Augmented Reality Application for Science Education on Animal Classification

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***Abstract*—At present, learning media for the introduction of animal classifications based on food types have been applied in education today using books as learning tools. Student learning process is directed at the student's ability to memorize information, the student's brain is forced to remember and hoard various information obtained from the educator. Therefore, based on the issue, an Augmented Reality technology is then proposed to create an interesting real-time 3-dimensional (3D) animation. The animations were built using Blender while the AR development process uses the Vuforia SDK. This application displays animal objects that are classified by type of food such as carnivores, herbivores, and omnivores. These results are then tested on an elementary school students (7-9 years old). The results obtained from 20 respondents explained that this application can help students understand the classification of animal groups by type of food and can be used as an alternative multimedia learning solution about animal classification.**

Keywords—augmented reality, education, animal classification, learning effectiveness

I. INTRODUCTION

The introduction of animal groups based on food types are usually limited to print media such as books, at this time smartphone device users have been widely used by various groups, where the use of smartphones can be widely used for various kinds such as calling, sending messages, browsing the internet, and others. With the technology in smartphones, it can also be used as a learning media, so that it can be used wherever and whenever, the development of smartphone hardware specifications at this time is sufficient in the development of software that previously could be run on PC devices that can be run on smartphone devices. Smartphone software developers have developed Augmented reality technology that was previously developed on PC devices where this technology utilizes the existing camera on a smartphone [1].

Currently, learning media material classification of animal groups based on the type of food that is applied in education is to use books and use teaching aids as learning aids and the learning process is directed at students 'ability to memorize information, students' brains are forced to remember and hoard a variety of information in can be from educators. Another way to get around it that is by using Augmented Reality technology in making 3-dimensional animation (3D) to make it look more real-time and interesting.

Augmented Reality (AR) leads to dramatic changes in technology in human life. There are two different types on the main types and characteristics of AR systems: socially oriented AR and game-oriented AR [1]. Users given unlimited freedom and practical choices to engage and to create their character in virtual activities on the socially oriented colleagues, otherwise users had limitation on the availability of certain activities specifically to certain characters because of appropriate rules and regulation on the game-oriented AR [2]. Students are allowed to experience them carefully, observe and operate objects with their own hands using the learning environment created by AR.

The majority of parents try to be able to participate in the learning process of their children [1]. However, this participation did not occur in the early stages of children's development and education. Parent participation in children's learning process is very important because children will feel cared for, so the child will easily learn classification.. The purpose of grouping animals is to make it easier to recognize, compare and study animals. Comparing means finding similarities and differences in the characteristics or characteristics of animals. The grouping of animals is based on similarities and differences in characteristics possessed by animals, such as food eaten and habitat. Animals that have the same characteristics are grouped in one group.

The purpose of animal classification is to classify animals based on the similarity of characteristics possessed, describe the characteristics of an animal type to distinguish it from other types of animals, find out kinship, give a name of kinship whose name is unknown. Classification is a good way to simplify animal study objects. In addition, studying classification in biology is very important in understanding the diversity of animals that are very complex in the world. Each animal has characteristics that distinguish it from other animals, but there are some animals that have one or more things in common. This paper aims to assist students in classifying animals based on their food with the AR application, students will learn while playing, so they can quickly understand animal classification materials. This application displays animal objects that are classified by type of food such as carnivores, herbivores and omnivores. Therefore, the following research questions will be examined by this study. this study will examine the following research questions:

- How can the augmented reality application provide information about classifications of animals based on their type of food?
- What is the level of use of augment reality applications for science education on animal classification?

II. PROPOSED METHOD

A. Research Design

Research Design is a blueprint or framework that helps researchers in research that provides an outline and details of

each research procedure from questions to research problems to data analysis, research design.

Fig. 1 depicts a flow chart containing the steps that must be carried out in the AR application methodology for science education on animal classification. The application created aims to help students understand the classification of animals based on their food. This application is designed to ease the user. This stage begins with the literature review, data analysis, design, implementation, testing and evaluation.

