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Development of Android-Based Physical Activity-Augmented Reality 3D Interactive Media for Physical Education Subjects for PDPD (Students With Disabilities) in SLB to Support the MBKM Program

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Abstract

This study seeks to evaluate the effectiveness, appeal, and practicality of interactive learning tools utilizing Augmented Reality (AR). Employing a research and development approach, the study focuses on creating AR-based learning materials, drawing inspiration from the ADDIE development model's Analyze, Design, and Development stages. While the traditional ADDIE model comprises five stages, this research streamlines the process to three key stages. Validation tests conducted by both media and subject matter experts confirmed the high validity of the AR-based learning materials. Media expert evaluations yielded an Aiken's V value of 0.913, while subject matter expert assessments resulted in a value of 0.921, indicating strong validity. Subsequent tests involving 20 students with special needs from SLB Kediri City revealed high levels of attractiveness and user-friendliness, with 73% of participants finding the materials engaging and 91% expressing that they were very easy to navigate. In conclusion, the study suggests that AR-based interactive learning tools for Physical Education cater to the needs of students with disabilities in Kediri City. These tools not only capture students' interest but also offer ease of use. However, further evaluation through classroom trials is recommended to ascertain the effectiveness of AR learning materials in enhancing learning outcomes in Physical Education.

How to Cite

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INTRODUCTION

Advancements in technology and information have exerted a profound impact on various facets of human existence, notably within the realm of physical education tailored for children with special needs. Education, being one of the sectors significantly shaped by these advancements, undergoes a transformation fueled by technology and information. Education stands as a meticulously crafted endeavor, meticulously structured to facilitate students› learning within a supportive environment. The learning process, orchestrated by educators, unfolds as a thoughtfully designed undertaking aimed at furnishing students with enriching experiences. Through this process, students are nurtured to cultivate autonomous learning capabilities, fostering their journey towards self-directed learning (Muharram, 2020). One of the results of this development is that it allows teachers to be more efficient in delivering learning material to students with the help of learning media. According to (Muharram, N. A., & PUSPODARI, 2020), the use of learning media is an important component of learning resources. Technological advances have made it easier to access various types of learning media, and the preparation of learning media has become simpler. There is a variety of software that can be used to create learning media. Support from this software makes learning media more interesting and can be produced more easily. Learning media can be classified into four types, namely print media, audio-visual media, computer media, and visual media, as stated by (Muharram, N. A., & Putra, 2019). Audio-visual media is a type of media that does not only focus on sound aspects, but also includes visual elements, as explained by (Arief S. Sadiman, 2018).

As suggested by, the utilization of audio-visual media during learning endeavors can streamline the educational process, rendering it more straightforward, engaging, and effective (Jariono, G., Fachrezzy, F., & Nugroho, 2020). Utilizing audio-visual media within the learning context has the potential to capture students› attention, suggesting its capacity to enhance their engagement and interest during learning activities, particularly within the domain of physical education within special schools. Currently, there are various applications that aim to increase efficiency in various types of work, such as those that can be accessed via the web, desktop computers, or even smartphones, so many Augmented Reality (AR) applications have emerged that are designed to run on smartphones. The advantage of using this smartphone is the ease of operation via the touch screen (Prasetyo, P., & Meizar, 2020). Android-based smartphones, for example, offer various conveniences to their users.

Devices with the Android operating system are almost like mini computers, capable of performing a variety of tasks, from reading emails, playing 3D and 2D games, word processing, to surfing the web. This is due to the open nature of the Android operating system resources, which allows developers to develop applications more freely (Sagala, 2018). Therefore, using smartphones as a tool is expected to make it easier for developers to operate smartphone operating systems that run Augmented Reality technology in physical education subjects in special schools. According to (Shafique et al., 2018), Augmented Reality (AR) is a form of interaction that involves the real physical world with the addition of virtual computer elements that produce information, either directly or indirectly. AR is a technology that consists of two types, namely interactive and 3D-based, which combines physical objects with virtual elements (López-Ferrer, A., Marco-Ahulló, A., et., 2022). The advantages of AR, as stated by (Kadhum, M. M., Mohseen, H. S., & Saad, 2020), include higher interactivity, effectiveness in use, flexibility in implementation in various media, ability to model objects simply, lower production costs. affordable, and easy to operate (Mustaqim, 2019).

It is hoped that the use of Augmented Reality technology in physical education subjects in special schools can improve the learning process which was previously limited to books and monotonous teaching aids, where students were required to memorize and retain information. By applying Augmented Reality to physical education subjects in special schools, the learning process can become more interesting and can motivate students to learn more actively (Handayani, D. T., & Kartiko, 2021). According to the results of research conducted by (Saidin et al., 2019), the use of Augmented Reality technology in the learning context has several advantages, such as excellent potential and great benefits in the learning process. Previous studies conducted by (Handayani et al., 2018) regarding the use of Augmented Reality as an interactive learning medium in the introduction of computer network devices show that Augmented Reality technology can make the learning process more dynamic, effective and meaningful because it allows users to interact with virtual applications.

in real-time, while reducing boredom in learning.

