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Preliminary Evaluation of Augmented Reality for Learning Indonesia's Endemic Animal

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Abstract: In this experiment, an Augmented Reality (AR)application is used to improve students' learning outcomes in school. We proposed ARnimal, an app based on Augmented Reality (AR) technology. ARnimal helps students learn new things about Indonesia's Endemic Animal on the app. ARnimal also included a 3D view and animal description. 3D-based learning makes it easier for the students to visualize learning materials because they can see the animal's habitats in 3D. In this paper, we conduct the experiment based on the respondent's background in efficiency, learning, and engagement. Respondents involved 18 people who were divided into two groups based on their experience with AR, namely experienced with AR and never used AR. The results showed that there was no significant difference in efficiency, engagement, and learning based on the respondent's background ($p > .005$)

Keywords: *Augmented Reality, Teaching and Learning,Education, Animals,3D*

1. Introduction

Augmented reality technology is becoming more accessible to consumers. According to research, there is an estimated 600 million AR-enabled devices at the end of 2020, and that number is expected to grow to 1.70 billion by 2024.As more consumers adopt augmented reality technology, AR will go mainstream and cease to be seen as niche technology. 2020 was a significant growth period for AR. [1]. In real-world video games, players can naturally communicate and navigate with other players. This is the benefit of games, where the interface with the real world is intuitional. But on the other hand, it provides new animation. Content that can be fantastic or absurd in the real world is a feature of games [2].

Traditionally besides computers, computer games are locked within the limits of the smartphone screen also.[3][4]. Computer games provide a glance into the virtual environment, where the player is disconnected from the surrounding environment. When in ongoing game, players in the game world are present in the regular world . Video games combine the real-world entity in game world, then the common objects from daily life can become part of that game. This is an important benefit of playing that is not possible in common computer games[5] [6]. The technology known as augmented reality (AR) allows for the real-time integration of digital data with the user's environment [7]. It is currently possible to employ augmented reality (AR) in educational settings such as classrooms, and numerous studies have examined how it affects students' motivation and performance at various educational levels [8][9].

Augmented Reality (AR) is a technology that combines a 3D or 2D virtual object with a real 3D object and projects the object onto the virtual object in real-time. Augmented reality simply adds or supplements reality. Virtual objects display information that the user is unaware of. This makes Augmented Reality (AR) a suitable tool to help users perceive and interact with the real world [2][10].

Other technology can be used for applying permeate play. In the Alternative Reality Games (ARGs) use the real world for platforms, where many video game elements are used to create storylines that infiltrate the real world. In ARG, player room information is a website, email message, and physical location. In games that need to be more contextual, players are physically present in a location that is designed to join the game. Other than that, Immersive games can also be implemented using Augmented Reality (AR) technology to combine the real world with virtual environment [11]. Augmented reality has presented a recent way to associate with digital content. AR supports creating new game environments like virtual

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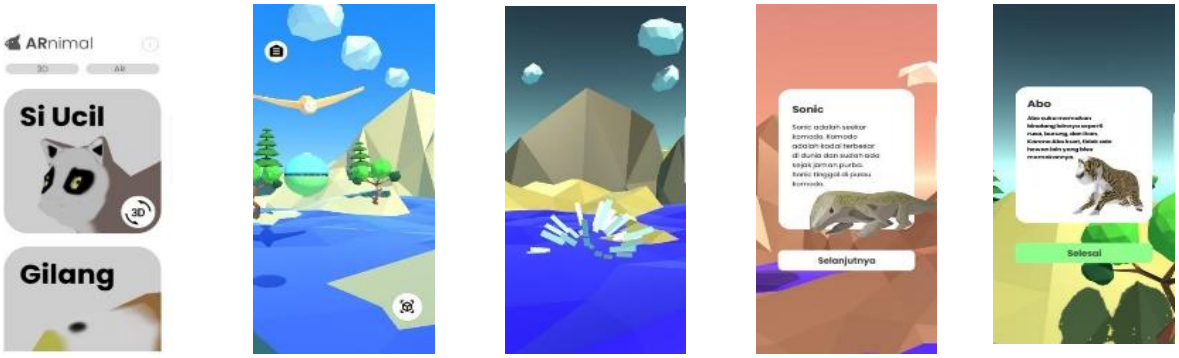
objects that are coated in the real world [12][13]. In this paper, we develop an application to learn about Indonesia's Endemic Animal through an augmented reality approach named ARnimal. We conducted a preliminary experiment by involving several respondents to evaluate this application.

Furthermore, this paper is organized as: 1) Introduction tells the research background. 2) related work describes related works to this research. 3) ARnimal explains the proposed research that describes our implementation of Augmented Reality (AR). 3) Method explains how the evaluation is conducted consisting: of research design, participant, and evaluation method. 4) Results describe the evaluation results and provide analysis through a statistical approach. 5) The conclusion in this section summarizes all the research that has been done.