A. Literature Review

AR can be characterized as thinking about its three attributes: consolidating this present reality with the virtual world, giving connection, and exhibiting three-dimensional (3D) objects [3]. AR gives the virtual world and this present reality at the same time to clients. Even though the virtual world has a few points of interest, for example, 3D symbols, rich correspondence channels and rich cooperations [4][5], genuine encounters give significant chances. Particularly, the rise of 3D protests, in reality, makes a supernatural inclination that causes an abnormal state of astonishment and interest [5]. Likewise, content, pictures, recordings and activities and 3D models can be utilized for instructive AR applications. This AR trademark makes it viable [4]. A few AR studies have been done in different fields of training. AR innovation additionally gives numerous instructive advantages. There are three studies that the authors use as material to analyze the educational benefits of the Augmented Reality application.

The first research aims to apply subjective examination and meta-investigation in the elements of presentation representation, content creation, and assessment strategies. This audit is distributed on IEEE Xplore. The researcher concludes that AR has three main options: documentation that can be certified, relevant perceptions, and vision-haptic representation. The creator also reasoned that three administrations, were upheld by existing hypotheses: experiential learning, the vision activity vision and the learning hypothesis of views and sounds [11].

The second research has a positive impact on AR for education: spatial learning structures, increased collaboration, motivation, language associations, long-term memory storage, and increased understanding of content. While the negative effects: tunneling attention, difficulty Usability, ineffective class integration, student differences. The analysis in this study is an audit study looking at substitute learning in AR versus non-AR applications [12].

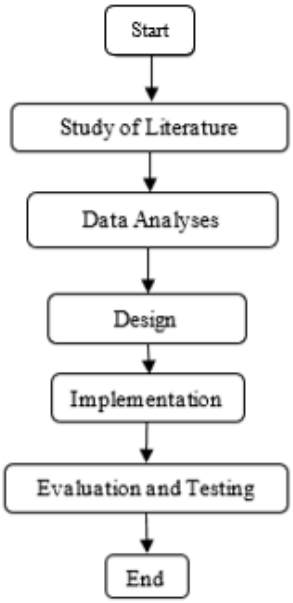

Fig. 1 Research Design Flow Chart

The latest research is entitled New technological trends in education: Seven-year forecasts and convergence. In this study explained that the number of articles about increasing AR has not been shown by this innovation as an underlying stage in teaching. The advancement of AR for portable that extends the truth is considered a useful meta trend. Innovation tends to be in teaching from 2004 to 2014 through a bibliometric investigation of the Horizon Report at the AR point as well as on various subjects of learning improvement innovation.

B. Data Analyses

Children's opinions have been evaluated using descriptive techniques (frequency, mean and standard deviation). Children's behavior pattern is observed through a form of observation. The researcher first observes the behavior of all children in the observation process and then checks and corrects all data to provide reliable results. Each observed conduct is registered in the form and calculated from the video recording. Their values, percentages and standard deviations have been descriptively analyzed. Two interview questions determine the moment they are involved with toys, the children's cognitive achievements. ach question is analyzed in two categories as appearance descriptions and broad descriptions. If a child only describes what he has seen, it is evaluated in the description of the appearance. For example, the statement of children as "I see a cow. Cows eat grass and leaves. "Given the code as two numbers of frequencies in the appearance description category. If a child expresses his own thoughts, imagination, and comments, it is calculated for broad descriptions. For example, a child says, "I think cats only eat fish and chicken-like my pet cat." Calculated as one frequency calculated in a broad description category. Finally, a correlation test is conducted to understand the relationship between their behavior and cognitive achievement. As a result of abnormal data distribution, the Spearman Correlation test was used. To ensure the reliability and validity of the study, two learning technology experts examined all research processes. In addition, all data collection tools were selected from the literature. Analysis of cognitive achievement and behavior pattern analysis was carried out by researchers twice.

Basically, three components are used for the main interaction in augmented reality technology which is a smartphone/tablet that functions as a device for augmented reality software. Second, smartphone cameras as marker recognition tools and markers as augmented reality locations. These three components must work together at the same time to trigger and enlarge the animation object.

