

Learning Media Of Mathematical Operations In Early Childhood Based Augmented Reality

Ahmad Ihsan

Informatic Engineering Department
Samudra University
Kota Langsa 24416, Indonesia
e-mail: ahmadihsan@unsam.ac.id

Munawir

Informatic Engineering Department
Samudra University
Kota Langsa 24416, Indonesia
e-mail: munawir@unsam.ac.id

Fazri

Informatic Engineering Department
Samudra University
Kota Langsa 24416, Indonesia
e-mail: fazri@unsam.ac.id

Abstract— Along the development of technology, the limitations of print-based learning media can be minimized, one of them by utilizing augmented reality (AR) technology. This technology combines the virtual world and the real world in real time in aids with technology devices such as computers, tablets, and smartphones. AR-based learning media not only can display objects in two dimensions, but also in three dimensions. Utilization of augmented reality technology has been widely developed for education as a learning tool. By using augmented reality, a student can learn visually and interactively. Learning will be more effective with the form of virtual teaching materials simulated. In this research, developed augmented reality technology for introduction of numbers, symbol introductions and simple mathematical operations that are presented virtually. This research is intended to be a learning tool that is useful to streamline the learning process of mathematics subjects for children of early age. The results of research, students' ability in recognizing the numbers 0-9 of 32 students who tested reached 62.5%. Students' ability in recognizing mathematical symbols reaches 68.75%, students' ability in mathematical arithmetic operation: sum of 56,25%, reduction of 65,625%.

Keywords- Augmented reality; learning media; marker;

I. INTRODUCTION

Learning media commonly used in schools is print media. The media is widely used because it is considered practical, can adjust based on student ability, and easily distributed, but this media has limitations that can not display certain objects such as sound, moving images, as well as three-dimensional objects. Print media learning has not maximized to increase the interest and effectiveness of learning process for children of early age because it is less varied, so that contrary to the purpose of learning media, namely as a learning tool that is useful for streamlining the learning process.

Along with the development of technology, the limitations of print-based learning media can be minimized, one of them by utilizing augmented reality technology. This technology can combine virtual world and real world in real time if supported by technology devices such as computers, tablets, and smartphones. Supported by adequate devices such as smartphones and augmented reality technology, print-based learning media not only can display objects in

two dimensions on paper, but also in three dimensions, video, and sound.

In its implementation, Utilization of augmented reality technology has started to be developed for education as a learning tool. By using AR a student can learn visually and interactively and more effectively with the form of virtual teaching materials simulated.

In this study, developed augmented reality technology for the introduction of mathematical symbols in the form of symbols of simple mathematical operations that are presented virtually with the aim of helping children of early age in recognizing mathematical symbols and help math lessons more interesting and fun as well provides a variety of learning media to improve the interest of early childhood learning in learning mathematics.

II. LITERATURE REVIEW

2.1 Definition of Augmented Reality

Augmented Reality known by its English abbreviation AR (augmented reality), is a technology that combines two-dimensional and three-dimensional virtual objects into a real three-dimensional environment and projects those virtual objects in real time. Unlike virtual reality that completely supersedes reality, reality is added simply to add or complement reality.

AR technology has been developed in many ways, in the utilization of this technology can be used in terms of:

1. Augmented Reality Interactive Games
2. Augmented Reality Presentation
3. Augmented Reality Event
4. Augmented Reality High Tech Environment
5. Augmented Reality Website
6. Augmented Reality Promotion

Augmented Reality works based on the used image detection marker. The calibrated camera will detect the marker provided, then after recognizing and marking the marker pattern, the camera will calculate whether the marker matches the database it owns. If not, then the marker information will not be processed, but if appropriate then the marker information will be used to render and display 3D objects or animations that have been created previously.



Figure 1. Augmented reality with marker

2.2 Mathematical operations

There are several count operations that can be imposed on numbers. These operations are: (1) summation; (2) reduction; (3) multiplication; (4) division. These operations are so closely related that understanding the concepts and skills of performing one operation will affect the understanding of other concepts and operating skills.

