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Design Of Augmented Reality Applications Class XII High School Physics Book Chapter III Magnetic Fields Android Based

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Abstract: The teaching and learning process in schools still uses textbooks as a guide for student learning, especially physics learning in the field of magnetic fields. This makes it difficult for students to illustrate and explore magnetic field material, thereby limiting students' real learning opportunities and making students' interest in learning physics in class very low. In this problem, students need appropriate and effective media to provide a better understanding of the concept of magnetic field learning. The solution that can be implemented is by designing and building an Android-based Augmented Reality application that is capable of illustrating objects or material in physics books, especially the magnetic field chapter in three-dimensional (3D), apart from that, animation and audio are also applied to the material. Based on the average evaluation results in this Augmented Reality application, students can more easily understand magnetic field material with more than 96.17% in the very good category. It can be concluded that the learning media using Augmented Reality techniques in the class XII high school physics package book is suitable for use as a learning aid.

Key words: *Physics, Magnetic Fields, Augmented Reality, Three Dimensions, Animation*

1.0 Introduction

Physics is a science that applies scientific attitudes, scientific products, and scientific processes (Fatonah et al., 2020). For high school students, physics is considered a difficult subject (Septarini & Kholiq, 2021), so students are less interested in studying physics subjects and this causes the physics learning process to not be as expected. One of the problems students have in the learning process in physics-related classes is not understanding the concepts of the subject matter. This is what causes students' learning activity in participating in physics lessons in class to be low (Sandari, 2021). Some learning media that use textbooks have advantages and limitations (Bakri et al., 2018). Learning media using textbooks can also result in students' learning processes not being optimal, and very minimal in generating students' interest and motivation in the learning process. This is because textbooks only use two-dimensional drawing methods which can make students quickly feel bored.

One of the physics materials that requires in-depth conceptual reasoning is the magnetic field which is taught to class XII high school students. In research conducted by Anugrah et al, 73.3% of students and teachers stated that one of the physics materials, namely magnetic fields, was material that was difficult to understand. So, it requires appropriate and effective media to teach the concept of magnetic field learning. In interpreting concepts into real forms, students' abstract thinking skills are needed and need to be trained (Yovan & Kholiq, 2022).

The solution that can be done to overcome this problem is to use effective technology, along with the technology used, namely Augmented Reality. Augmented Reality technology is the technology that uses the concept of adding 2D and 3D to the student learning environment. Augmented Reality can animate digital objects and characters from textbooks, so it becomes a solution for students in the learning process. So, by using Augmented Reality as an alternative learning media in line with

current technological developments, it is hoped that the process of student learning activities will become more interesting and can be one solution in overcoming difficulties in the student learning process using textbooks. The learning method using Augmented Reality can provide a learning process that is more interactive, effective in use, easy to operate and understand. Based on the description above, this research aims to increase students' understanding of the concept of magnetic fields and make it easier for students to interact in a real way with magnetic field material.

2.0 Literature Review

In the world of education, the use of technology is very necessary to support student learning media, one of which is using Augmented Reality (AR) technology. In previous research, there have been many AR products that have been developed to help students learning media, including mathematics learning (Meilindawati et al., 2023), introduction to electronic components (Harahap et al., 2020), biology learning about the nervous system (Aripin & Suryaningsih, 2019), and learning bacterial classification (Febriza et al., 2021) and many others. The development of learning media with augmented reality achieves the criteria of validity, practicality (Widayanti & Nur'aini, 2020) and effectiveness and is suitable for use in learning media (Bakri et al., 2018) (Septarini & Kholiq, 2021) Apart from that, learning media with augmented reality can also improve students' understanding of material concepts (Sudirman et al., 2020) (Pratiwi & Riyanto, 2022), as well as obtaining student learning outcomes using augmented reality learning media. better and increasing (Widayanti & Nur'aini, 2020)(Nasrulloh et al., 2022)