Fig. 2 is an illustration of the work of the software. It started with the user run the software, use the camera on a smartphone, then directed toward the marker that has been provided, the object will appear augmented reality and user are free to interact with the software.

III. MATERIALS AND METHODS

There are several methods that can be used in augmented reality, one of which is Marker Based Tracking. This marker is usually a square black and white illustration with a thick black border and a white background, in this study using markers that contain patterns from animal images. The computer can recognize the position and orientation of the marker object and create a 3D virtual world, which is a point (0,0,0) and an axis consisting of X, Y and Z. This marker

based tracking has long been developed since the 1980s and started developed in the use of Augmented Reality.

A. *Unity 3D*

Unity 3D is a software for the game engine to build 3D games. Game engine is a element behind each video game's scenes. Unity can be used to create a game that can be used on desktop systems, smartphones from Android, iPhone, PS3, and even X-BOX. Unity is an embedded instrument for games, architecture building and simulation creation. Unity can be for online games and PC games. Unity 3D's characteristics include the following:

- Integrated environment for growth (IDE) or embedded environment for growth.
- Application outcomes are disseminated across multiple platforms
- The graphics engine utilizes Direct3D (windows), OpenGL (Mac, Windows), OpenGL ES (iOS) and Proprietary API (Wii)
- Mono game scripting. Scripting based on Mono, an NETFramework open-source application. In addition to programming, UnityScript can be used (custom language with JavaScript-inspired syntax), C # or BOO languages (which have Python-inspired syntax).

Unity supports the development of android applications. Before you can run applications made with Android Unity, you need the Android developer environment settings on the device. For that, the developer needs to download and install the Android SDK and add physical devices to the system. Unity allows calling custom functions written in C / C ++ directly and Java indirectly from C # scripts.

B. *Vuforia SDK*

Vuforia is an Augmented Reality Software Development Kit (SDK) for mobile devices that enables AR apps to be created. The Vuforia SDK, which is called Vuforia AR Extension for Unity, is also available to be combined with Unity. Vuforia is an SDK provided by Qualcomm to help developers create Augmented Reality (AR) applications on mobile(iOS, Android). Vuforia SDK has been used successfully in several mobile applications for both platforms.

AR Vuforia offers a manner of interacting that uses a cellphone camera to be used as an input device, as an electronic eye that acknowledges certain markers, so that the screen can show a mixture of the application's true world and the world drawn. In other words, Vuforia is a computer vision-based SDK for AR. Another sort of implementation for AR is AR based on GPS. Vuforia benefits:

- Full of miracle. Because by using AR technology, mediocre pictorial paper when projected into a gadget camera that has Vuforia technology in it, the gadget's screen which originally had a blank paper background changes its appearance by adding sensational 3D graphics.
- Free to choose the desired favorite game background. Because with Vuforia technology, smartphones can easily play favorite games with different game backgrounds.
- Unlimited interactions. When using Vuforia technology, it can interact more freely than games that use 2D or 3D technology, because games with AR make users forget the boundary between the real world and the world of technology.
- It's fun. The three basic fun words have broad meanings, but the goal remains one that is pleasing to those who play it. Vuforia is Fun technology, where gamers will get broad happiness.
- Value Added. With Qualcomm's Vuforia technology, AR developers can maximize their ability to create technologies that have high added value. AR developers can create content ranging from; games, applications, advertisements, presentations, and many other things that can be explored to make money.

IV. AUGMENT REALITY APPLICATION

A. *Flowchart Software*

A flowchart is a visual portrayal of the arrangement of steps and choices expected to play out a procedure. Each progression in the succession is noted inside a graph shape. Steps are connected by associating lines and directional bolts. This enables anybody to see the flowchart and consistently pursue the procedure from start to finish.

