Utilization of Augmented Reality in Automotive Subjects for Basic Competencies of Four-Wheeled Vehicle Brake Systems

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Abstract - In automotive learning, teachers generally use books and teaching aids as learning media. Automotive learning outcomes show the low value of learning outcomes. Thus a learning media is needed that can help improve learning outcomes. One way to overcome this problem is to use learning media that utilize augmented reality technology. In this study, a learning media using augmented reality technology based on android was developed to simulate the brake system on four-wheeled vehicles in 3 dimensions. The Augmented Reality work system used is marker based tracking, and uses 3D Max software and the Vuforia plug-in. In terms of pedagogy, this learning system uses the Modality Principle. Participants are class XI students of SMK YPM 4 Taman. This research uses experimental research. The students involved were 44 students divided into 2 groups, with each group consisting of 22 students. Both groups received a pre-test and a post-test. The experimental group was given treatment with Augmented Reality-based learning media, while the control group did not use conventional learning media. After making comparisons, the results show less than optimal due to the pandemic period. The results showed that the pre-test result between the control group and the experimental group was 49.32, and the post-test result for the control group was 62.73, while for the experimental group it was 73.18. So that from the difference in the difference in post-test scores between the experimental group and the control group shows that the treatment factor by providing Augmented Reality-based learning media in the experimental group has an influence. From observations and interviews, students were more active in learning activities and students were eager to take part in learning. This proves that students are interested in this media which can generate motivation to learn.

Keywords: Augmented Reality, Automotive Brake System, Learning Media.

I. INTRODUCTION

Vocational education is education that prioritizes the mastery of skills for graduates. Not only skills, but also knowledge to support these skills. Students must learn in order to get the knowledge in question. One of the skills in vocational education is light vehicle technology. Light vehicle technology graduates are required to master knowledge and skills in the field of light vehicle technology. One of the basic competencies found in light vehicle technology expertise is about brake systems, where students are expected to be able to identify and understand the mechanisms of the brake system itself.

For fun and interactive learning purposes, adequate learning media is needed. With adequate learning media it will help students’ imagination in recognizing real objects and systems before students carry out practicum activities. Through the 3D object making software, components for the brake system itself are compiled, resulting in a 3-dimensional form of the brake system working mechanism which will be utilized by students in learning.

The components of the brake system are arranged in such a way through Augmented Reality (AR) technology so that they become interactive information that can facilitate the intended learning. AR is a concept that combines the virtual world with the real world to produce information from data taken from a system on the designated real object so that the boundary between the two becomes thinner. AR can create interactions between the virtual world and the real world, all information can be added so that the
information is displayed in real-time as if the information
becomes interactive and real.

To see how much influence with learning using this
augmented reality, a division of groups is carried out where
each group will receive a pre-test and post-test. The
difference is that one particular group uses conventional
learning (without augmented reality) and another group
uses augmented reality.

According to Faieza Abdul Aziz [1] that the AR-
based application developed has great potential in
automotive maintenance training. And the results show the
effectiveness of applications developed for training
purposes.

II. USING AUGMENTED REALITY AS LEARNING
MEDIA

Augmented Reality is a technology that combines
two-dimensional and / or three-dimensional virtual objects
into a real three-dimensional environment and then projects
these virtual objects in real time [4].

The way AR works is divided into two types based
on the method, namely:

a. Augmented Reality Marker

Marker is usually a black and white illustration of a
square with a bold black border and white background.
The computer will recognize the position and
orientation of the marker and create a 3D virtual world,
namely the point (0,0,0) and 3 axes namely, X, Y and Z.

b. Markerless Augmented Reality

In this method, markers are not used to display digital
elements. The development of markerless augmented
reality can be markerless tracking, such as:

• Face Tracking

Face tracking is markerless AR that uses an
algorithm developed so that computers can
recognize human faces in general by recognizing the
position of the eyes, nose and mouth. And ignore
other objects around it.

• 3D Object Tracking

Unlike face tracking, which only recognizes human
faces in general, 3D object tracking techniques can
recognize all forms of objects that are around

• Motion Tracking

This technique captures motion, widely used in film
productions that attempt to simulate motion.