2. Related Work

In Previous research, The AR application was created using an AR technology based on the syllabus in Indonesia. The augmented reality applications are used for providing animal recognition learning. The AR app includes the names, foods, habitats, and custody of the animal. The purpose of AR applications is to teach learning in 3D and Accumulate AR technology [14][15]. The application is developed using unity and built to the cellphone so with the help of the camera on smartphone, it detects a marker in the book, and it will display a 3D visualization of the animal. AR applications can also detect videos to teach learning in 3D view. In this research, the animals that are contained in the AR application include sharks, lemurs and tigers. AR application running on android that displays learning in 3D view. This AR application includes 3D animal images with information about animals [16].

AR is increasingly being used for educational settings and often to help students with complicated subjects [17]. Students who struggle with geometry, for instance, can utilize augmented reality to view and edit 3D geometric structures. The ability to teach kids about different cultures through virtual field excursions using augmented reality is another educational use for the technology [18]. According to Project, less than 10% of schools presently use augmented reality in the classroom, even though AR and related technologies like VR are growing in popularity in education. The bulkiness of AR technology, the caliber of AR educational content, doubts about its academic worth, and a lack of paper money are a few factors suggested for the delayed adoption of AR in education [19]. AR gives teachers the chance to assist students in understanding abstract ideas [20]. By utilizing the dialogue and testing that AR.



(A) (B) (C) (D) (E)

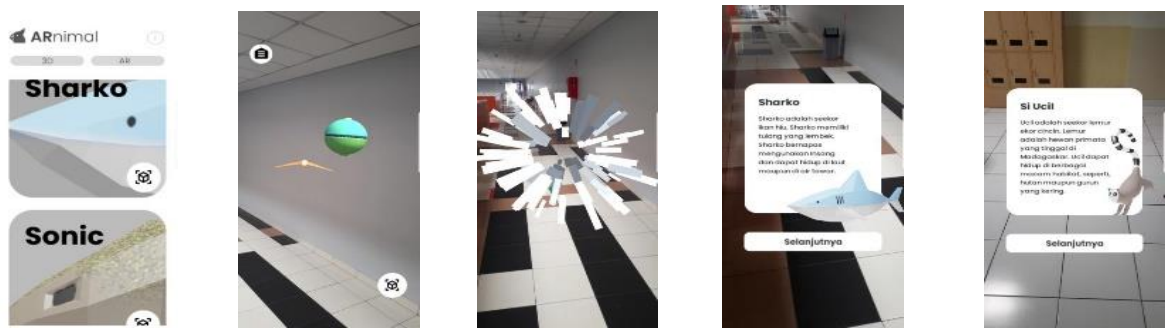
Fig. 1. ARnimal in 3D Mode : (A) Main Menu in 3D Mode. (B) Throwing Ball in 3D Mode. (C) Catching Animal in 3D Mode. (D) First Animals Description. (E) Second Animals Description

3. ARnimal

ARnimal is an AR-themed application created using the Unity Game Engine. In addition to unity, there are several other applications that are used, namely Blender, Figma, Audacity, etc. The aim of this application is to teach students to use AR technology for learning animal content. ARnimal is made using unity and has been built into a smartphone so that with the help of the camera on the smartphone it will display a 3D visualization of animals. This application includes the name, food, place of residence, and several other descriptions of the animal. This application can be played in two modes, namely 3D mode and AR mode.

In 3D mode (See Figure 1) and AR Mode (See Figure 2), have several scenes in each mode with the same functions in general. The first scene in Figure 1 (A) and Figure 2(A) are the main menu in the 3D and AR modes. In this scene, the user can press the animal button to catch the animal. In addition, users can also

press the 3D button to switch to AR mode. Figure 1 (B) and Figure 2 (B) are the scene where the user catches an eagle. In this scene, the user will press the screen and the ball will follow the direction of the touch. After the user catches the animal there will be a firecracker that will appear as shown in Figure 1 (C) and Figure 2 (C). Then, the user catches the animal, the user can see descriptions of the animal that has been captured such as Figure 1 (D), Figure 1 (E), Figure 2(D), and Figure (2E). There are 5 different animals in the ARnimal app, such as the Sumatran Tiger (See Figure 1 E), Java eagle (see Figure 1 B), Kalimantan lemur (See Figure 2 E), Komodo dragon (See Figure 1D), and Banteng Shark (See Figure 2 D). All these animals have characteristics of Indonesia's Endemic Animal. On other hand, users can learn through the description after catching the animal. This approach makes the learning experience more visualized and interactive for the users through both modes.



