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Learning of Animals Based on Mobile Applications Augmented Reality at SD Bintara I

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Abstract — The problem with teaching young children to recognize animals in English is the lack of interactive media that is interesting and easy to understand, which results in low interest and comprehension among children. This study aims to develop an interactive learning application based on Augmented Reality (AR) to help children recognize animals in English in a visual and fun way. The development method used is the Prototype method with stages of needs analysis, design, implementation, and testing. This application was built using Unity, Vuforia SDK, and the C# programming language, and displays 3D animal objects that are scanned through markers accompanied by voice pronunciation in English. In addition to displaying AR objects, this application also has a feature to imitate sounds and check whether the child's voice matches the animal sound they are imitating. Testing results from 15 respondents expressed an average satisfaction rating of 4.08 on a scale of 1 to 5. Therefore, this AR application is suitable for use as an interactive learning medium for introducing animals in English.

Keywords – Augmented Reality, Interactive Learning, Mobile Application, Android.

I. INTRODUCTION

The use of technology in education continues to grow rapidly, offering great potential to improve the quality of learning as well as student interest and engagement. Technologies such as Augmented Reality (AR) can create a more interactive and enjoyable learning experience, surpassing the limitations of conventional methods that are often monotonous. AR, defined as technology that combines virtual objects (2D or 3D) into the real environment in real-time [1], is now increasingly popular in education to enrich the learning experience.

In the context of English language learning, especially vocabulary, teaching methods are still dominated by traditional media such as books or 2D images. This approach is often ineffective in attracting students' interest due to the lack of interactive elements, which are essential in today's digital age. In fact, mastery of English is crucial for accessing global educational and cultural resources [2]. Therefore, innovation in teaching methods is urgently needed to improve students' English language skills. AR technology has the potential to be an innovative solution to overcome this challenge by presenting 3D visualizations of vocabulary that can improve students' understanding and memory, while motivating them in the learning process.

Learning English from an early age is very important because childhood is a golden period in language development, when children have flexible brains that are able to absorb new information quickly. hildren learn languages effectively through fun interactions, repetition, and exposure to environments rich in language stimuli [3]. Visual and auditory methods, such as pictures, videos, sounds, and songs, are very helpful because children find it easier to understand concrete concepts.

The use of interactive media, educational games, or technology-based applications such as AR has been proven to have a positive effect on improving students' academic achievement [4]. Interactive learning media are tools designed to enable active interaction between learners and learning materials, rather than simply presenting information in a one-way manner. These media combine images, sounds, videos, text, and animations, making the learning process more lively

and less boring [5]. They come in various forms, ranging from educational applications, animations, educational games, to AR/VR technology. Research shows that interactive media improves concept understanding, memory retention, and problem-solving skills, as well as being able to cater to various learning styles [6]. In the context of English, interactive media allows students to not only see vocabulary, but also hear pronunciation, try using it, and understand its meaning in a clear visual context.

Augmented Reality (AR) is a technology that instantly integrates virtual elements into physical reality, often used in education to display interactive 3D objects that aid in understanding the material. AR increases students' engagement and enthusiasm for learning by presenting material in a visual and interactive way.

Fig.1. AR Technology Example

Some AR implementation methods include:

a) Marker-Based AR: Uses visual markers recognized by the camera to display virtual objects on top of them. A popular example is the Vuforia SDK.
b) Markerless AR (Location-Based AR): Does not require markers, but instead uses GPS, compasses, and other sensors to determine the device's position and display virtual content according to its geographical location (e.g., Pokémon Go)
c) Projection-Based AR: Projects light directly onto real surfaces to create the illusion of depth or interaction.
d) Superimposition-Based AR: Replaces the original appearance of an object with an added virtual display.
e) SLAM (Simultaneous Localization and Mapping): Maps the environment in real-time to track the user's position and place virtual content stably without markers.

