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# DEVELOPMENT OF AUGMENTED REALITY-BASED LEARNING MEDIA ON COMPUTER HARDWARE MATERIAL AT SMK ISLAM 1 DURENAN

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***Abstract - This study aims to develop augmented reality (AR)- based learning media on computer hardware material at SMK Islam 1 Durenan. The background of this study is based on the lack of interactive learning media that can visualize the physical form of computer hardware components in a real and interesting way. The research method used is R&D (research and development) with the ADDIE model (analysis, design, development, implementation, evaluation). The development process begins with a needs analysis through interviews with teachers and students, then continues with media design using the Assembler Edu application. The media developed allows students to see 3D models of computer hardware components through a smartphone camera combined with a marker. Furthermore, a limited trial was conducted on class X TKJ 1 students of SMK Islam 1 Durenan to measure the feasibility of the media. The results of the feasibility test showed that this AR-based learning media received an assessment from media expert 1 of 75% with the category "Feasible", the assessment from media expert 2 received a score of 88.5% with the category "Very Feasible". While from the material expert it was quite high, with a score of 82% which was categorized as "Feasible". Thus, this augmented reality-based learning media is worthy of being used as a supporting tool in the computer hardware learning process in SMK.***

***Keywords: Learning Media, Augmented Reality, Hardware, Assembler Edu, SMK***

## I. INTRODUCTION

The rapid advancement of technology has significantly transformed many aspects of life, including the way we learn in the field of education. Technology is no longer considered a supplementary tool but has become a crucial prerequisite to support learning processes. It enables teachers and students to easily access various learning resources, provide teaching materials, and create more engaging learning methods. The use of digital technology in education can be defined as a digital processing system that encourages active learning, knowledge construction, inquiry, and exploration among students, while also enabling remote communication and data sharing between teachers and/or students in different physical classroom locations (1).

The rapid development of Information and Communication Technology (ICT) has brought major changes to the world of education. The integration of technology in education supports various learning styles by offering visual and interactive resources (2). Instructional media plays an essential role in the teaching and learning process. One of its primary benefits is improving students' understanding of the material. According to Wijaya et al. (3), effective instructional media can explain abstract concepts more specifically, making them easier for students to comprehend. The use of interactive and engaging learning media allows students to better grasp the concepts conveyed by the teacher.

In the context of computer hardware learning, the use of interactive media such as Augmented Reality (AR) helps students to effectively visualize computer components, providing a more immersive and meaningful learning experience. Vocational learning environments particularly benefit from AR, as Sirakaya & Cakmak (4) found that AR enhances achievement and task completion speed in computer hardware courses. Priyolistiyanto et al. (5) also stated that conventional learning tends to be passive and does not sufficiently engage students. In this learning context, Augmented Reality is applied as an innovative instructional medium that can increase student interaction and improve their understanding of the learning material. Using AR in education allows abstract concepts to become more concrete and easier for students to comprehend. Furthermore, the application of Augmented Reality can serve as a solution for inclusive education, addressing current challenges in providing education for students with disabilities. AR-based instructional media presentations include learning content consisting of teaching material presentations and 3D object presentations (6). Students with disabilities often face various challenges in accessing

learning media provided in conventional classrooms. In response to this issue, Augmented Reality offers a solution that can help overcome these obstacles.

Computer hardware refers to the physical components of a computer system, categorized by the data it contains or operates on, in contrast to software, which instructs hardware to perform specific tasks (7). It is therefore essential to develop a solid understanding of computer hardware, particularly for students in vocational high schools (SMK) who study in Computer and Network Engineering (TKJ) or Software Engineering (RPL) programs. Hardware plays a critical role in information systems, serving as the foundation for data collection, input, processing, output, storage, and distribution.