3.0 Methodology

This research uses a multimedia development method (Multimedia Development Life Cycle) (Rotinsulu et al., 2018). This method has 6 stages, namely Conceptualization, Design, Material Collection, Manufacturing, Testing, and Distribution. In the first stage of conceptualization, this research will develop an Augmented Reality with the concept of Magnetic Fields using the Android platform with a 3D display intended for class XII students. 3-dimensional (3D) objects that are used as Augmented Reality in the Class XII Physics Package Book Chapter 3 Magnetic Fields include:

1. Direction of magnetic induction
2. The magnitude of the magnetic induction of the circular wire carrying current on its axis
3. Ampere's law
4. Large magnetic induction inside the solenoid

5. Large magnetic induction inside the toroid
6. Magnetic force in a current-carrying conductor
7. Magnetic force between two long, parallel conductors
8. Magnetic force on electrically charged particles
9. Galvanometer
10. Electric motor
11. Instrument for measuring blood flow speed
12. Siklotron

The second stage of design, the design stage is used to describe the process of each application creation scene, where the application is created according to adjusted specifications based on Figure 1. Application creation flowchart below. The following is a description of the Application Design Flowchart:

1. Determine the 3D object data to be created and data to design Augmented Reality.
2. Designing 3D objects using blender software.
3. 3D objects are saved in FBX format.
4. Loading 3D files into unity software.
5. Importing marker images into the target database in Vuforia.
6. Importing Vuforia license keys and marker database to unity.
7. Designing Augmented Reality into unity.
8. Loading the developed application into an application file.
9. Carry out a testing or quality control process to see errors in the Augmented Reality design process.
10. If the design fails, repeat the steps from the Augmented Reality design process.
11. If the design is successful then the Augmented Reality Class XII Physics Book Chapter 3 Magnetic Fields can be used for the user

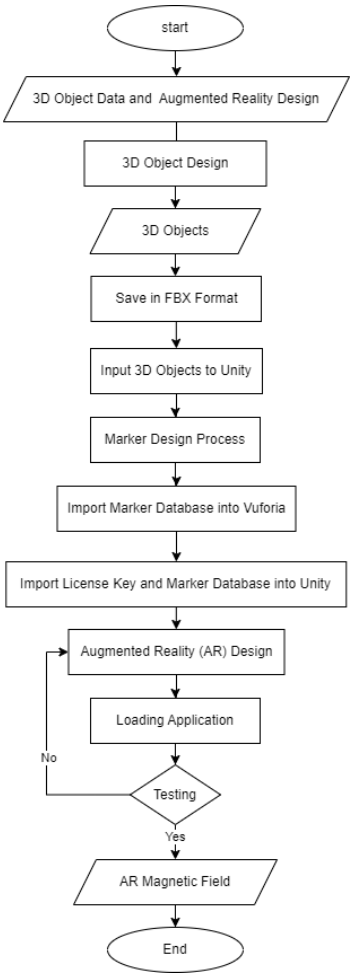


Figure 1. Application Design Flowchart

The third stage of collecting materials, in this research, collecting materials was carried out using several methods, namely (1) Observation, the author came and observed directly to see the method of delivering learning at school. (2) Literature Study, the author uses books, journals, national and international publications related to research on AR, to obtain theories that support solving research problems. (3) Documentation, the author collects data in the form of images and descriptions from the class XII Physics textbook written by Marthen Kanginan, Erlangga publisher, which will be used in creating 3D models and implementing AR.

The fourth stage is Manufacturing, the stage of creating all objects based on concepts that have been designed and will be implemented. In the process of creating this AR application, the author first determines the object that will be used as a 3D animation sourced from the Class XII Physics Package Book, especially in Chapter three Magnetic Fields. Twelve images will be used as markers. Then these markers will be combined in a catalog in this AR application. This application was made using several

software, namely Blender, Unity, Android SDK and the Vuforia database. The manufacturing process is in accordance with the stages in Figure 1.

The fifth stage of testing, this stage is also called the alpha testing stage, where testing is carried out by the manufacturer at a location that has been observed through questionnaires or in the manufacturer's own environment.

The final stage of distribution is the stage where the application is stored in a storage medium, either offline or online. This stage can also be called the evaluation stage for developing finished products to make them better.