This study uses several key technologies and tools, namely:

a) Unity: A game engine for developing cross-platform 2D and 3D applications, including AR applications, with a visual editor that facilitates the integration of elements.
b) Vuforia Engine SDK: A popular SDK for developing marker-based tracking AR applications, used to detect animal markers and trigger the appearance of 3D models and sounds.
c) Blender: Open-source software for creating and editing 3D objects, used to create 3D animal models.
d) Android Studio: Used for manifest customization and the Android application build process.
e) Microsoft Visual Studio: Development environment for writing code.
f) Krita: Used for marker design.
g) APKPure: An application distribution platform.
h) Google Forms: Used for user testing.

II. METHODOLOGY

This research is in the field of interactive multimedia technology development, specifically Augmented Reality (AR) applications in education. AR enables the real-time integration of virtual objects (2D/3D) into the real world through electronic devices using cameras and marker or target recognition systems.

The type of research used is applied research, which aims to develop and produce a tangible product in the form of an AR-based learning application. This product is expected to be used directly as an educational tool. In addition, this research is also descriptive quantitative, where data collection is carried out to describe and analyze user responses to the application through a Likert scale questionnaire.

The development model used is the Prototype method. This method is iterative, producing applications based on direct feedback from users through the creation of initial prototypes that are tested and refined. The main stages include:

a) Needs Identification: This stage is carried out to explore user needs and define the main features of the application. The target users are early childhood children (kindergarten or lower elementary school) who are in the early stages of learning English. The application is designed to help them recognize the names of animals in English through visual and audio interactions using AR technology.
b) Initial Prototype Development: The initial prototype of the application was developed based on the identified requirements. This prototype includes the user interface (UI), initial interaction with AR markers, and some key features such as the appearance of 3D animal models and audio pronunciation. The tools used include Unity for application development and Vuforia SDK for AR marker recognition.
c) Prototype Evaluation: The initial prototype was tested by a limited number of users (e.g., classmates, children, or teachers) to obtain

feedback on the appearance, ease of use, and effectiveness of the AR features. Testing was conducted through direct observation and user experience evaluation questionnaires.

d) Revision and Improvement: Based on the evaluation results, improvements and refinements were made to the prototype. Changes included improvements to the display, increased AR response speed, and refinements to speech pronunciation. This stage can be repeated until the final prototype meets user requirements.
e) Final Development and Implementation: Once the prototype is deemed suitable, the application is fully developed. All multimedia elements, such as 3D animal models, audio, and AR markers, are integrated. AR features are optimized to run well on various Android devices. Implementation is carried out using Unity and Vuforia, with the build process resulting in an APK file.
f) Application Distribution: Applications that have been completed and tested are then distributed in the form of APK files that can be run on Android devices. The files are shared via Google Drive or cloud storage, and are accompanied by usage guides to make it easier for users to access the application's features.

This study was conducted at Bintara 1 Public Elementary School, Jl. Bintara VI, West Bekasi District. This location was chosen based on the suitability of the elementary education level with the target users of the application and the ease of access for limited data collection. Data collection was conducted online through a Google Form questionnaire distributed to teachers and students after they interacted with the application.

This Augmented Reality (AR)-based application system uses Unified Modeling Language (UML) to visualize, specify, construct, and document software system artifacts. Prior to the development stage, UML is essential for defining the structure and behavior of the system. To illustrate the architecture and interactions of the system in this design, two important types of UML diagrams are used namely.

a) Use Case : The focus of a Use Case Diagram is how the system functions from the actor's point of view. This diagram effectively shows the relationship between actors and the features provided by the system. In designing this AR application, the Use Case Diagram will show how users interact with the system to achieve specific goals. For example, this diagram will show how users interact with the system to do certain things, such as scanning markers to display 3D animal objects and hearing the pronunciation of the animal's name. This will help to understand the functional interaction of users with the application as a whole.

Fig.2. Use case Diagram AR

b) Activity Diagram: Visualize workflows in the system, explaining the sequence of steps taken by users and the system, such as learning flows and quiz flows. These diagrams help you understand where processes begin, decisions are made, and how the system responds to user actions.