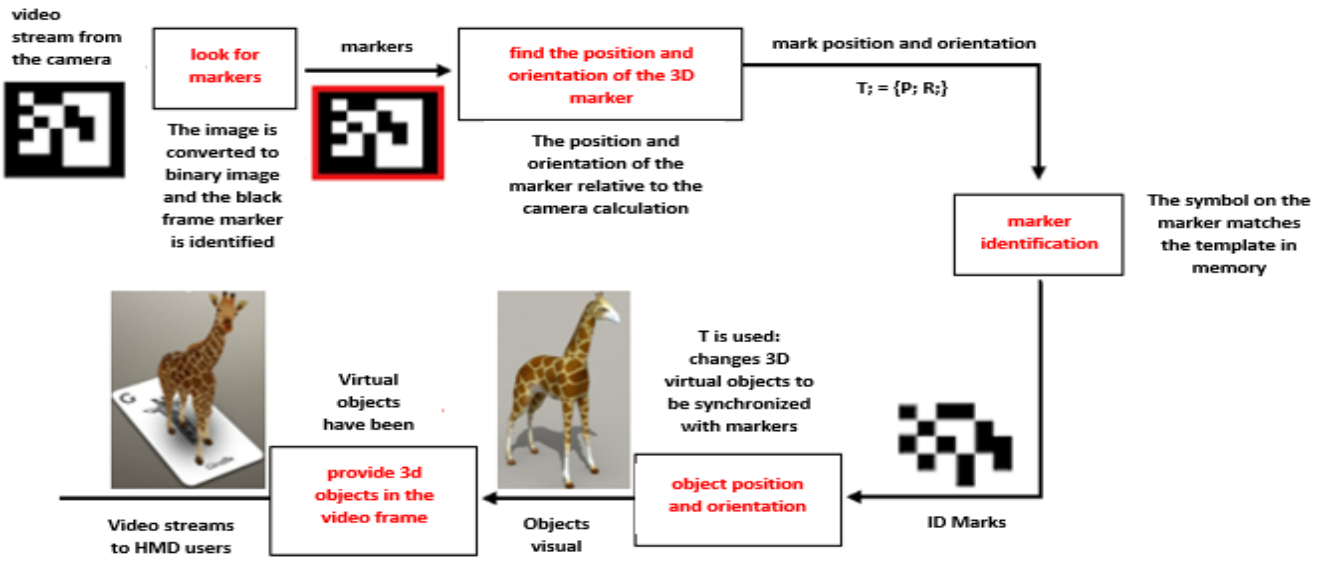

Fig. 2 Augmented Reality General Mechanism

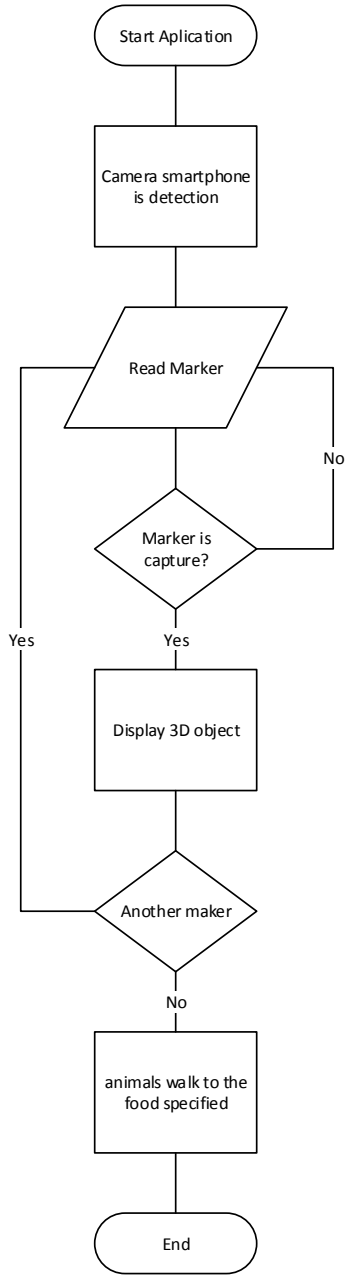

Fig. 3 Increased Flow of Reality Used by Users

Fig. 3 illustrates the flow of augmented reality mechanisms used by users. Users here are children. Children can detect markers, then when the marker has been detected the 3D animal animation selected will display. Then the animal will walk towards the food according to the type of animal.