Drawing from this rationale, Augmented Reality (AR) technology is anticipated to offer students diverse viewpoints and ignite their creativity, facilitating comprehension of subject matter within physical education classes in special schools. Consequently, researchers have opted to craft interactive learning materials grounded in augmented reality for use in physical education curriculum within special school settings.

METHOD

This study focuses on creating interactive learning materials for physical education subjects in special schools using Augmented Reality (AR) technology. The methodology employed is Research and Development (R&D). The development process follows the ADDIE model, which comprises five key stages: analysis, design, development, implementation, and evaluation (Sugiyono, 2018). However, this study focuses solely on three stages: analysis, design, and development, excluding implementation and evaluation. While the conventional ADDIE instructional development model encompasses five stages,an alyze,design,development,implementation,and evaluation this research streamlines the process to three stages: analysis, design, and development. This modification was made to align with the research design aimed at creating Augmented Reality-based learning tools for physical education subjects in special schools.

Data Collection Instruments and Techniques Data collection was carried out based on the following types of research instruments: 1. Needs Analysis Data Data collection techniques at the needs analysis stage were carried out by observing and distributing questionnaires regarding learning media available in schools in physical education subjects in special schools , students' interest in the learning media provided at school, in physical education subjects in special schools and the use of smartphones during classroom learning activities. 2. Researchers employ material expert validation questionnaires and media expert validation questionnaires as instruments to validate the product and gather data and responses relevant to the problem formulated. Data on the validity of Augmented Reality-based learning media products carried out at the initial product trial stage were obtained through media validation tests and material validation tests using the Aiken's V formula. According to (Hendryadi, 2017), Aiken (1985) The researchers devised the Aiken's V formula to compute the content validity coefficient, which relies on assessments by an expert panel comprising n individuals. This formula evaluates the degree to which an item accurately represents the construct being measured. By using a questionnaire to three Nusantara University PGRI Kediri lecturers and one teacher with the aim of determining the feasibility of the product being developed. 3. Attractiveness and Ease Data Data on the attractiveness and ease of Augmented Reality-based interactive learning media products in physical education subjects in special schools were obtained from questionnaires given to students through one-on-one trials of the learning media developed.

Data Analysis Techniques Data analysis was carried out in this research by collecting all the necessary data, namely data from the preliminary study stage and the development stage. Preliminary Study Stage Data analysis in the form of facts about current learning, teaching materials and media used, complete equipment, learning media used and use of smartphones in class in physical education subjects in special schools. Next, it is described in the form of the results of distributing a questionnaire to 20 students with special needs in the city of Kediri in physical education subjects at special schools, then analyzed and interpreted in writing the background and making the product.

This stage functions to simplify the application development flow which is made to suit your needs. This stage includes:

System architectural design involves detailing the workflow of physical education learning media for children with special needs. Augmented Reality architectural stages are constructed utilizing the Unified Modeling Language (UML) model, which is a mechanism for object-oriented software system development, employing diagrams and connecting texts. This design phase encompasses the creation of use case diagrams, sequence diagrams, and activity diagrams. A use case diagram is a description of the functions of a system that can be accessed by users. The following is a use case diagram used to build learning media for computer network installation.

The instruments used were initial needs analysis data at the Kediri city special school, then product validation data at the Kediri city special school and data on the attractiveness and ease of conducting research.

This section explains research activities such as treatment, participant activities in research, and other matters related to procedures during research. The steps for obtaining research data carried out at special schools in the city of

Kediri are by carrying out the preliminary stage, after the preliminary stage is carried out then proceeding to the development stage, where this development stage includes developing product design validation data analysis.

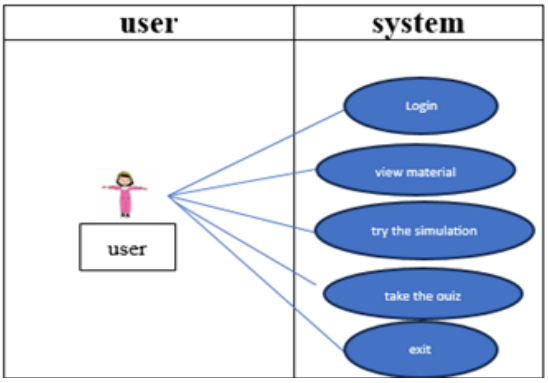

Figure1. Usecase Diagram for Physical Education AR Learning Media Applications
Activity Diagram Login

