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## The Effectiveness of Augmented Reality App to Improve Students Achievement in Learning Introduction to Animals

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### ABSTRACT

In this experimental study, AR book app is used to improve student learning outcome of kindergarten in animal introduction subject. AR book app is an application based on Augmented Reality (AR) technology that adapts the kindergarten curriculum in Indonesia. AR book app has included 3D view and animal video. 3D based learning makes it easy for students to visualize learning materials and video based learning to makes students give attention when learning activity. In a field experiment at kindergarten, 111 kindergarten students was divided into two groups participated in learning activity that using different learning media. The two groups were group A and group B. Group A is an experimental group which taught using Augmented Reality (AR) book app. Group B is control group which taught using group note methods. Experimental result showed that students' performance in learning improved significantly by using Augmented Reality (AR) book app media. In this study, students indicated that the experimental group learning outcome is better than the control group.

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## 1. INTRODUCTION

Information and Communications Technologies (ICT) advancements have made computers are vital in education by providing new learning media, contents and strategies [1]. Nowadays, the Information and Communication Technology (ICT) had been a real role, including the life of Children. Children are attentive in ICT by combining both playing and learning. ICT helps to develop curiosity, observation, and experimentation in children. Therefore, need to be made tools, apps, and services specifically for children [2].

Recently to improve user satisfaction and experience in learning Technology Enhanced Learning (TEL) has increased the development of new technologies, one of which is Augmented Reality (AR) [3]. In a survey defines that Augmented Reality (AR) need to have three characters that are combining real and virtual, interactive in real time, and 3D object [4]. Appearing of 3D objects in real world creates a magical feeling causing a high degree of surprise and curiosity [5].

Based the study regarding the technology trends in education, and recasted that the use of mobile AR in education is one of the promising research areas in the near future [6]. In addition, texts, images, videos, and animations as well as 3D models can be used for made learning media Augmented Reality (AR). It is this factor that makes AR effective [7].

AR can show virtual objects display information that can help the user perform tasks [8]. Augmented Reality (AR) is one the growing technologies that have a great pedagogical potential and increasingly developed educational researchers [9]. AR technology means people ability performance was significantly better and enrich students learning motivation as well as their frustration tolerance [10].

12 Through AR, learning has been brought to a 20v dimension where the students can easily visualize subjects and easily understand complex concepts [11]. In addition, the experiment results show that the student experimental group obtained significant results in terms of motivation, relevance, confidence, and satisfaction in using AR-based mobile devices for learning [12]. The Learning achievement of experimental group use AR learning significant 16 better than the control group, which is directly guided in the giving of information [13]. AR book learning group got better scores on the written test than the control group received learning with lectures, slides, and video recordings [14]. Students who used Augmented Reality (AR) based media have better academic performance than the group who used notes. In fact, 80% of students using AR based media passed the final exam while only half of the students using group notes were able to do final exam [15]. While currently many teachers still using traditional learning media [16] one of them using group note. The learning outcomes of using group note result in low achievement [15,17].

One of the lessons in kindergarten is animals, on the contrary animals learning in kindergarten is still less than optimal [18]. As a result in this stu 5 the researchers made a learning media using Augmented Reality book (AR book) app with animals subject. To improve students learning outcome in learning introduction to animals used AR book app in kindergarten as an alternative learning media. AR applications with animals subject which is available are not adapt to the curriculum in Indonesia. In this study, AR book which is made adapted to the curriculum of kindergartens in Indonesia with animals subject. Participants in this study were group A and group B. Group A is an experimen 15 group which is taught using AR book app. Group B is the control group which is taught using group note. Pre-test and post-test were used to evaluate the effectiveness of AR book app as learning media to introduction of animals.

## 2. ICT IN KINDERGARTEN

Although various technologies can be used for early childhood education, the use of computer and smartphone are currently getting more attention [19]. Currently, many ICT applications and services have been developed for children. With learning media, learning performances are more effective and more children interaction [20].

Many researchers are developing ICT applications for kindergarten children aiming for the future to prepare children for using ICT services in the modern world. E-learning in the world of children can help develop knowledge and skills. With technology, education will provide different elements such as with text, video, audio, graphics, and animation. This will make it easier for children to receive information [2].

## 3. AUGMENTED REALITY FOR EDUCATION

22 AR can be defined in which virtual objects are brought to the real world [21]. This technolog 6 allows users to interact with virtual objects in real time [22]. Azuma defines a 6 road AR consisting of three characteristics [4]: (a) the relationship between virtual objects that ex 13 in the real world (b) users can interact in real time (c) displaying objects in 3D. AR can be developed 6 utilizing and connecting innovative technologies such as mobile devices and wearable computers [23]. Previously, desktop computers had the ability to graphics processing to support AR implementations, but not portable due to hardware limitations. In recent years and increasingly advanced technological developments, AR implementations use mobile devices that have advantages such as graphics processing, portability, user-friendly, and personnel operations. [24]

Many educators and researchers are enthusiastic about using AR in the teaching and learning process [25]. AR technology can provide new tools for building constructive learning environments. Previous research has determined that the value of learning outcomes with AR media has increased significantly in recent years so it is considered a significant pedagogical tool to improve learning outcomes [26]. AR technology is recommended as a key technology education for the next five years [27]. Other studies emphasize five potential applications of AR in education: (1) Studying the identification and observation of 3D objects [28]. (2) Incorporating wireless Internet technologies and locations for learning anywhere [29]. (3) Create learners with passion in the presence, readiness, and deepening of the material [30]. (4) visualizing the abstract concept [29]. (5) formal and informal learning acts [31].