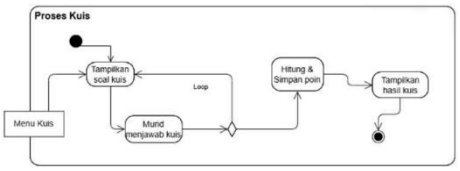

Fig.3. Activity Diagram AR

The user interface (UI) is designed to be attractive, child-friendly, and easy to use, considering that the target users are early childhood/elementary school children. The design principles applied include:

a) Use of Bright Colors and High Contrast to attract attention and ensure the visibility of icons/text.
b) Large buttons with clear icons to make it easier for children to recognize and press the buttons
c) Simple, intuitive, minimalist, and linear navigation (Main Menu → Guide → Marker Scanning → Detection Results) with back and help buttons.
d) Main Menu Display, Guide, Quiz, Camera, and Marker Detection Results: The design includes a main screen with “Learn,” “Quiz,” “Download Marker,” “Google Forms,” “Guide,” and “Exit” options; a guide screen; a quiz screen; a camera (scanner) screen; and a detection results screen that displays 3D objects and pronunciation sound..
e) Simple animations: Page transitions, button effects, and animal object movement animations were added to make the app more appealing.

III. RESULTS AND DISCUSSION

Black Box testing is used to evaluate the functions and outputs of a system based on specific inputs without regard to its internal structure. This testing ensures that the system operates according to its functional specifications. The test results show that the application's main features marker detection, 3D model

display, menu navigation, sound playback, and marker download work as expected. Thus, this application can be used as an interactive AR learning medium.

Table 1. Test Result

No	Feature Tested	Input	Output	Result	Explanation
1	Marker Detection	Camera pointed at the marker	3D Model appears and other UI	Success	As expected
2	Quiz	Answer is selected	Score is saved if correct	Success	The score will be displayed at the end
3	Menu Navigation	"Learn" button is pressed	Moves to AR Scene	Success	Camera activates with a delay
4	Download Marker	"Download Marker" button is pressed	Link Enters Google Drive	Success	Link is valid
5	Google Form	Press the "Google Form" button	Link opens in the browser	Success	Link is valid
6	Object Rotation	Press the "Rotate" UI button	3D Animal object rotates clockwise	Success	As expected
7	Animal Sound	Press the "Sound" UI button	Animal sound plays	Success	As expected
8	Animal Description	Press the "Info" UI button	Animal description appears along with audio in English	Success	As expected

Fifteen users (parents, elementary school teachers, and elementary school students) were tested using a Google Form questionnaire with a Likert scale of 1–5. The average score showed Figure 4.

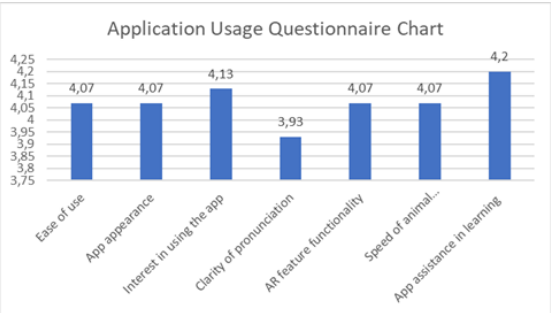

Fig.4. Questionnaire result

Figure 5 shows the main menu containing Learn, Quiz, Guide, and Download Marker and the AR display results. This feature displays 3D objects and provides information.

Fig.5. Main menu AR & AR Display

IV. CONCLUSION

Based on the results of research and development of interactive learning applications based on Augmented Reality (AR) for animal recognition in English, it can be concluded that:

a) By utilizing AR technology, students can observe animals in a three-dimensional format that can move and make sounds, creating a more engaging and immersive learning experience.
b) Based on user evaluations, most respondents stated that this application is easy to use, interesting, and helpful in the learning process.
c) This application can be an innovative alternative learning medium that supports the improvement of English language learning quality.

The suggestions that can be given from the results of this study is the use of AR applications must be supervised by teachers or parents, especially for young children. This is to ensure that the application is safe and helps students understand it. In addition, further research can be conducted to determine the extent to which the use of this application quantitatively improves student learning outcomes in the long term.

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