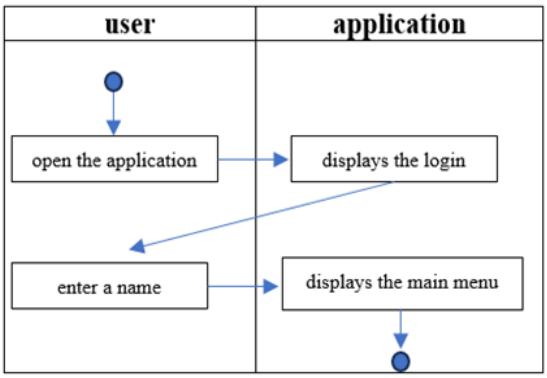

Figure2. Activity Diagram Login to physical education material

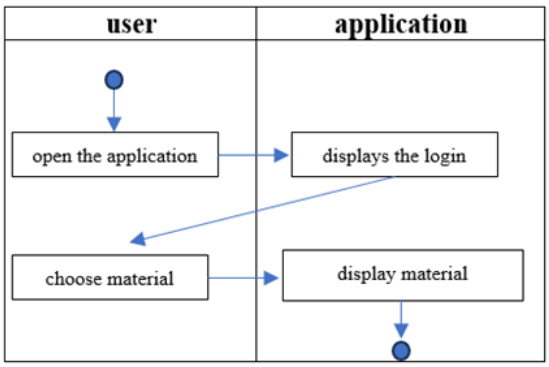

Figure3. Activity Diagram Viewing Material

The data analysis technique used is One-One Test Analysis. At the one-on-one test stage, it is carried out to obtain data on the attractiveness and ease of interactive learning media for students with special needs, guidance for students through student response questionnaires. The attractiveness and ease test involved 20 students as data subjects. The results of the attractiveness and ease of testing are analyzed and used as a basis for revising Augmented Reality-based interactive learning media products. The questionnaire used has 4 answer choices, so the total assessment score can be found using a formulation.

Table 1. Criteria for Attractiveness and Convenience of AR-based learning media in Physical Education learning

Mark	Attractiveness Criteria	Convenience Criteria
81%-100%	Very interesting	Very easy
61%-80%	Interesting	Easy
41%-60%	Quite interesting	Quite easy
<49%	Less attractive	Not Easy

Mayuriko Olivia Pertiwi, 2019

Based on research (Burhanudin, 2017) entitled Development of Augmented Reality-based learning media in basic electronics subjects, it is said that Augmented Reality (AR) technology serves as an educational tool that prompts students to engage in real-world thinking without the necessity of direct access to practical tools. Analysis conducted at SLB in Kediri city revealed that the instructional materials utilized by teachers lacked innovation and integration with technology. Consequently, students expressed a need for engaging and practical learning media enriched with 3D virtual images like 3D animations (Augmented Reality) within physical education subjects.

RESULTS AND DISCUSSION

There are 3 categories that are validated in Android-based physical activity-augmented reality 3D interactive media for physical education subjects in PDPD using Augmented Reality, including media expert validation, material expert validation processes encompass both media and learning design aspects. Media experts assess fundamental movements and Android applications, while material experts evaluate physical education materials and Android applications. Learning design experts, on the other hand, scrutinize lesson plans and syllabi. Media experts involve three validators in total, namely 2 lecturers from Universitas Nusantara PGRI Kediri, each lecturer from the physical education study program and sports teaching master's study program and one lecturer from the physical education teacher at Junior high school 3 Kediri. There are 3 material

expert validators, namely 2 lecturers from physical education and sports teacher masters at Nusantara PGRI University, Kediri and 1 physical education teacher at Junior high school 3 Kediri. The results of the learning device validation are presented in **Table 2.**

Table 2. Scores from validation results of Android-based physical education learning tools

Validator	Validated Product Score		
	Media	Material	Learning Design
1	99	66	
2	91	65	34
3	93	64	
Skor Total	283	195	34
Presentase	94,33%	90,01%	88,34%
Criteria	Very good	Very good	Very good

After carrying out expert validation, the development of Android-based physical activity-augmented reality 3D interactive media for physical education subjects in PDPD using Augmented Reality in physical education materials was then revised according to the validator's criticism and suggestions before conducting product trials. Conclusively, the expert validation discussion results indicate that the Android-based interactive media designed for physical education, particularly the Physical Activity-Augmented Reality 3D for PDPD students, is valid and appropriate for dissemination. The integration of Augmented Reality into physical education materials has opened up new avenues for enhancing the quality of learning by seamlessly blending the virtual and real worlds.

