# Augmented Reality In Science Learning For Elementary School Students

Dudu Suhandi Saputra[1], Sigit Vebrianto Susilo[2], Yunus Abidin[3], Tita Mulyati[4]
{d.suhandi.s@gmail.com[1], sigit.vebrianto@gmail.com[2], yunusabidin@upi.edu[3],
titamulyati@yahoo.com[4]}

Universitas Majalengka, Majalengka, Indonesia[1,2],
Universitas Pendidikan Indonesia, Bandung, Idonesia[3,4]

**Abstract.** This study is motivated by the students' poor understanding when studying science. This research aims to improve the understanding and motivation of students studying science while learning. The method used in this study is an experimental method for 40 elementary school students in Skalame 1 in the Leles district of Garut Regency, West Java. Research results show that augmented reality in scientific teaching materials can improve the understanding and learning motivation of elementary school students. Augmented reality has a positive effect on the student's enthusiasm for science learning, as the learning skills are so much fun that the student does not get bored while studying the material.

**Keywords:** Augmented Reality; Teaching Materials; Natural Sciences

## 1 Introduction

The results of the PISA tests and surveys in 2018 with scores of students' Reading, Mathematics, and Science abilities of 371, 379, and 396 positioned Indonesia in 75th position out of 80 countries that took tests and surveys [1]. According to TIMSS, Indonesian students had an average score of 397 in mathematics and science, placing them at level 45 out of 50 countries for mathematics and level 45 out of 48 countries for science in the evaluation and survey[2], [3]. This indicates that Indonesian students' performance in mathematics and science is the worst in the world, compared to Singapore, which ranks first in TIMSS. All elements involved in the sphere of education in Indonesia must pay special attention to this. Based on the above issues, the learning process needs to be updated to motivate students to engage in the learning process. It aims to achieve learning goals and break the paradigm that learning is still teacher-centric. Furthermore, one of the efforts to improve the quality of education is through a digital-based learning process [4]. The presentation of natural science learning materials with augmented reality is seen as having ease of use. It is also easy to develop and follow the characteristics of elementary school students [5], [6]. Based on this, augmented reality in science teaching materials for elementary school students is needed to improve the quality and quality of education in Indonesia.

Another basis for consideration is that augmented reality in natural science teaching materials can provide challenges and learning motivation for students. Through the use of

technology, students are expected to acquire cognitive skills. Nonetheless, students will also acquire the knowledge and skills to make good use of technology, one of the skills of the 21st century [7]. It can be understood that the development of educational technology brings convenience, especially in the learning process. Furthermore, it is also possible for educational technology to change the orientation of learning from what was originally only a presentation of knowledge from one party to a guidance process for interactive knowledge exploration involving students. Furthermore, One of the uses of technology in education is the use of augmented reality technology [8]–[11]. By examining the level of cognitive development experienced by students, it is understandable that augmented reality technology can be beneficial in learning, especially in the education of abstract concepts [12]-[14]. Nowadays, the demands of the times are starting to emphasize technology literacy so that teachers must be able to utilize technology itself in the learning process [15]. This learning must be designed to stimulate student learning motivation because augmented reality-based learning presents learning material and contains information related to the material studied by the students themselves. The learning process will be much more fun and more enjoyable. This means that students feel the learning process by utilizing information and communication technologies. Based on the above explanation, researchers need to conduct scientific research on augmented reality in science teaching materials for elementary school students.

## 2 Methodology

### 2.1 Research Design

This study aims to determine how effective the use of augmented reality in scientific materials is for students. This type of study is quasi-experimental by designing controls for pre-test and post-test. The pre-test and post-test control group designs are randomly selected and consist of two groups of pre-test and post-test after learning. This will determine if there is a difference between the control group and the experimental group. Experimental classes were treated with augmented reality-based science materials, and contrast classes were treated with traditional materials. We compared the results of the pre-test and post-test in the experimental and control classes.

### 2.2 Respondent

In this study, the participants were fourth-grade elementary school pupils. In this study, the purposive sampling strategy was utilized to collect data (purposed sample). Purposive sampling is a sampling approach that takes into account a number of factors. Purposive sampling is used because it takes two classes with similar abilities and can represent the population's features. Forty students were selected from the sample.

### 2.3 Instruments

The equipment used in this study is a science learning device with augmented reality. The next learning resources used are lesson plans, student worksheets, and practice questions.

## 2.4 Data Analysis

Data collection for this study was obtained by conducting pre-tests and post-tests. Pre-tests are used to measure  initial abilities before learning begins, and post-tests are used to measure students' abilities after learning is complete. Pre-tests and post-tests were given to the control and  experimental classes. Next, a mean difference test of initial performance was performed in each experimental group. This is done to determine if there is a difference in the average initial performance of the two groups. The test used is an independent sample test with a significance level of 0.05.