## 4. RESEARCH METHOD

### 4.1. AR Book App

AR book app was developed using augmented reality technology based on a curriculum kindergarten in Indonesia. AR book app in the study is used to provide a learning introduction to animals for kindergarten students aged 5-6 years old. AR book app includes the name, food, place of living, and animals breeding. The aim of using the AR book app is to teach the learning in 3D views. In the design process first, created a marker

then register in vuforia after that printed marker on the book. The marker represents a single object of an animal which developed using unity. The app already developed in unity in the build to a smart phone so that with help of a camera on a smart phone when it detects a marker in the book, it will bring up a visualization of 3D animals. AR book app can also detect video to teach the learning in 3d view. In this study, some animals which contained in AR book app including giraffe, butterfly, chicken etc as an example in figure 1 that is giraffe animal. In Figure 1, AR book app run on android which display the learning in 3D view. In this app includes 3d animals images, information from animals and students can rotate the animals to seen from all directions.



Figure 1. Sample AR Book App Run in Android

#### 4.2. Research Design

The study sample was divided into two groups: experimental and control. These two learning models have the same goal in introduction to animals, it is improving student's achievement. The difference is one of these two learning models using Augmented Reality (AR) book app as a media to support learning and other models using group note. Experimental group learning used AR book app in learning introduction to animals, while the control group learning activities used group note. After determining experimental and control group, the next step is holding pre-test and post-test in each group to compare their achievement before and after treatment.

#### 4.3. Participants

The study was conducted in three schools with different backgrounds to determine the effectiveness of AR book app in different cases. The study included students in kindergarten in the second semester of the 2017-2018 academic year in Semarang. Participants in the study were divided into two groups: experimental and control. The study participants in the first school are 47 students with details of 26 students for experimental group (AR book app) and 21 students for control group (group note). The study participants in the second school are 33 students with details of 15 students for experimental group (AR book app) and 18 students for control group (group note) and the last study participants in third school are 31 students with details of 15 students for experimental group (AR book app) and 16 students for control group (group note).

#### 4.4. Research Process

After determined the control and experimental groups. The first step of this study is to provide pre-test questions related to introduction animals learning for students in experimental and control groups, to get the value of Mean, Variance, and Standard Deviation. The next step is the provider of treatment, in control group treatment is given group note while in experimental group using AR book app learning. The third step is to do a post-test in both groups to compare the achievement results between control group who used group note with experimental group who used the AR book app learning media. Then, the post-test results in each group were calculated using independent sample t-test to find the effect of AR book app as learning media.

### 5. RESULTS AND ANALYSIS

Statistical tests are one part of applying experimental methods that allow researchers to make a cause-and-effect relationship between an independent variable and a dependent variable [26]. As many as 20

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questions are given on to each student to know the students' understanding of name, food, place of living, and animal breeding. This study used the t-test to determine the differences between the control and the experimental groups is based post-test result. Tables 1 and 2 show the performance of learning on control and experimental groups. Table 1 showed the pre-learning performance of control and experimental groups in each school. Table 2 shows the post-learning performance of control and experimental groups in each school.

Table 1. The Result of the Learning Performance for Pretest in Control and Experimental Groups

School	Group	Participants	High Scores	Lowest Scores	Mean	Standard Deviation
School 1	Control	21	92	36	69,14	15,39
	Experimental	26	96	28	60,31	16,77
School 2	Control	18	86	32	60,78	14,27
	Experimental	15	84	48	68,80	11,33
School 3	Control	16	92	44	70,75	13,91
	Experimental	15	84	48	68,40	11,86

Table 2. The Result of the Learning Performance for Posttest in Control and Experimental Groups

School	Group	Participants	High Scores	Lowest Scores	Mean	Standard Deviation
School 1	Control	21	100	56	83,62	10,65
	Experimental	26	100	60	88,92	12,35
School 2	Control	18	96	56	74,22	10,10
	Experimental	15	100	68	91,20	8,96
School 3	Control	16	96	64	79,25	10,35
	Experimental	15	100	68	91,20	8,96

Table 2 is used in the next step to find out the effectiveness of AR as media on learning using independent-sample t-test. The first step to calculate the t-test is searching for data normality with chi-square ( $X^2$ ) and data homogeneity (F). The following results of the normality test are presented in Table 3. This normality test uses student learning outcomes (pretest and posttest values). Data is normal if  $X^2_{count} < X^2_{table}$  with  $dk = k-1$  and  $\alpha = 5\%$ . The finally homogeneity test results are presented in table 4 data is homogeneity if  $F_{count} < F_{table}$  with  $dk = k-1$  and  $\alpha = 5\%$ .