Furthermore, student responses via Android-based interactive media (physical activity-augmented reality 3D) on physical education subjects on PDPD were given to 20 students to assess their suitability using a student questionnaire. The results of student assessments of learning media are presented in **Table 3.**

Table 3. Student Assessment Results Scores on Android-based interactive media, physical activity-augmented reality 3D, physical education subjects at PDPD

Total Score	Presentase	Criteria
1760	88,9%	Very good

From the student feedback, it is evident that the Android-based interactive media, specifically the Physical Activity-Augmented Reality 3D for PDPD physical education subjects, effectively integrates Augmented Reality into learning materials for children with special needs. Shafique et al. (2018) underscored the practical utility of Augmented Reality for facilitating interactive and immersive learning experiences directly involving students. Similarly, Mustaqim (2019) highlighted Augmented Reality as an engaging approach for student participation in learning activities. These emerging technologies facilitate student-centered learning environments and encourage collaborative interactions, thus promoting a deeper comprehension of the subject matter.

The data pertaining to student learning outcomes in this study comprises two sets: initial data and final data. The initial data was derived from the odd semester UAS scores, while the final data was gathered from the results of post-tests. In essence, Table 4 provides an overview of the learning outcomes for both control and experimental class students.

Table 4. Learning Outcome Data

Deskripsi	Normalitas		Homogenitas
	E	K	
Preliminary data	0,245	0,200	1,097
Final Data	0,239	0,234	1,086

Based on **Table 4** information is obtained regarding the values for the normality test and homogeneity test. The initial data normality test for the experimental class obtained a value of Lcount = 0.2457 < Ltable = 0.2596 and for the control class a value of Lcount = 0.2007 < Ltable = 0.2596. Testing the homogeneity of the experimental class and control class, the initial data obtained a value of Fcount = 1.0789 < Ftable = 1.8540. The final data normality test for the experimental class obtained a value of Lcount = 0.1250 < Ltable = 0.1548 and for the control class a value of Lcount = 0.1200 < Ltable = 0.1548. Testing the homogeneity of the experimental class and control class, the value Fcount = 1.0789 < Ftable = 1.8546 was obtained. Therefore, it can be inferred that both the initial and final data for both the experimental and control classes exhibit normal distribution and homogeneity. With the confirmation that both sets of initial and final data demonstrate normal distribution and homogeneity, a t-test will be conducted to determine whether student learning outcomes following the utilization of Android-based learning media utilizing Augmented Reality surpass those of traditional learning methods. The outcomes of the

t-test are delineated in **Table 5.**

Table 5. T-test results

Aspect	t^{hitung}	t^{tabel}
Learning outcomes	7,086	1,575

Based on **Table 5** information is obtained regarding the value of tcount = 7.086 and ttable = 1.575. Because tcount = 7.086 > ttable = 1.575. It can be concluded that the average learning outcomes of students who use Android-based physical activity-augmented reality 3D interactive media in physical education subjects in PDPD assisted by Augmented Reality technology in physical education material are better than the average learning outcomes students who use conventional learning. The ADDIE model uses five development stages, namely: 1. Analysis, namely carrying out needs analysis. Identifying problems, identifying products that suit targets, thinking about products to be developed. 2. Design, the design stage is the stage of designing the product concept to be developed. 3. Development, development is the process of making the design a reality. 4. Implementation, implementation is product testing as a concrete step to implementing the product we are making. 5. Evaluation, namely the process of seeing whether the product created is successful, in accordance with initial expectations or not.

The research findings reveal the following: (1) The process of creating Android-based learning media utilizing Augmented Reality involved various stages, including the development of specialized materials serving as physical education teaching aids, featuring markers to support Augmented Reality functionality, and the creation of an Android application incorporating information on quizzes, games, and Augmented Reality elements; (2) The Android-based learning media employing Augmented Reality in physical education material for children with special needs is validated and deemed suitable for educational purposes, as affirmed by media experts, material experts, learning design experts, and student feedback; (3) The Android-based learning media employing Augmented Reality in physical education material for children with special needs is practically implemented in learning activities, evidenced by a student response rate of 98%.

Considering the findings and discourse, the "Development of Android-based physical activity-augmented reality 3D interactive media for physical education subjects in PDPD using Augmented Reality in physical education material" is deemed appropriate for educational purposes, as confirmed by media experts, material experts, learning design experts, student feedback, and learning outcomes. Additionally, the utilization of Android-based media employing Augmented Reality in physical education material for children with special needs yields superior learning outcomes compared to traditional learning approaches.

CONCLUSION

According to the field test findings, the average learning outcomes observed in the experimental class, which utilized Android media augmented with Augmented Reality, surpassed those of the control class, which employed conventional learning methods. This suggests that the development of Android-based learning media incorporating Augmented Reality is efficacious.

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