

GARHANA: DEVELOPMENT OF APPLICATIONS FOR ELEMENTARY SCHOOL STUDENTS TO LEARN ABOUT SOLAR AND LUNAR ECLIPSES BASED ON AUGMENTED REALITY

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ABSTRACT

Lunar and solar eclipses are unusual phenomena that only happen for a limited time. The way eclipses happen has been described in science classes. Learning materials must be able to accurately depict the eclipse's process. Integrating technology and media can create interactive educational content. One of them is augmented reality, which can show actual three-dimensional things. This educational resource's components include 3D objects, markers, and smartphone-accessible applications. Blender, Unity, and Vuforia were used to develop the media.

Keywords: eclipse, augmented reality, and learning media

1. INTRODUCTION

Understanding the learning material requires the use of learning media in a significant way. The efficiency of the learning media in accomplishing learning objectives and assisting students in comprehending the materials presented are the most crucial factors in the selection of learning media¹. However, the learning media in eclipse learning still uses images and replicas. Image media is part of visual media, namely media that uses the ability of the eye or sight senses². Replica media is an imitation of the original form in 3D³. There are shortcomings in image and replica learning media such as, image media only emphasizes visual perception, is less effective if the objects displayed are complex, very limited in size for large groups.

Meanwhile, replica media is expensive and requires a lot of time, requires skills in the manufacturing process, students will not understand if the form of 3D media has no similarities with the original object, and the lack of tools to create 3D media. The use of image media is still not enough to help describe the process of an eclipse event, because the image media is still two-dimensional. Thus, there is a need for learning media that can visualize a phenomenon concretely.

Learning media that is integrated with Augmented Reality can help students in learning. Augmented Reality (AR) is a technology that combines virtual objects in a real environment, then projected in real-time⁴. In addition, AR can visualize abstract concepts into concrete concepts⁵.

To make the content about the eclipse phenomena easier to understand, it needs to be presented in a format that can exhibit educational content. Therefore, it is essential to provide alternate learning materials that use augmented reality. to boost student interest in and comprehension of learning.

2. LITERATURE REVIEW

2.1 Augmented reality

Augmented reality mixes the virtual world, which can foster students' imagination, with the actual world directly, augmented reality has the potential to improve students' enthusiasm for learning. With the help of interactive augmented reality, students may view the issue clearly and directly and can envision the outcomes of the teaching process that is being given to them by teachers⁶.

In line with the goals of the learning media, AR learning media can represent abstract concepts for the comprehension and organization of an object model, making AR a more effective medium. Due to the nature of educational media, which is to support students in the learning process with the presence or absence of educators in the educational process, the use of educational media with augmented reality can directly provide learning whenever and wherever students want to carry it out the learning. This can encourage the mindset of students to think critically about issues and events that exist in daily life⁶.

To make it simpler for people to understand the process of solar eclipses, mobile Augmented Reality application for the process of an eclipse occurring has been developed. Because the presented image is so realistic, visualization in the form of a 3D object can aid in making the eclipse process easier to comprehend. The results of the application's testing using the black box test and the feasibility test, each of which receives a 100 percent value, demonstrate that the application is functioning properly and is acceptable⁷.

3. METHOD

Augmented Reality is a field of technology that integrates the real world (Real World) and the virtual world (Virtual World)⁶. Users of this application are more engaged with their surroundings thanks to the employment of this technology. One area where augmented reality technology has seen extensive use is in education. Utilizing the Unity 3D engine and Blender for 3D modeling, this application was created. Android-powered smartphones are compatible with this application.

Application development uses the waterfall method which consists of requirements engineering, design, implementation, testing, release, and maintenance stages⁸. Requirements engineering is the first step to determining user and system requirements. When teaching and learning activities take place in the classroom, there must be a review of the needs of the students in the learning process and an alternative learning method that is appropriate for students.

Design and implementation is the stage of designing the display to process information and provide convenience for students. There are several main elements in this interactive animation learning media there are several main elements, namely the introduction of material, animation of the solar system, and quizzes. And also design 3d objects and marker books.

Testing and release, at this stage the application is tested internally, which is carried out by the developer. And also external trials were conducted on students as users. Next is Maintenance, at this stage, the finished learning media is then carried out by selecting the application. And also corrected errors in the application⁹.

4. RESULTS AND DISCUSSION

The goal of this research is to provide educational materials that can explain how solar and lunar eclipses occur. Augmented reality can be integrated to make learning for students more effective and efficient. There are four sections in the program, including goals, augmented reality, quizzes, and credits, on the home page. The learning objectives and learning indicators on the goal menu are those that are in line with the learning curriculum. The next menu item is the quiz, which includes inquiries concerning lunar and solar eclipses. This menu's objective is to gauge students' comprehension following their use of instructional media. Also, there is a credit menu, which includes details about the application's creator. This is how the application looks.

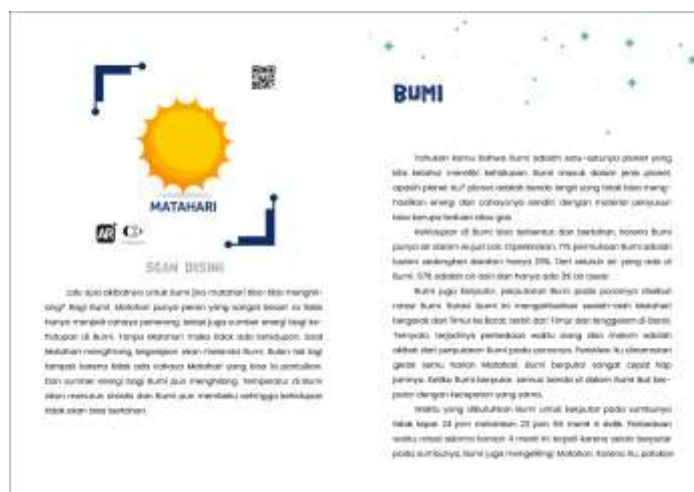
The AR menu is quite crucial in this application since it uses Augmented Reality technology to show 3D things when the solar and lunar eclipses are happening. The sun, earth, and moon are shown as three-dimensional (3D) objects.



Figure 2. Display of 3D Objects

Furthermore, there is audio and animation that goes along with this menu that explains how solar and lunar eclipses happen. A marker book is required to operate this menu. The marker book is on exhibit here.



Figure 3. Display of marker book cover**Figure 4.** Display of the contents of the marker book

Color selection is crucial when creating the visual appeal of applications and marker books since it can influence how someone perceives information¹⁰. It becomes an intriguing color combination when white, blue, and green are combined. Additionally, consider selecting ornaments that fit the lesson's overall subject. An animated 3D item will appear when the camera is pointed at a specific marking book. The view of augmented reality is shown here.

**Figure 5.** Augmented reality display

Application testing was done when creating this instructional resource. A total of 50 students from an elementary school participated in the trial. When collecting information, it is evaluated from a variety of angles, including design, usability, and content clarity. The outcomes of the experiments that were run are listed below.

Table 1. Application Trial Results

Aspect	Presents (%)
Good app display	96
Good bookmarker	84
Ease of use of media	86
Clarity of the material in the application	62
Clarity of the material on the marker book	72

According to the aforementioned findings, the marker book and application's correctness of look fulfilled expectations. The usability of educational media is also good. However, a lot of work needs to be done to generate high-quality learning materials in the areas of content clarity and marker books.

5. CONCLUSION

According to the explanation above, the creation of Augmented Reality-based learning media is made up of several components. In addition, there is a need for application assessments from all angles to create comprehensive learning media. As a result, it is necessary to monitor the development of the GARHANA application to improve it.

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