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# Development of Interactive Basic Astronomy Learning Media Using Augmented Reality Based on the Multimedia Development Life Cycle (MDLC)

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## **Keywords**

*Augmented Reality; Astronomy; Android; Science Literacy; Learning Media.*

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## **Abstract**

Interactive learning media play a vital role in increasing children's interest in learning by presenting information visually. However, most existing educational media remain limited to conventional formats, providing few opportunities for children to directly interact with learning materials. This condition creates a need for alternative media that can deliver educational content with a higher level of interactivity. This study aims to develop an Augmented Reality (AR)-based learning media as a means of introducing basic astronomy to children. The development utilizes the Multimedia Development Life Cycle (MDLC) model. The media is designed as an Android application featuring simple cartoon-style 3D space objects, with AR cards as markers for content activation. This approach is expected to enhance children's engagement and comprehension by offering more interactive learning experiences.

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## **1. Introduction**

Interactive learning media play a crucial role in enhancing the quality of the learning process, especially due to their ability to present information visually and attractively (Putri & Hidayat, 2025). Previous studies have shown that AR-based learning media can improve students' understanding of basic concepts through interactive presentation. However, most learning resources used in schools are still in conventional forms such as textbooks and static images, thus providing children with limited opportunities to directly interact with the material. This condition results in low interest among children in learning science, including astronomy, which actually has the potential to foster curiosity and develop critical thinking skills at an early age (Yusuf et al., 2025).

One technology that has great potential to address these limitations is Augmented Reality (AR). AR technology allows the presentation of three-dimensional objects through mobile devices, providing a more interactive learning experience. AR has proven effective in increasing student engagement, as demonstrated in research that developed AR-based geometry learning media for elementary school students. With interactive features such as object rotation and zoom, students become more interested in exploring the material. This indicates

that AR aligns with the characteristics of children who generally prefer visual-based and hands-on learning (Saputra et al., 2025).

To produce AR learning media that is well-structured and meets learning needs, a systematic development method is required. This study employs the Multimedia Development Life Cycle (MDLC) model, which consists of phases including conceptualization, design, material collection, production, and product testing (Saputra et al., 2025). Several studies have confirmed the effectiveness of MDLC in developing AR-based learning media, such as which successfully created AR applications for agricultural education (Tallulembang et al., 2025), and which developed AR media on the topic of the human digestive system (Saputra et al., 2025).

Based on the explanation above, this research focuses on the development of interactive AR-based learning media for basic astronomy, featuring simple cartoon-style three-dimensional objects. The media is designed as an Android application utilizing AR cards as content activation markers.

## **1.1 Literature Review**

### **1. Augmented Reality in Education**

Several studies have demonstrated the benefits of Augmented Reality (AR) technology in diverse educational settings. AR-based applications in agriculture have proven to facilitate independent learning for farmers by providing interactive simulation of cultivation processes, effectively minimizing the risk of errors and optimizing learning outcomes (Tallulembang et al., 2025). In vocational education, AR-based media for motorcycle servicing equipment enables students to virtually interact with 3D models, improving motivation and engagement due to its visual attractiveness and safety benefits (Madani & Rosanensi, 2025). Furthermore, in the realm of computer hardware, AR media helps students overcome the limitation of static illustrations by providing manipulable 3D visualizations that foster deeper understanding and contextual learning (Setiawan & Widodo, 2025).

### **2. AR for Science and Early Childhood Education**

Research in biology education confirms that integrating AR to visualize human digestive systems significantly enhances students' comprehension of complex concepts. Interactive 3D representations enable middle school students to easily grasp the structure and function of internal organs (Rista Karentius & Hardiyantari, 2025). Similarly, AR-based flashcard applications, such as ARphabet, present an innovative approach to early literacy, making learning letters enjoyable and motivating for young children through interactive 3D objects (Chairil Andri et al., 2025).

### **3. Theoretical Foundations: Interactive and Multimedia Learning**

Interactive learning media bridge the gap between abstract concepts and tangible experiences by combining textual, visual, and audio elements within a system (Sa'ida Zahara et al., 2025). The integration of multimedia, supported by the principles of cognitive multimedia learning theory, further reinforces student comprehension and engagement through multimodal presentations (Muhammad Akhyar Aji Saputra et al., 2025). The focus on interactivity enables learners to explore content directly, reinforcing both cognitive and affective skills (Mayer, 2002).

### **4. Mobile Learning and Flashcards for Children**

Mobile learning, especially within the context of visual and contextual instruction, has been shown to increase accessibility and engagement for children (Strataki, 2022). Interactive mobile applications incorporating animation and audio effectively promote science literacy and critical thinking skills in elementary education (Nugroho et al., 2022). AR-based flashcards further intensify interest and efficacy by presenting 3D objects that students can manipulate directly, significantly improving motivation and conceptual understanding (Candra Prastiti et al., 2025).