Table 3. The Result of the Data Normality Test with Chi-Square ( $X^2$ ) uses Students Learning Outcomes (Pretest and Posttest Values)

School	Group	Data	$X^2$		Criteria
			Count	Table	
School 1	Control	Pretest	2,97	11,07	Normally Distributed
		Posttest	4,69	11,07	Normally Distributed
	Experimental	Pretest	2,13	11,07	Normally Distributed
		Posttest	9,92	11,07	Normally Distributed
School 2	Control	Pretest	1,89	11,07	Normally Distributed
		Posttest	10,32	11,07	Normally Distributed
	Experimental	Pretest	9,00	11,07	Normally Distributed
		Posttest	4,59	11,07	Normally Distributed
School 3	Control	Pretest	2,70	11,07	Normally Distributed
		Posttest	7,28	11,07	Normally Distributed
	Experimental	Pretest	8,61	11,07	Normally Distributed
		Posttest	7,78	11,07	Normally Distributed

Table 4. The Result of the Homogeneity Test (F)

School	Data	F		Criteria
		Count	Table	
School 1	Pretest	1,18	2,07	Homogene
	Posttest	1,34	2,07	Homogene
School 2	Pretest	1,58	2,42	Homogene
	Posttest	1,26	2,42	Homogene
School 3	Pretest	1,37	2,46	Homogene
	Posttest	1,33	2,46	Homogene

1 Table 5 the results of posttest learning value between the control and experimental group 14 based on the independent sample t-test. The result of posttest learning was significant by the first school ( $t = 2,20$ ,  $p = 1)3 < 0,05$ ), second school ( $t = 6,99$ ,  $p = 0,00 < 0,05$ ), and third school ( $t = 4,58$ ,  $p = 0,00 < 0,05$ ).

Table 5. The Results of the Posttest Learning Value Between the Control and Experimental Groups Based on the Independent Sample T-test

School	Group	Participants	df	T		Sig. (two-tailed test)
				Count	Table	
School 1	Control	21	45	2,20	1,67	0,03*
	Experimental	26				
School 2	Control	18	31	6,99	1,69	0,00*
	Experimental	15				
School 3	Control	16	29	4,58	1,69	0,00*
	Experimental	15				

\*Indicates  $p < 0,05$

11 In Table 6 the gain score show improvement of learning 17 comes from the pre-test and post-test values of the experimental and control groups. From the results of the study showed that in the experimental group there is a high increase compared to the control group

Table 6. Gain Scores

School	Group	Mean		Gain Score	Categories
		Pretest	Posttest		
School 1	Control	69,14	83,61	0,46	Middle
	Experimental	60,80	88,92	0,71	High
School 2	Control	60,77	74,22	0,34	Middle
	Experimental	68,80	91,20	0,71	High
School 3	Control	70,75	79,25	0,29	Low
	Experimental	68,80	91,20	0,71	High

5 This research was conducted to find out the effectiveness of augmented reality to improve student's learning achievement in animal introduction learning. The t-test result is that student 10 is using AR book apps perform significantly better than those taught using group notes. The results show that AR 10 book applications contribute to improving academic achievement rather than using group records. However, it was found that the experimental group showed better results on achievement than the students in the control group. In the control group, students need to visualize the object. In the experimental group, the child will see the object as 3D directly. Students in the experimental group also pay more attention to the learning process, about which books can bring up 3D objects makes them more curious, and this makes them more interested in learning. The participants considered the AR book app as magical. In this study, AR book applications using smartphones so that with AR-based learning can be done anywhere and anytime.

Basically, children in the current era cannot be separated from the smartphone. They are less interested in story-based media that makes them bored quickly. With the technology, they are more interested in video, song, animation. So with the AR application, it can include video, song, 3D animation in one application so that children will be more interested. Where it can be applied to their learning media in school to attract students in learning.

This changes the negative thoughts of parents to a smartphone, they can provide learning using AR learning. He is able to combine learning and play, learning AR reduces boredom in students. Although students have the freedom to operate smartphones, learning activities remain under the control of the teacher. Learning AR book applications can show animals easily as many of them have not seen animals directly. Students' satisfaction in learning using AR, they obtain information with interesting and can review learning

## 6. CONCLUSION

AR book app is a book made using augmented reality technology with the learning introduction to animals, which in adapt kindergarten curriculum in Indonesia. AR book app can be implemented for learning media using a smartphone. AR book app has many advantages compared to group notes that can display animals in 3D. In this study comparing learning using AR book app with learning using group note. Learning outcome using AR book app has better than using group note. The future study, expected to implement AR book on other subjects and the authors suggest research done more than three schools to prove the effectiveness of AR Book 5 app in many cases.

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