## 3  Results and Discussion

The results of the data analysis in this study aimed to clarify how augmented reality can be used in science materials for elementary school students.

**Table 1.** Values of Descriptive Statistics of Pretest and Posttest in Experiment Class and Control Class

|  | Respondent | Mean |
|---|---|---|
| Pretest Experiment Class | 20 | 44,90 |
| Pretest Control Class | 20 | 48,15 |
| Posttest Experiment Class | 20 | 65,70 |
| Posttest Control Class | 20 | 55,05 |

It is understandable that the average score of pre-deployment science students was 44.90 in the experimental class and 48.15 in the control class. In addition, the average student score after action in the experimental class was 65.70, and the average score in the control class was 55.05. Descriptively, we can see that there is an average difference before and after using augmented reality in elementary school science classes. See the figure below for more information:
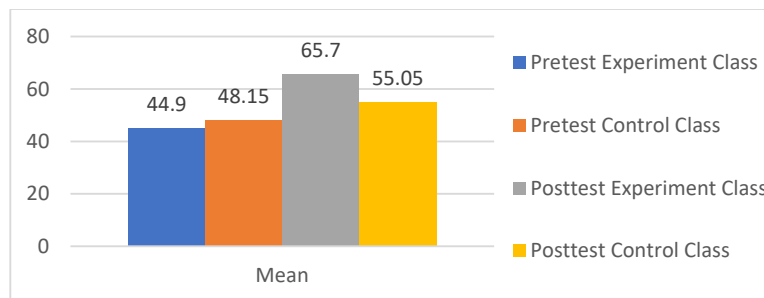


**Fig. 1.** Comparison of pre-test and post-test

Next, the researchers performed a paired sample t-test in the experimental and control classes. Below is a table showing the results of statistical analysis of the paired sample t-test:

**Table 2.** Paired Sample T-Test

| Class | Value of Sig. |
|---|---|
| Experimental pre-test – experimental class post-test | 0,000 |
| Experimental pre-test – experimental class post-test | 0,062 |

From the test results table, the significant difference between the experimental classes is 0.000. It can be said that the significance value of the experimental class is less than 0.05 (sig .2 tailed <0.05). There is a difference in the understanding of competent students before and after using augmented reality in science materials for experiential education. In addition, the control class significance is 0.062. It is understood that the significant value of the control class is greater than 0.05. Keep in mind that there is no difference in understanding the concepts of science before and after studying in the control class. In addition, researchers performed a simple linear regression test to test the effect of the independent variable on the dependent variable. You can also see how big the impact is. The results of a simple linear regression test are shown in the following table:

**Table 3.** Simple Linear Regression Test

| Regression Test | R | R Square |
|---|---|---|
| Understanding of Science Concepts | 0,562 | 0,315 |

If the correlation value (R) is 0.562, we can see that the coefficient of determination (R-squared) is 0.315. The results of these statistical tests can be used to infer the augmented reality of science materials for elementary school students. From the results of the above explanation, it can be seen that the comprehension of science students raises the average score before and after the test. The average score of students' understanding of science in experimental classes before and after the test increased by 20.80. In addition, the augmented reality of science classroom materials affects elementary school student's understanding and involvement in science learning by 31.50%. In addition, augmented reality is said to be able to create interactions between the natural world and the virtual world. It is further said that Augmented Reality can create interactions between the natural world and the virtual world. The information can be added to be displayed in real-time as if it were interactive and authentic. [16]-[19]. In addition, Augmented Reality (AR) displays real-life physical objects in real-time by adding objects from the virtual world and adding information to existing real-world objects. It is understood that this digital augmented reality technology can combine real and virtual objects that exist and are displayed on digital devices [20], [21]. The above explanation is consistent with research on augmented reality and shows that augmented reality in learning can enhance the enjoyment of learning [22], [23]. In addition, research on augmented reality as a new metaphor for human-computer interaction technology states that users feel the process of direct interaction [24]. In addition, developed augmented reality can create a new, more interactive atmosphere in learning. This usually seems boring to learners [25].

## 4 Conclusion

Based on the results of the research and discussion described above, it can be concluded that augmented reality in natural science teaching materials can improve elementary school student's understanding ability and learning motivation. The increase in the value of learning outcomes is influenced by the classroom activities of students and teachers. Augmented reality

positively affects students' enthusiasm for learning natural sciences because it creates learning techniques that are enjoyable for students. For further research, it is better to do research related to other learning to understand the impact of augmented reality on the acquisition of other students' abilities.

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