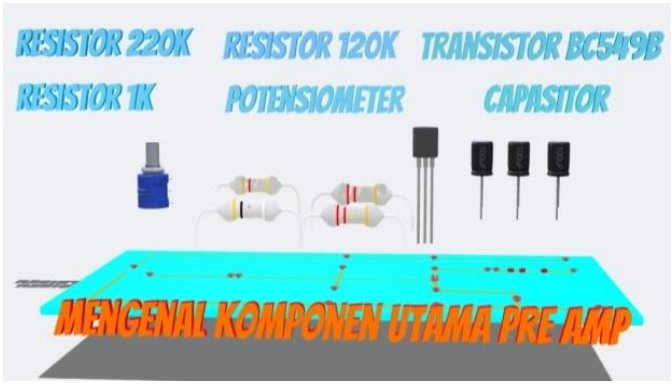

Figure 14. 3D Pre Amp Components

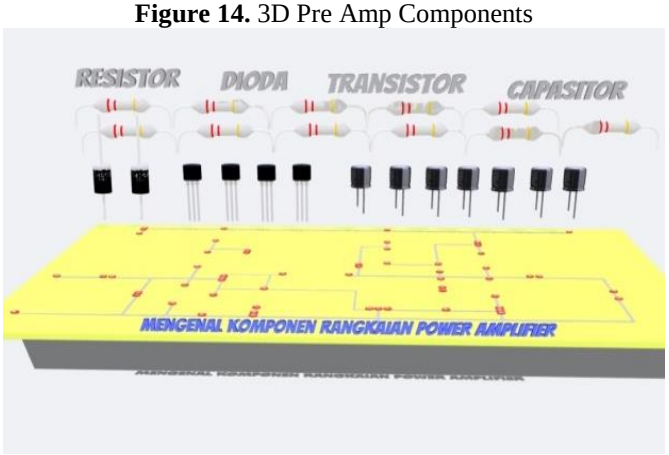

Figure 15. 3D Power Amp Components

On this page the user will be shown several main components and 3D text of the names of the components used in the circuit being created along with animations and sound explanations about these components.

7) Circuit Simulation

On this page the user will be shown an interactive animation related to a simulation of the placement of components in the path related to the pre amp and power amp circuit material.

Figure 16. Interactive Simulation of Pre Amp Circuit

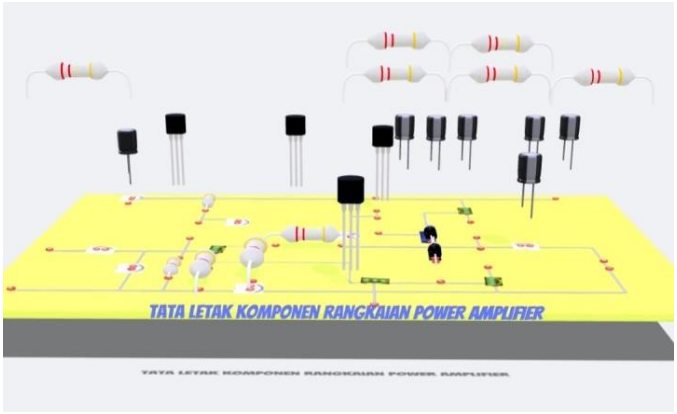

Figure 17. Interactive Simulation of Power Amp Circuit

The developed interactive learning media design has material and media validity tested by four experts, namely 2 teachers as media and material experts and 2 lecturers as media and material experts. The validation results are presented in Tables 2 and 3.

TABLE II.
MATERIAL VALIDATION RESULTS

Validator	Persentase	Category
Material expert 1	88%	Very Valid
Material expert 2	90,7%	Very Valid
Average Validation Results	89,35%	Very Valid

TABLE III.
MEDIA VALIDATION RESULTS

Validator	Persentase	Category
Media expert 1	97,3%	Very Valid
Media expert 2	98,7%	Very Valid
Average Validation Results	98%	Very Valid

Based on the percentage of material validation results of 89.35% and media validation results of 98%, it proves that the design of interactive learning media based on Augmented

Reality in the subject of planning and installing audio video systems for pre amp and power amp material as an interactive learning media device is very appropriate and in accordance with learning outcomes and the flow of learning objectives for use in the learning process.

Apart from validating media and materials to test the suitability of interactive learning media, media practicality was also carried out using media practicality test instruments for 15 students of SVHC 1 Batipuh. From the results of practicality and filling out the student response questionnaire, an average of 4 points was found with good criteria and it can be concluded that interactive learning media based on augmented reality in pre amp and power amp material is very interesting and effective in helping students understand the learning material.

2. Discussion

Observations were conducted from July to December 2022 at SVHC 1 Batipuh and it was found that students' weakness in understanding the theoretical concepts taught in the subject of Planning and Installation of Audio Video Systems. This lack of understanding is due to the lack of student interest in participating in the teaching and learning process because educators have not adopted means that can captivate the attention of students; innovative and engaging learning tools are needed for students.

In the interactive learning media application based on Augmented Reality using Assembly Edu, there are 2 user categories: teachers and students. Teachers can log in to directly access the Augmented Reality learning media database and edit data such as materials, animations, quiz questions, text, images, videos, and sounds, and review the results of the changes made. Meanwhile, students can only access the provided content.

The design of interactive learning media based on Augmented Reality contains references from previous research. Prayuda & Elza, development of Augmented Reality-Based Basic Electricity and Electronics Learning Media in Vocational High School (Score: 71, Mean Validity Score: 88.7%, Valid Media Category). Fitri Ayu, the Utilization of Augmented Reality as Learning Media During the Pandemic in Graphic Design Courses. The research method used is the Multimedia Development Life Cycle (MDLC). Gina Molina and Thamrin, the Development of Augmented Reality-Based Electronic Component Learning Media. With user testing results obtained by students reaching 92.63% with a highly practical category. In this study, I investigated the design and implementation of interactive augmented reality (AR) learning media for the PISAV subject.

IV. Conclusions

The implementation of AR learning media in the PISAV subject can enhance the success of the curriculum in providing a more interactive and comprehensive learning experience. Our findings support the idea that the integration of advanced technologies like AR can add value to the learning process, enabling students to be more engaged and understand the material better. The research results show that the use of AR learning media can increase students' interest and engagement in PISAV learning. Through direct experience and visualizations obtained from AR technology, students can easily grasp complex and abstract concepts in this subject.

AR learning media allows direct interaction between students and learning content, enabling adaptive and personalized learning. Students' ability to interact with 3D objects and view additional information in real-time can deepen their understanding of the subject matter. Although AR learning media offer many benefits, there are some challenges that need to be addressed, such as device availability and technology accessibility. Nevertheless, the development of technology and the increasing accessibility of AR devices promise significant opportunities to expand the use of this learning media in educational contexts.

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