4.0 Data Analysis and Findings

A. Main Menu Display

In the menu display there are 5 buttons, namely Scan Marker, Help, About, Download Marker and Exit. Scan Marker button to scan each predetermined object, Help button to move to the Help page, About button to move to the About page, Download Marker button to download marker to be scanned and the Exit button to exit.

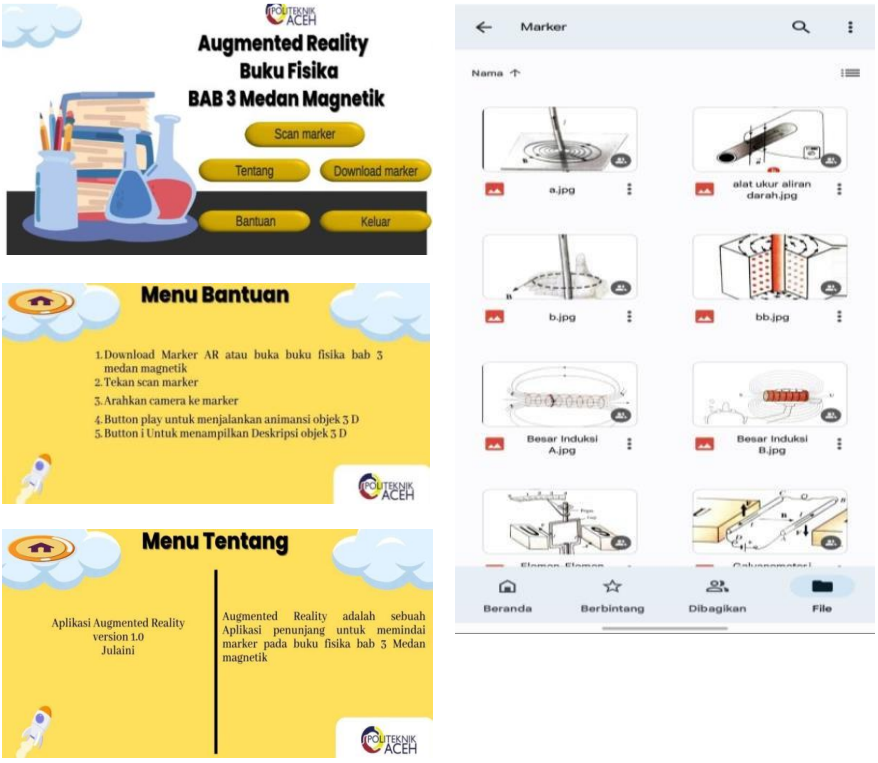
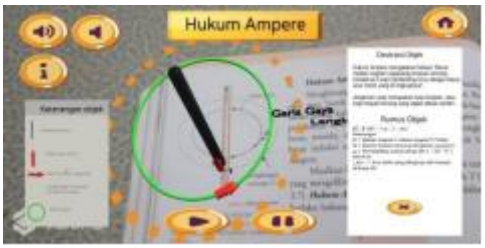
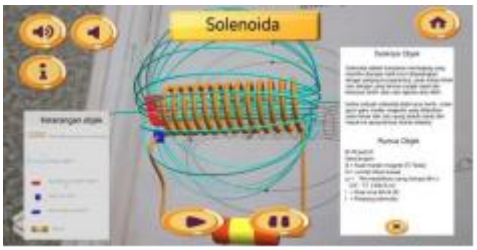
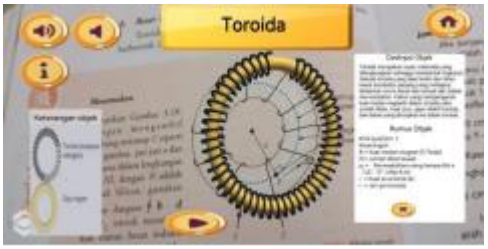


Fig 2. Main Menu Display

B. Display of 3D Objects







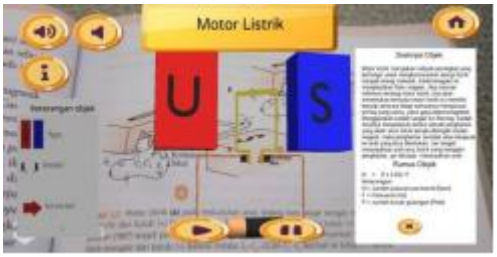


Fig 3. Display of 3D Objects

In the AR menu, there are several buttons that function for sound and music, and there is also a material button to display material according to the 3D object being scanned.