(A) (B) (C) (D) (E)

Fig. 2. ARnimal in AR Mode (A) Main Menu in AR mode users can press the AR button to switch to 3D mode. (B) Throwing a ball in AR mode. (C). Catching Animals (Firework animation after catching animals) in AR. (D) Description of the first animal. (E) Description (Animal Contents)

4. Method

4.1 Research Design.

The research sample was divided into two groups: the experimental group and the control group. The Control group contains research on people (user) who have experience using AR, while the Experiments group are for people who have never used AR. In this study, we will compare the control group and the experimental group to investigate the difference based on the participant's background. The user will be given a questionnaire after using the ARnimal in both modes.

4.2 Respondent.

In this study, we involved 18 people (ages: 10-19) who were mostly random teenagers that lived in Jakarta, Indonesia. Half of these respondents stated that they had used AR and the other half stated they had never used AR.

4.3 Evaluation Method.

The evaluation questionnaire variables that we compare for the respondents are Innovation, Learning, and Engagement. These three variables contain six questions. This means each variable consists of 2 questions (see table 1). Respondents will give a score to assess our game variables. In the parameter scale, respondents will choose a value of 1-5 which means the higher the better (Likert Scale). This Likert Scale consists of interpretations such as: very good (score range: 4.21 - 5.00), good (3.41 - 4.20), moderate (2.61 - 3.40), bad (1.81 - 2.60), very bad (1.00 - 1.80).

Table 1. QUESTIONNAIRE

VARIABLE	Item	Questions
EFFICIENCY (EFN)	EFN 1	I feel that learning through AR is more effective than learning at school
	EFN 2	I think most people can understand to play this game very fast.
LEARNING (LRN)	LRN 1	I learned new things about animals.
	LRN 2	I can become a better learner if I play this game.
ENGAGEMENT (ENG)	ENG 1	The interactions I feel with animals feel natural.
	ENG 2	The behavior of animals in the virtual environment is close to my expectations.

5. Results

The results of the questionnaire will be measured in terms of validity (r) and reliability (a) of the values of each question (See Table 2). Moreover, the result indicated that questions in all the variables are valid (r > .428) and reliable (a > .60).

In Table 2 indicates a good variable Efficiency (Mean = 4.055). This means that all respondents learn effectively and quickly understand well. Meanwhile, the Learning variable is interpreted as good (Mean = 3.83). This explains that all the respondents learned a lot of new things and became better students with good interpretations. While the Engagement variable is interpreted as good (Mean = 3.745). This explains that all respondents feel the application is natural and has a good environment as their expectations. Furthermore, we found that our application is very easy to understand (EFN 2) by respondents with an average of 4.438.

In Table. 3, We used t-test (Welch's) and Mann-Whitney U because some of the results are normal distribution, and the other results are not normal. The LRN and ENG variables were carried out using the t-test (Welch's) method because the Shapiro-Wilk Test had p>0, 05 which means normal. As for the value of the EFN variable, it is done using the Mann-Whitney U method because the results of the Shapiro-Wilk Test have p <0.05, which means it is not normal.

Table *2.* Result

VARIABEL	Item	MEAN		SD		r	a
EFFICIENCY (EFN)	EFN 1	3,688	4,055	1,195	1,043	.811	.839
	EFN 2	4,438*		0.892		.689	.857
LEARNING (LRN)	LRN 1	3,813	3.83	0.981	0.969	.789	.837
	LRN 2	3,875		0.957		.774	.840
ENGAGEMENT (ENG)	ENG 1	3,438	3,745	1,263	0.918	.884	.816
	ENG 2	4,063		0.574		.743	.853

Table. 3 Signed Rank Test

	Shapiro-Wilk Test	**t-test (welch's)**		**Mann-Whitney U**	
	p	***t***	***p***	***z***	***p***
EFFICIENCY (EFN)	0.031	-0.536	0.601	-0.859	0.390*
LEARNING (LRN)	0.123	-1,030	0.325*	-1,249	0.212
ENGAGEMENT (ENG)	0.118	-0.869	0.406*	-0.923	0.356

In the Efficiency variable, the results showed that there was no significant difference between the control group and the experimental group (p = 0.390). This shows that the background of the respondent does not affect the learning speed and effective understanding of the ARnimal application. While the Learning Variables obtained a significant value of 0.325. This means that there is no significant difference between the control group and the control experiment. This shows that the background of the respondent also does not affect learning about new things and becoming a better student. In the Engagement variable, it was found that there was no significant difference between the two groups (p = 0.406). This shows that the background of the respondent also does not affect the natural level of the application and the expected level of the environment.

6. Conclusion

In this paper, we support previous research that AR can be used for learning [21-24]. In this paper proves that AR technology can also be used to study Indonesian animals because of how well our application may be interpreted in terms of efficiency, learning, and engagement. In the efficiency section, it can be indicated that our application can be quickly understood. From the results of the study, it can be seen that the background of the respondents does not affect the results of efficiency, learning, and engagement (age:10-19). Even though the respondents

are small, we can look for insights regarding efficiency, learning, and engagement through our application. In future research, we plan to investigate acceptance, usability, or/and user experience with many more respondents. References and Footnotes

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