Consequently, it is important to introduce computer hardware components so that students become increasingly familiar with various types of computer hardware (8). Choosing the appropriate hardware is crucial to ensuring optimal performance within an information system. This study was conducted at SMK Islam 1 Durenan, selected due to its sizeable student population and well-equipped facilities. Moreover, the choice of a vocational school as the research location aligns with the objective of vocational education to equip students with practical skills that prepare them for employment after graduation. The researcher selected the 10th-grade TKJ class as the research subject because it is one of the skill programs directly related to computer hardware material.

## II. RESEARCH METHODS

This study employed a Research and Development (R&D) methodology based on the ADDIE development model, which includes five stages: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model is considered highly relevant as it adapts well to various conditions, and revisions and reviews can be made at any stage (9). R&D is a method used to produce specific products and test their effectiveness within educational environments. This study adopted a research and development approach, a research method aimed at producing specific products and testing their effectiveness (10). The purpose of research and development is to create innovations that enhance the quality of learning through the development of more efficient and effective instructional media, materials, and learning methods.

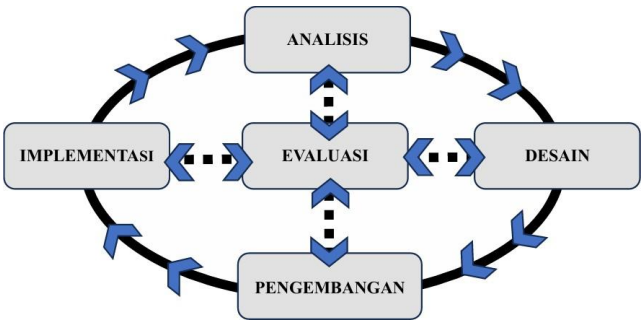



Figure 2.1 ADDIE Model Stages

The ADDIE model components are systematically organized to support instructional design that considers learning strategies, materials, facilities, teacher competencies, and student characteristics to produce an effective, innovative, and engaging model. The ADDIE model adapts well to various conditions, with revisions possible at every stage, making this method highly relevant for this research. The ADDIE model was selected because it provides a systematic procedure for developing effective and efficient learning media. Each stage in the model is interconnected and aimed at developing instructional products that meet student needs.

### *A. Analysis Stage*

The analysis stage aims to identify the root causes and impacts of each problem on the learning process. This problem analysis was conducted to determine the need for developing appropriate instructional media. The analysis concluded that students require a new innovation in computer hardware learning that can be accessed via smartphones. Augmented Reality (AR) learning media enables students to visualize objects in an interactive, engaging, and flexible manner.

### *B. Design Stage*

The instructional media was designed using the Assembler Edu application, which can display 3D objects based on Augmented Reality. In this stage, the media design concept was created, including the initial display, material pages, material description pages, quizzes, menu pages, 3D object displays, and component definition description pages. The instructional material design covered components such as the motherboard, RAM, CPU, visual interaction, and quizzes. The model was developed following the ADDIE principles. The media interface was designed with attention to user-friendly principles and aesthetics. The media navigation flow was designed simply: Home page → Material, Quiz, 3D menu → List of hardware types → List of hardware components → 3D object display → Function description. Users can choose other objects or exit the application.

### *C. Development Stage*

At this stage, the Augmented Reality-based instructional media was developed according to the previously designed concept. The development process involved using the EDU Assembler application as the main platform for media production and as a mixer application for 3D object production. Predefined computer hardware objects were produced as 3D models. Each object was assigned colors, textures, and dimensions appropriate to the actual device. Upon completion, the objects were exported in .glb format, enabling their integration into the EDU Assembler application.

Once all 3D objects were finalized, the next step was to design the user interface and embed the objects into the Assembler Edu application. The home page was created, featuring the media title and navigation buttons to the material, quiz, and 3D pages. The material page contained explanations of computer hardware, the quiz page featured

buttons linking to quizzes, and the 3D page contained menus for different hardware categories. The 3D menu page consisted of buttons for input, processing, and output devices. Selecting any of these categories displayed the relevant 3D hardware types. Entering the 3D menu page displayed 3D computer hardware objects alongside their function descriptions. Each page included navigation buttons for moving to the previous page. The AR display design was implemented according to the design stage results and refined based on expert feedback.