The sum operation is basically a rule that associates each pair of numbers with another number. Reduction operation is the opposite of the addition operation.

Multiplication operations can be defined as repeated summations. Suppose that the 4×3 multiplication can be defined as $3 + 3 + 3 + 3 = 12$ while 3×4 can be defined as $4 + 4 + 4 = 12$. Conceptually, 4×3 is not equal to 3×4 , but if the result is seen then $4 \times 3 = 3 \times 4$. Thus multiplication operations fulfill the nature of the exchange.

The division operation can be defined as a repeating reduction. Mathematically written as $a : b = a - b - b - b \dots = 0$. For example, $24 : 3 = 24 - 3 - 3 - 3 - 3 - 3 - 3 - 3 = 0$. Means $24 : 3 = 8$. This result is indicated by the number of numbers 3 that appear as the number of the reducers. The division operation is the opposite of multiplication operations. If a number a divided by number b yields the number c (denoted by $a : b = c$), then the corresponding multiplication concept is $c \times b = a$.

2.3 Augmented Reality Technology In Learning

AR is an innovation of interaction technology between human and machine, which can be used to attract users. AR works by inserting a virtual object in a real object that allows its users to view the results simultaneously. AR has several characteristics, such as combining 3D virtual objects and real objects, and can interact at the same time.

AR is a new form of human and machine interaction that brings new experiences to its users. AR's priority is that AR can cause the effects of computer animation in the real world. The AR application uses a webcam that will detect the markers that have been created and displays the combination of real images with animations. Webcams are used as 'eyes' of technologyAR to detect markers and then process them and will generate virtual interactions that appear on a real screen display.

Applying the innovation of AR Technology in learning, it will create an effective learning atmosphere and provide an overview of real-world environment in computer-based learning system. AR is applied in the education world because the virtue that is owned by combining real-world situations and virtual objects can be used to solve problems in understanding the lessons delivered.

III. RESEARCH METHODOLOGY

The design of the first stage is to design the shape of the marker and make the model of mathematical count symbol as seen in figure 2. The design of marker is made with the following conditions:

- Frame-shaped 4
- Size of marker with length 21 cm and width 15 cm
- Markers are colored to attract students' attention
- Shaped patterns of mathematical numbers
- The patterns inside the frame must be unique (if rotated-the pattern shape is not the same)

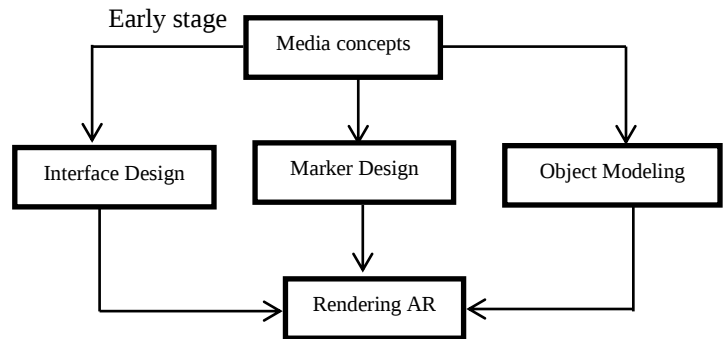


Figure 2. Blog diagram form marker and symbol model

The form of numerical marker and the mathematical operation marker can be seen as follows:



Figure 3. Form marker number 1-9

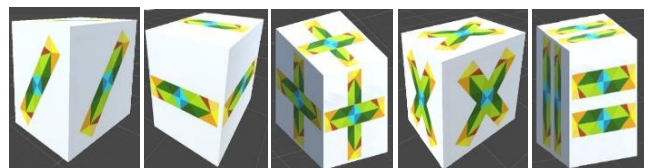


Figure 4. The 3 dimensional model of mathematical operation

The design of the introduction of mathematical operations using augmented reality is as follows:

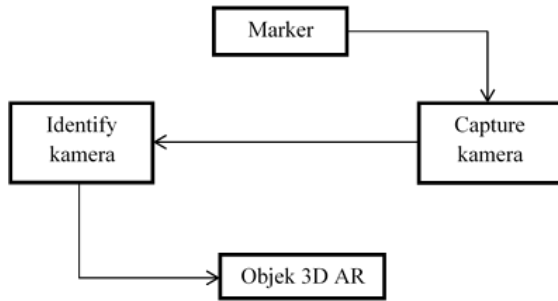


Figure 5. Blog diagram designing the introduction of Augmented Reality based operations

After marker making, the marker is captured by the camera to detect the shape of what operating object will appear after the camera capture. AR starts with start, then initialization of image, tracking, then will appear information that have been registered before.

The data collection technique used in the research is observation. observation is a technique or how to collect data by conducting observations of ongoing activities. The test data obtained after the observation on the students TK/PAUD Permata Bunda. The number of students tested in TK/PAUD Permata Bunda is 32 Students. Instrument of data collection in this research use check list observation sheet. Researchers checked every incident that occurred in the study.

Criteria for the average score of ability to count children according to Acep and Yoni are as follows:

Table 1. Criteria for Average Children Ability Scores

No	Criteria	Value	Capability Criteria
1	Very good	7,50–10,00	Growing Very Good (GVG)
2	Good	5,00–7,49	Growing Up Expectations (GE)
3	Enough	2,50–4,99	Start Growing (SG)
4	deficient	0–2,49	Not to Grow (NG)

IV. RESULTS AND DISCUSSION

The result of tracking and testing of augmented reality in the students of TK / PAUD Permata Bunda Kota Langsa are as follows:



Figure 6. Results of tracking augmented reality

Trial is needed to acquire the expected output of the software. The trial by using Android based smartphone with specified specification is shown on table 2.

Table 2: Specification of Smartphones

No	Type Device	Specification	Detection Time	Minimum Range	Maximum Range
1	Lenovo G40	Webcam HD 720p@30fps	10 seconds	10 cm	48 cm
2	Smartphone Xiaomi Redmi Note 4 64 GB	Kamera 13 MP, 4160 x 3120 pixels, Video 1080p@30fps, 720p@120fps	5 seconds	12 cm	55 cm
3	Samsung Galaxy J5	Kamera 13 MP, f/1.9, 28mm, autofocus, Video 1080p@30fps	2 Second	12 cm	58 cm

Table 2 shows the specification of smartphones that are used in trial process. The trial of the application is done by using several comparing parameters.

The average time of detecting target object is 5.7 seconds which is acquired by calculating the detecting time using device 1 which is 10 seconds, device 2 which is 5 seconds and device 2 which is 2 seconds.

The trial of minimum distance of marker detection and quality tester of 3D animation is aimed for determining the minimum distance between the smartphone with the target object in the process of marker detecting.

The minimum distance of marker detecting by using device 1 is 10 cm with the quality that is displayed is categorized good. Meanwhile, the minimum distance of marker detecting by using device 2 and 3 is 12 cm with good quality 3D animation display. The device specification influences the minimum distance of marker detection.

Data retrieval process in TK/PAUD Permata Bunda shown on figure 3:



Figure 7. Data retrieval process in TK/PAUD Permata Bunda

The results of observations before and after the use of Augmented Reality in TK / PAUD Permata Bunda are as follows :

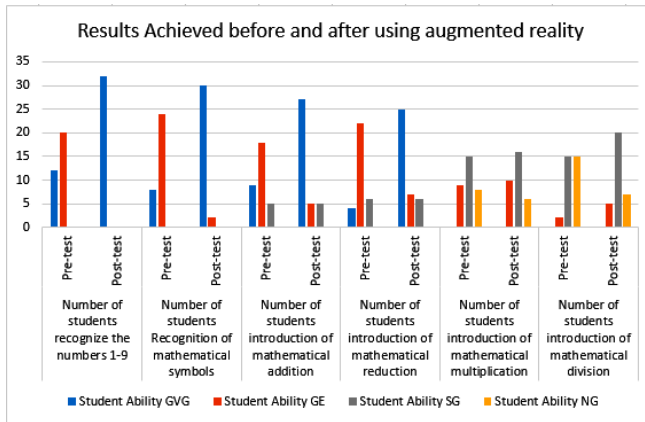


Figure 8. Results of observations before and after the use of Augmented Reality in TK / PAUD Permata Bunda