## 5. Multimedia Development Life Cycle (MDLC) in Educational Media

The MDLC model offers a structured and flexible approach for developing AR-based educational media, supporting systematic integration of multimedia elements and ensuring effective content delivery (Dahoklory et al., 2025). Evidence shows that employing MDLC significantly enhances learning outcomes, especially when used to develop AR and VR materials across various formal and informal educational settings (Alfa Budi Prasetya Laruanaung et al., 2025).

## 6. Research Gap

Despite growing evidence supporting AR media for education, few initiatives target the integration of AR for basic astronomy learning tailored specifically to young children. Existing studies rarely address the design of cartoon-style, interactive learning objects or comprehensive mobile applications using AR flashcards on Android platforms. This research seeks to fill these gaps by developing an interactive, visually engaging AR learning application for children to explore fundamental astronomy concepts.

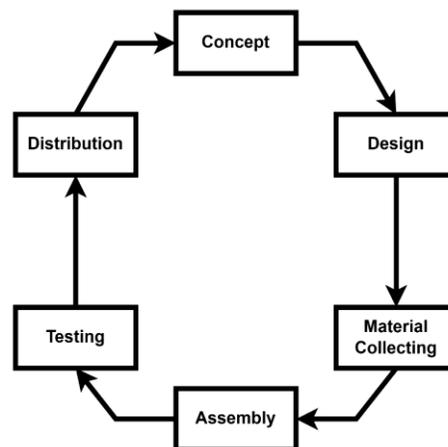
## 2. Research Methods

### 2.1. Research Design

This study adopts the Multimedia Development Life Cycle (MDLC) as the development methodology. MDLC consists of six key phases:

- Concept
- Design
- Material Collecting
- Assembly
- Testing
- Distribution.

This model was chosen for its flexibility and suitability in multimedia and interactive application projects, ensuring a systematic development process tailored to educational objectives.



*Fig 1. MDLC Phase Flowchart*

### 2.2. Sampling

The primary target users of the developed application are children regardless of their specific educational level. While the application is designed to be accessible for preschool, kindergarten, and elementary school-aged

children, it is not restricted to use within formal school environments. Instead, this AR learning media is intended to support self-guided learning at home, enabling children and their families to engage with educational content independently. User characteristics, such as age and prior familiarity with technology, are taken into account to ensure usability and maximize engagement in various home-based learning contexts.

### 2.3. Data Collection

Relevant multimedia assets, including images, simple 3D cartoon-style models of space objects, instructional text, and audio were curated. The AR application uses Unity as the main development environment and Vuforia SDK to implement marker-based AR functionalities.

### 2.4. Measures

Evaluation of the application was conducted through:

- Functional testing on multiple Android devices for technical reliability and AR marker detection.
- User trials and feedback collection (e.g., user observation or supervisor review of real application testing sessions).

### 2.5. Visual Documentation

Several visual aids support the explanation of the methodology:

Flowcharts detail the logic and sequence of application operation.

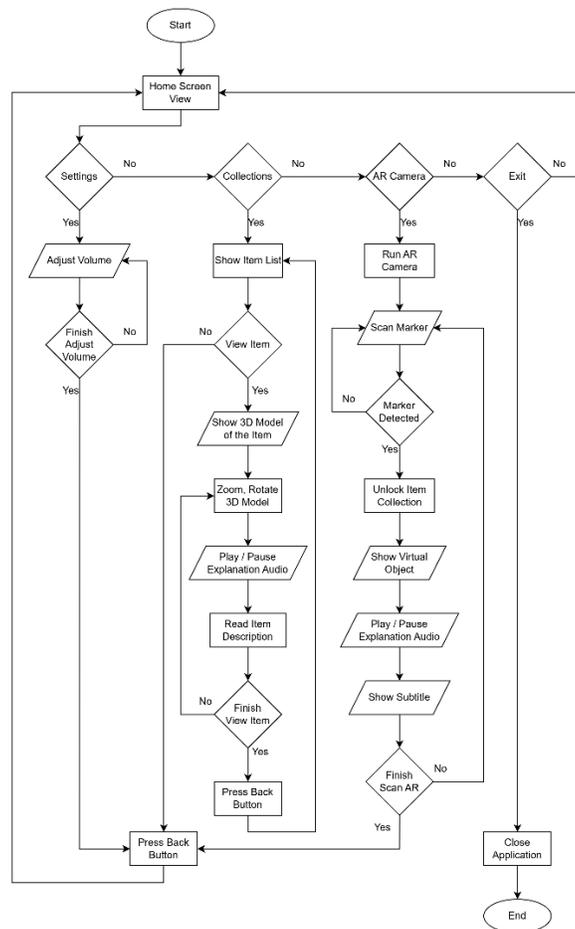


Fig 2. Application Flowchart

Use-case diagrams illustrate the actor-system interaction.



Fig 3. Use Case Diagram

Storyboards describe the narrative or sequence of user interaction in the application.