### *D. Implementation Stage*

The Augmented Reality-based instructional media using Assembler EDU was implemented for Grade X students at SMK Islam 1 Durenan after completing the development and internal testing phases. The purpose of this implementation was to test the media's effectiveness in helping students understand and improve their mastery of computer hardware material in a real classroom environment.

The implementation was carried out in several phases. Students were introduced and guided on how to use the Augmented Reality learning media. The teacher explained the learning objectives, the benefits of using Augmented Reality technology, the steps to access it, and the available 3D models in Assembler EDU. After the briefing, students independently used the Augmented Reality learning media via their smartphones or tablets.

### *E. Evaluation Stage*

After implementing the Augmented Reality learning media using Assembler EDU for Grade X TKJ students at SMK Islam 1 Durenan, formative assessments were conducted to evaluate its effectiveness. The assessment involved observations, interviews, and surveys to collect feedback from students and teachers.

A summative evaluation was then performed to assess the overall effectiveness and efficiency of the Augmented Reality learning media using the full Assembler EDU system. The evaluation included testing student learning outcomes, conducting interviews with teachers, and distributing user satisfaction surveys. The results indicated that students' understanding of computer hardware material improved after using the Augmented Reality-based media.

**Table 2. 1** Feasibility Score Calculation

$$\text{Feasibility Percentage} = \frac{\text{Data Collection Score}}{\text{Maximum Score}} \text{ X } 100\%$$

After obtaining the results of the feasibility presentation, the outcomes were then adjusted based on the percentage rating scale criteria to determine the feasibility level. The following table presents the percentage rating scale criteria used in this study:

**Table 2. 2** Interval Presentase

| Interval | Category |
|---|---|
| 100% – 86% | Very Feasible |
| 85% – 71% | Feasible |
| 70% – 56% | Fairly Feasible |
| 56% – 0% | Less Feasible |

## III. RESULTS AND ANALYSIS

### 1. Result of First Media Expert Validation

The validation process for the learning media was conducted by Dr. H. Abdul Haris Indrakusuma, M.Pd as the first media expert. This validation aimed to determine the feasibility of the developed Augmented Reality learning media before it was tested on students. Based on the results of the first media expert validation, a total score of 57 out of a maximum of 76 was obtained, with a feasibility percentage of 75%. Referring to the media feasibility criteria, this percentage falls into the "Feasible" category.

### 2. Result of Second Media Expert Validation

Hasil validasi media pembelajaran yang dinilai oleh ahli media The second media validation was conducted by Mr. Bian Dwi Pamungkas, M.Pd, who assessed the feasibility of the learning media based on several aspects. Each aspect consisted of multiple items evaluated by the second media expert. Based on the validation results, a total score of 46 out of a maximum of 52 was obtained, resulting in a feasibility percentage of 88.5%. According to the feasibility criteria, this percentage falls within the "Very Feasible" category. However, there were several shortcomings noted, such as a background design that was less relevant to the presented material and the need for several revisions in the interface and navigation to better align with the intended learning concept.2 yaitu Bapak Bian Dwi Pamungkas M.Pd penilaian kelayakan media pembelajaran yang terdiri dari beberapa aspek. Setiap aspek terdiri dari beberapa butir pernyataan yang dinilai oleh ahli media 2. Berdasarkan hasil validasi dari ahli media 2, diperolah data berupa nilai skor dengan total 46 poin dari skor maksimal 52 poin, dengan presentase kelayakan sebesar 88,5%. Mengacu pada kriteria penilaian kelayakan media presentase tersebut berada pada kategori "sangat layak". Namun, terdapat beberapa kekurangan, di antaranya baground media yang kurang relevan dengan materi yang disajikan, serta perlu dilakukan beberapa revisi pada tampilan dan navigasi agar lebih sesuai dengan konsep pembelajaran yang diusung.