B. Scene Design Main Menu Application

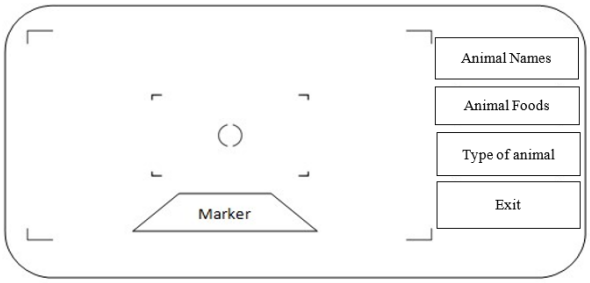

Fig. 4 Menu Utama Scene Design

The Fig. 4 is a component design on the main menu, while the components used in the scene above are as follows:

- AR Camera , used as a scanning tool using the camera sensor to detect the marker.
- Animal names, used to display 3D animal objects.
- Animal food, used to display 3D animal food objects.
- Type of animal, used to display the type of animal selected.
- Exit, used to exit the application

C. Detail Type of Animal Design

The Fig. 5 is a component design on the Detail Type of Animal Design while the components used in the scene above are as follows:

- Type of animal, used to display the type of animal selected.
- Text_Info, used to provide information on animal knowledge
- Btn_Back, used to return to the main menu Marker Design

Markers used in this study are based on cubes that have markers with pictures of animals (carnivores, herbivores, omnivores) as can be seen in Fig. 6. Unity 3D as an application tools engine for the AR and Vuforia SDK as a development device used to create and produce augmented markers reality the result of marker analysis is a set of coordinates at the marking point of the coordinated point collection representing an area that can be marked as a marker.

D. Scene Design 3D Object

The 3D design used for this study is animal species (carnivores, herbivores, omnivores) and foods consumed by fertilized animals. With this 3D design, children can learn to recognize animals easily and can interact with AR directly. 3D object can be seen in Fig. 7.

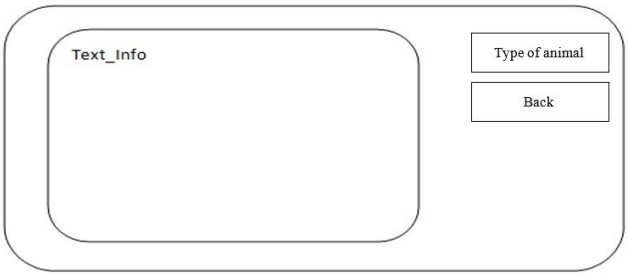

Fig. 5 Detail Type of Animal Design

E. Marker Design

Fig. 6 New Alba Floor Plan

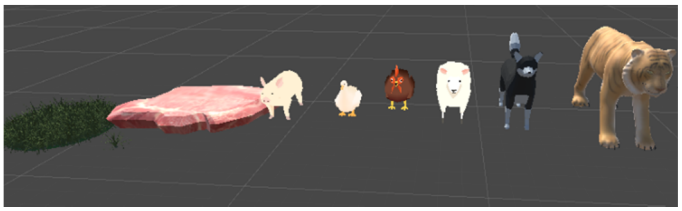

Fig. 7 Animals Object 3D

V. Evaluation and Testing

The testing period of the Augment Reality Application for Science Education on Animal Classification is finished by two techniques, in particular approval testing and convenience testing. Approval testing is done to test whether the application has satisfied every useful necessity that have been recently characterized. Though ease of use testing is a companion test to see if the Augment Reality Application for Science Education on Animal Classification is utilized by great clients or not.

A. Validation and Discussion of Results

Approval testing is finished by the discovery strategy which intends to decide if each useful necessity tried is substantial or not. Approval testing is done with experiments on each utilitarian necessity. At that point the consequences of approval tests will be introduced in table structure. The test outcomes are said to be substantial if the outcomes acquired are equivalent to the normal outcomes.

Black Box Testing on the Augment Reality Application for Science Education on Animal Classification. Tests are carried out after the implementation of the method compiled by the author. Black box testing is a test that is done by observing the results of the execution of the test data and checking the functional of the software.