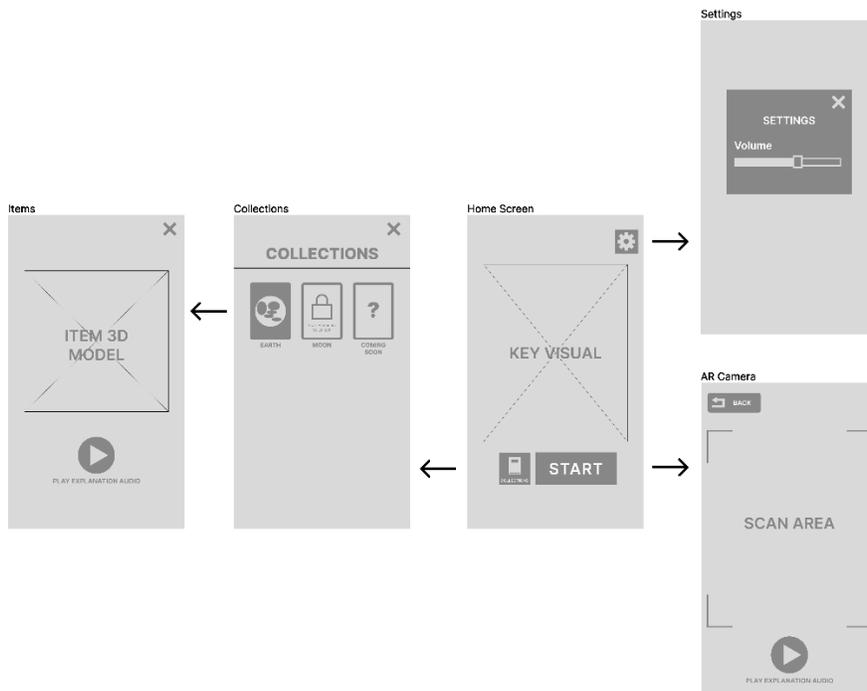
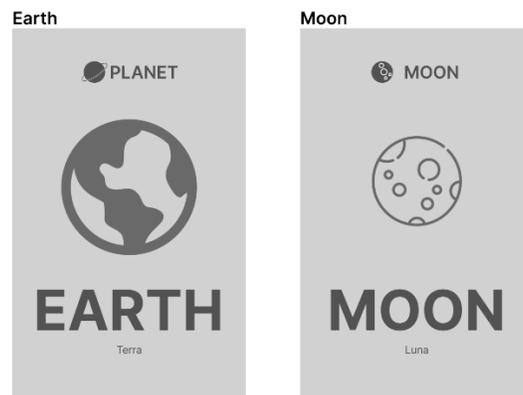


Fig 4. Application Storyboard

Layout and interface mockups show the designed AR card markers.



*Fig 5. Flashcard Design*

### **3. Result and Discussion**

As the current stage of the research focuses on the design and development planning of the AR-based interactive learning application, the main outcomes are the conceptual framework, storyboard, interface prototypes, and evaluation plans.

#### **3.1. Platform Compatibility and Prototype Design**

The planned application will target Android devices with version 10 or higher, chosen based on the prevalence of such devices among the target community. This choice ensures greater accessibility and aligns with contemporary hardware used by most families.

#### **3.2. Evaluation and User Assessment Plan**

Although the application is still under development, the evaluation strategy has been carefully prepared. The intended participants for initial usability testing include:

- The principal investigator (self-test)
- Peers or fellow university students (peer review)
- Supervising lecturers (expert validation)

This ensures the system is reviewed from technical, educational, and user-experience perspectives. The minimum intended respondent pool is 3-4 individuals for initial feedback.

#### **3.3. Survey Indicators and Data Collection**

The evaluation instrument will use a survey targeting three main assessment indicators:

- Navigation ease
- Visual comfort
- Information completeness/accuracy

Respondents will be asked to use the application and then fill out the survey, rating each indicator on a predetermined scale (e.g., Likert scale 1-5).

### 3.4. Prospective Result Scenarios

The actual technical tests, marker detection, and live user trials will be conducted once the application and AR flashcards are fully realized. At this stage, several possible developments are being planned, such as extending the material scope, initially “Earth and Moon” content, with an option to add “Sun” and other celestial objects if development proceeds ahead of schedule.

### 3.5. Discussion and Future Directions

This forward-looking evaluation plan is designed to ensure the validity and usability of the AR learning application. The research is structured to allow iterative improvements based on early tester feedback and technical evaluation. Expected future findings include the identification of practical challenges in AR marker detection, user engagement patterns, and areas for additional content development.

## 4. Conclusions

This study presents a comprehensive development plan for an interactive Augmented Reality (AR) learning application designed to introduce basic astronomy concepts to children at home. Although the application has not yet been released and no implementation results are available at this stage, the proposed methodology, design framework, and evaluation approach are expected to provide a solid foundation for future development.

The primary goal of this research is to foster children's interest in astronomy through engaging, interactive experiences, thus making science learning more appealing and accessible. Key limitations recognized in this stage include the need for ongoing adaptation to newer versions of development tools and technology, which may evolve during implementation.

For future researchers and developers, it is recommended to expand the content scope and collaborate with local communities or schools to maximize the application's impact and reach. Ultimately, nurturing children's curiosity toward science and encouraging them to ask why and how things happen is a crucial first step toward developing critical thinking skills, with astronomy serving as a promising entry point.

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