### 3. Result of Material Expert Validation

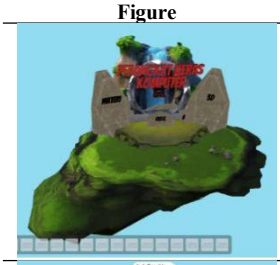
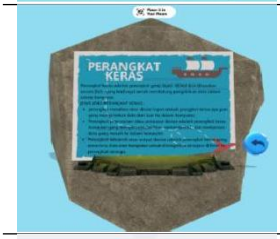
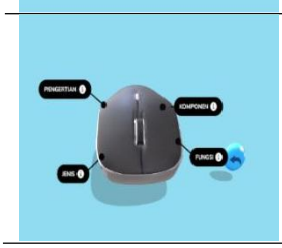
The material expert involved was Mrs. Jamitun, a teacher at SMK Islam 1 Durenan, and the homeroom teacher of class X TKJ 1. The researcher distributed a questionnaire to determine the media's feasibility score prior to student testing and to revise the media if necessary. Based on the questionnaire results, the Augmented Reality learning media received a total score of 56 out of a maximum of 68, with a feasibility percentage of 82%. According to the feasibility assessment criteria, this score falls into the "Feasible" category.

### 4. Learning Media Display Results

After going through the development, validation, and revision processes, the Augmented Reality learning media was declared finalized and ready for use. The media has met the feasibility criteria in terms of appearance, content, and interactivity, and is considered capable of supporting

students in the learning process. The finalized version of the media is now available for use.

**Figure 3.1** Learning Media Display

| Figure | Description |
|---|---|
|  | The initial display of the media, featuring buttons for Media, Quiz, i, and 3D. |
|   | When the Media button is selected, the slide switches to the learning material. The material display presents an explanation of computer hardware. |
|   | In the Quiz display, there are two quizzes for student practice. When students select a quiz, they will be redirected to a website hosted on Quizizz. |
|  | When the i button is selected, it displays the profile of the media developer. |
|   | The Hardware Menu display appears when the 3D button is selected, featuring three submenus: Input, Process, and Output. |
|  | After the user selects a hardware menu, the display will show the selected hardware category. |
|   | The 3D Hardware Display presents the selected hardware component in 3D, along with several key points explaining the selected hardware component. |

The testing phase for the Augmented Reality-based learning media was conducted in two stages: a small group trial and a large group trial. These trials aimed to assess the feasibility and student responses to the media before its broader implementation in classroom learning. Based on the results of the small group trial in class X TKJ 1, the media received a total score of 117 points out of a maximum of 136 points. This resulted in a percentage score of 86.03%, placing it in the "feasible" category. Meanwhile, in class X TKJ 2, the trial yielded a score of 112 out of 136 points, corresponding to a percentage score of 82.35%, also categorized as "feasible."

Due to time and location constraints, the researcher focused on one class that demonstrated better responses and a higher feasibility percentage. Based on the trial results, class X TKJ 1 showed a higher percentage score of 86.03%. Therefore, class X TKJ 1 was selected for the large group trial, as the Augmented Reality learning media was deemed more effective and suitable for this class. In addition to achieving a higher respondent score, the media was better received and proved to be more effective for students in class X TKJ 1. The results of the large group trial indicated that the learning media received a very positive response from students, achieving a percentage score of 79.50%, which falls into the "feasible" category. The media was considered engaging, easy to understand, and helpful in enabling students to comprehend the subject matter more clearly through the 3D illustrations presented.

## IV. CONCLUSION

The result of this research is an Augmented Reality (AR)-based learning media developed using the Research and Development (R&D) method. The media was tested by media experts, material experts, and students through several stages of validation and trials. The AR learning media demonstrated significant improvements, consistent with previous research conducted at SMK Negeri 1 Bukittinggi, which also showed significant outcomes.

Based on the validation results from media and material experts, a significant percentage score was achieved, with an average score of 88% from media experts and 85% from the material expert, both categorized as "feasible" and "very feasible." This finding is in line with studies by Argamakmur and Atlantis Press, which concluded that AR-based media is both feasible and effective for educational purposes.