4.0 Discussion and Conclusions

This Android-based Augmented Reality application from the Class XII High School Physics Package Book uses observational data collection techniques. The analysis used in this research is quantitative analysis, namely analysis using questionnaires and students as respondents. The correspondence was 120 vocational school students with each questionnaire having 10 questions. Based on data analysis, the results of student responses to the application obtained a score of 1,154 with a total of 1,200 questions, so the resulting percentage was 96.17% in the very good category. The following questionnaire is used to test the feasibility of using the application:

Table 1. Questionnaire Table

No.	Question	Evaluation	
		Agree	Don't agree
1	Using the application increases understanding and interest in studying the Class XII Physics Package Book	117	3
2	The application has clear instructions for use	113	7
3	The app doesn't crash during use	112	8
4	The application appearance is attractive	115	5
5	The material and animations displayed are clear and easy to understand	116	4
6	This application helps in studying material in the Class XII Physics Package Book	120	0
7	The audio used sounds clear	118	2
8	The 3D objects displayed are attractive	116	4
9	The navigation buttons used are simple and easy to understand	113	7
10	Applications help the learning process be more interactive and fun	114	6
Amount		1154	46

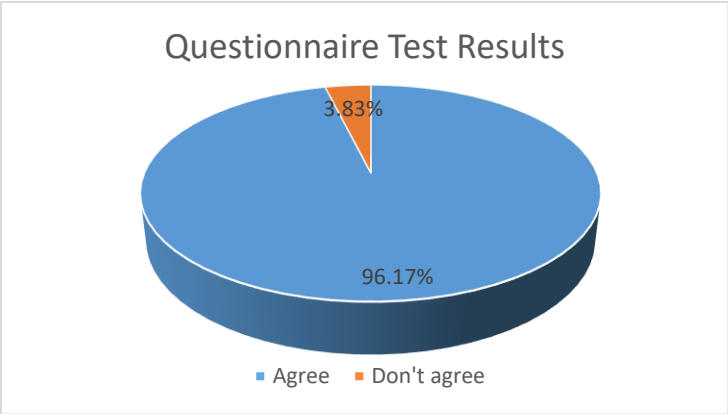


Fig 4. Questionnaire Test Results

The results of implementing the use of AR media in physics learning, especially the concept of magnetic fields, show that the AR media developed is quite effective in helping students understand the concept of magnetic fields. In the students' opinion, one of the factors that makes students interested in studying magnetic field material using AR is that the use of 3D animation makes it easier for students to visually represent complex magnetic field objects that are easier to describe visually. The use of AR media which presents visual representations in 3D form will certainly have a positive impact on students' ability to understand abstract concepts. The use of 3D visualization through AR media will simplify the presentation method so that the explanations given by the teacher will be more effective and students will understand the material more easily. Apart from that, this AR media has several shortcomings, including being too sensitive to changes in the user's point of view, there are still few media developers, and the memory required to operate this media is quite large (Oktavia, 2022), RAM capacity, camera resolution, and Android version as well. This has a big influence on how fast or slow the delay of this AR application is.

This research only focuses on learning which was initially textbook based and became interactive multimedia based. It is hoped that future researchers can develop this AR application to assess the evaluation of this learning. So, it not only makes it easier for students to learn but also makes it easier for teachers to assess student learning outcomes.

After carrying out the planning stages up to testing, conclusions can be drawn:

1. Android-based augmented reality application was successfully built using Unity, Vuforia, and Android SDK
2. This Android-based Augmented Reality application can make it easier for students to understand the concept of Magnetic Field learning.

3. This Android-based Augmented Reality application can help students develop their interest in learning
4. Using the Augmented Reality application makes students' learning more practical because it can be accessed anywhere and anytime.

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