The procedure of examination of the consequences of approval testing is finished by contrasting the reasonableness between the test and the framework plan that has been finished. On the off chance that the test outcomes are as per the framework structure, the application is legitimate or meets useful prerequisites. On the off chance that the test outcomes are not as per the plan, the application is invalid or does not meet the utilitarian prerequisites of the framework. In light of this, in the wake of dissecting the consequences of testing, that the Augment Reality Application for Science Education on Animal Classification which is a portable application has satisfied every single practical necessity as indicated by the aftereffects of framework structure or all highlights that have been tried are legitimate.

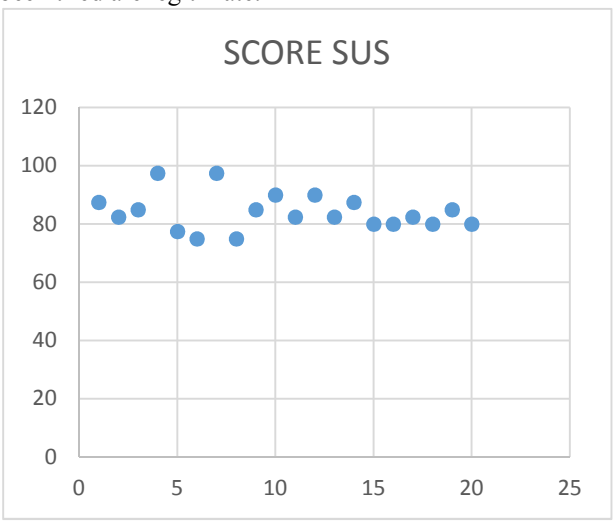

Fig. 8 Score SUS

B. Usability Testing and Discussion of Result

Ease of use testing is a test led to test whether the application can be utilized effectively by the client or not. Ease of use testing intends to discover how enormous the degree of fulfillment and comfort of clients of the application. The technique utilized in ease of use testing is the SUS (System Usability Scale) strategy. The SUS strategy is a test completed utilizing a survey comprising of a few inquiries.

The usability testing phase is done by giving an explanation of the application made to the respondent. Then ask the respondent to use the application and provide an assessment of the application using the questionnaire that has been given. The number of respondents who were asked to give a questionnaire assessment was as much as 20 because according to Nielsen [14] to get a better usability indicator was to use 20 respondents. Examples of each children (N = 20) maturing 6-8 including 10 boys and 10 girls in Early Childhood Education in Malang, Indonesia. The convenience sampling method was used for this study because we choose to be accessible and voluntary for students.

The way toward dissecting the aftereffects of ease of use testing is finished by taking a gander at the consequences of the SUS score figuring. The SUS score acquired on ease of use testing is 75.5%. In light of the explanation that the SUS score with a scope of 0-50 is in the "Not Acceptable" classification, the SUS 51-70 score is in the "Minor" classification and the SUS 71-100 score is in the "Worthy" class. Thus, the tests led demonstrate that the Augment Reality Application for Science Education on Animal Classification is anything but difficult to utilize and can be acknowledged by clients. The aftereffects of the restatement and computation of the poll are clarified in Fig. 8 which is an outline of the consequences of reiteration and count of the survey that has been given to respondents.

VI. Conclusion

The results of the study show the positive impact of augment reality for science education on animal classification on student learning performance. then some conclusions can be drawn as follows:

- AR Application for Science Education on Animal Classification can provide information on how to classify animals based on their food processes. From the number of respondents who were asked to give a questionnaire assessment of 20 respondents, 85% agreed that the AR Application for Science Education was easy to use and agreed that AR Application functions / features for Science Education were well integrated. The results of the validation testing analysis indicate that the AR Application for Science Education is in accordance with the application design with the test results valid, meaning that the AR Application for Science Education meets the functional requirements of the system and the application runs in real time.
- The SUS score obtained on usability testing is 75.5% which has been average from the value of 20 respondents. With an average of 75.5% the results of usability testing analysis on AR Application for Science Education fall into the category of "acceptable" which means that the application built can be accepted by the user and fulfill the functional requirements of the application.

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