**Table 4. 1** Validation Results

| Validator | Percentage | Category |
|---|---|---|
| Media Expert 1 | 75% | Feasible |
| Media Expert 2 | 88.5% | Very Feasible |
| Material Expert | 82% | Feasible |

The media was assessed to have engaging 3D visualizations and realistic material illustrations. However, suggestions were made to improve the background so that it would be more relevant to the presented content. The media was declared feasible for use because the instructional material aligned with the established basic competencies and was easy for students to understand.

This research concluded that Augmented Reality-based learning media can enhance and simplify students' understanding of computer hardware material. Consequently, this AR media is expected to increase students' motivation, ease information retrieval, cultivate interest in learning new materials, and serve as an alternative instructional tool for schools facing limitations in educational aids.

## REFERENCES

[1] Hidayat, N., & Khotimah, H. (2019). Pemanfaatan Teknologi Digital Dalam Kegiatan Pembelajaran. JPPGuseda | Jurnal Pendidikan & Pengajaran Guru Sekolah Dasar, 2(1), 10–15. https://doi.org/10.33751/jppguseda.v2i1.988

[2] Setiawan A, Ahmadi A, Sukirman. Enhancing Learning Experiences Using Markerless Augmented Reality in Computer Hardware Education. Dalam: Advances in Social Science, Education and Humanities Research [Internet]. Paris: Atlantis Press SARL; 2024 [dikutip 8 Juli 2025]. hlm. 72–9. Tersedia pada: https://www.atlantis-press.com/doi/10.2991/978-2-38476-342-9_10

[3] Wijaya R, Vioreza N, Marpaung JB. Penggunaan Media Konkret dalam Meningkatkan Minat Belajar Matematika. 2021;

[4] Sirakaya M, Kilic Cakmak E. Effects of Augmented Reality on Student Achievement and Self-Efficacy in Vocational Education and Training. Int J Res Vocat Educ Train [Internet]. 26 April 2018 [dikutip 8 Juli 2025];5(1):1–18. Tersedia pada: https://journals.sub.uni-hamburg.de/hup2/ijrvet/article/view/235

[5] Priyolistiyanto A, Sudargo S, Ulfatunni'mah D. Pengembangan Media Pembelajaran Kimia Berbasis Augmented Reality Materi Konfigurasi Elektron Dengan Metode Bohr And Stoner Pada Kelas X SMA. J Ilm Teknosains [Internet]. 14 Mei 2024 [dikutip 22 Februari 2025];10(1/Mei):10–5. Tersedia pada: http://journal.upgris.ac.id/index.php/JITEK/article/view/19034

[6] Djafar, S., & Novian, D. (2021). Implementasi Teknologi Augmented Reality Dalam Pengembangan Media Pembelajaran Perangkat Keras Komputer. Jambura Journal of Informatics, 3(1), 44–57. https://doi.org/10.37905/jji.v3i1.10440Abdillah GY,

[7] Andryana S, Iskandar A. Augmented Reality Sebagai Media Pembelajaran Perangkat Keras Komputer Dengan Fast Corner Dan Natural Feature Tracking. JIPI J Ilm Penelit Dan Pembelajaran Inform [Internet]. 30 November 2020 [dikutip 15 Februari 2025];5(2):79. Tersedia pada: https://jurnal.stkippgritulungagung.ac.id/index.php/jipi/article/view/1767

[8] Purba DER, Simangunsong RH. Game Pengenalan Komponen Perangkat Keras Komputer Berbasis Android Menggunakan Teknologi Augmented Reality Dengan Algoritma Fisher–Yates Shuffle. 2023;08.

[9] Safitri M, Aziz MR, Sjakyakirti U. Addie, Sebuah Model Untuk Pengembangan Multimedia Learning. 2022;

[10] Kamal M. Research And Development (R&D) Tadribat / Drill Madrasah Aliyah Class X Teaching Materials Arabic Language. 2020;4.