From the graph above shows that of 32 students tested, after using augmented reality students know the numbers 1-9 develop very well reach 100 percent. Students recognize the symbol of mathematical operations developed very well reach 93.75 percent. Introduction The operations of the mathematical summation developed very well at 84.37 percent and the introduction of mathematical reduction operations also improved very well to reach 78.13 percent.

The increase of knowledge ability to the introduction of the numbers 0-9, the introduction of mathematical symbols and mathematical operations (addition, subtraction, multiplication and division) before and after menggunakan augmented reality are as follows:

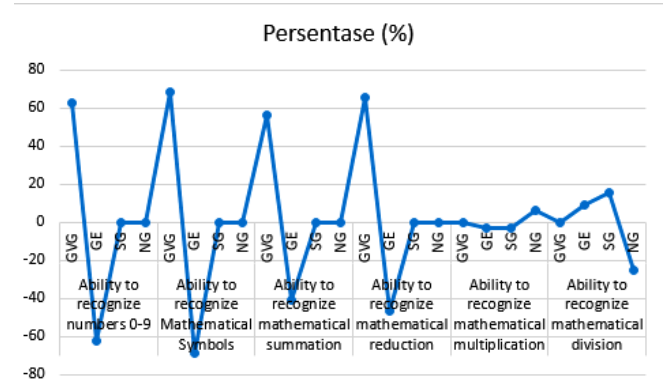


Figure 9. Increase of knowledge ability

From the graph above, it can be explained that the ability of students in recognizing the numbers 0-9 of 32 students who tested reached 62.5%. Students 'ability in recognizing mathematical symbols reaches 68.75%, students' ability in mathematical arithmetic operation: sum of 56,25%, reduction of 65,625%.

V. CONCLUSION

Ability student after using augmented reality is students know the numbers 1-9 develop very well reach 100 percent. Students recognize the symbol of mathematical operations developed very well reach 93.75 percent. Introduction The operations of the mathematical summation developed very well at 84.37 percent and the introduction of mathematical reduction operations also improved very well to reach 78.13 percent.

The ability of students in recognizing the numbers 0-9 of 32 students who tested reached 62.5%. Students 'ability in recognizing mathematical symbols reaches 68.75%, students' ability in mathematical arithmetic operation: sum of 56,25%, reduction of 65,625%

REFERENCES

- [1] Acep Yoni. (2010). *Menyusun Penelitian Tindakan Kelas*. Yogyakarta: Familia
- [2] Chairul umman, 2013, Implementasi Teknologi Augmented Reality Dalam Mempelajari Huruf Alphabetic Untuk Anak-Anak, Sekolah Tinggi Manajemen Informatika dan Komputer AMIKOM Yogyakarta
- [3] Nana Syaodih Sukmadinata. (2010). *Metode Penelitian Pendidikan*. Bandung: Remaja Rosdakarya.
- [4] Sanni Siltanen, 2012. "Theory and application of marker-based augmented reality. Finland. VTT Technical Research Centre of Finland
- [5] Setia Wardani, 2015, Pemanfaatan teknologi augmented reality (ar) untuk pengenalan aksara jawa pada anak, Jurnal Teknologi Volume 8 Nomor 2, Yogyakarta
- [6] Sugiyono. (2010). *Metode Penelitian Pendidikan Kuantitatif Kualitatif dan R& D*. Bandung: Penerbit Alfabeta
- [7] Woodrow Barfield, 2016, *Fundamental of wearable computer and augmented reality*, CRC Press, New York.