• GPS Based Tracking

This technique takes data from the GPS device and
the compass and displays it in the desired direction.

III. INTERFACE DESIGN

In developing this application there is an interface
design, it can be seen in the pictures below.
IV. RESULTS AND DISCUSSION

The testing process with pre-test and post-test was carried out to determine the level of difference before and after learning. The types of questions that will be given in the Pre-Test and Post Test are in the form of questions with cognitive, affective and psychomotor aspects. Meanwhile, to determine the level of usefulness of the system used a questionnaire based on the ISO 25010 standard on aspects of the Usability Test (Usability).

Table 1
Investigating Factor

| Variable | Factor | Item Number | Number of Question |
|----------|--------|-------------|-------------------|
| The level of understanding of class XI students of Light Vehicle Engineering towards learning with brake system material | Definition | 10, 18 | 2 |
| | Type | 4, 6, 14, 16 | 4 |
| | Component | 2, 3, 5, 11, 15 | 5 |
| | Mechanism | 1, 7, 8, 9, 17, 12, 13, 19, 20 | 9 |
| | | | 20 |

The number of questions used to determine the level of understanding of students was 20 items with 5 (five) indicators of how the drum brake worked, 5 (five) drum brake components and disc brake components, 4 types of drum brakes and disc brakes. (four) items, 2 (two) false air exhausts, 2 (two) item brake shoe clearance adjustments, 2 (two) items on the strengths and weaknesses of drum brakes and disc brakes.

Table 2
Results of the Validity Test of Student Understanding

| [1] Question | [2] r table | [3] r count | [4] Information |
|--------------|-------------|-------------|----------------|
| [5] Question 1 | 0.628 | [7] 0.3 | [8] Valid |
| [9] Question 2 | 0.427 | 0.3 | 2 | Valid |
| [3] Question 3 | 0.643 | 0.3 | 6 | Valid |
| [7] Question 4 | 0.734 | 0.3 | 0 | Valid |
| [1] Question 5 | 0.394 | 0.3 | 4 | Valid |
| [5] Question 6 | 0.457 | 0.3 | 8 | Valid |
| [9] Question 7 | 0.581 | 0.3 | 2 | Valid |
| [3] Question 8 | 0.310 | 0.3 | 6 | Valid |
| [7] Question 9 | 0.322 | 0.3 | 0 | Valid |
| [11] Question 10 | -0.119 | 0.3 | 1 | Invalid |
| [15] Question 11 | 0.415 | 0.3 | 8 | Valid |
| [19] Question 12 | 0.457 | 0.3 | 2 | Valid |
| [13] Question 13 | 0.652 | 0.3 | 6 | Valid |
| [17] Question 14 | -0.087 | 0.3 | 0 | Invalid |
| [21] Question 15 | -0.032 | 0.3 | 1 | Invalid |
| [25] Question 16 | -0.032 | 0.3 | 0 | Invalid |
| [29] Question 17 | 0.365 | 0.3 | 2 | Valid |
| [33] Question 18 | -0.064 | 0.3 | 5 | Invalid |
| [37] Question 19 | 0.573 | 0.3 | 0 | Valid |
| [41] Question 20 | 0.417 | 0.3 | 4 | Valid |

The mean value obtained from the pre-test results was for group A was 61.25 and for group B was 56.68. While the average score obtained from the post-test results for group A was 70.63 and group B was 79.50.

The increase in learning outcomes between group A and group B was 15.31% and 39.78%.
V. CONCLUSION

The program trial during the Covid19 pandemic was carried out in several stages, the first stage was an experiment by class XI students at SMK YPM 4 Taman which was carried out at their respective homes, so that neither classroom teachers nor researchers could directly observe and supervise participants students do the experiment. The second stage is an experiment conducted by the classroom teacher, and the result of the experiment concluded that the augmented reality-based application that was built could help students.

The test result using the latest smartphone, even with low lighting, the marker can be tracked quickly. And when using an older generation smartphone or using a tablet with low lighting, it will result difficult marker tracking process (tends to take a long time).

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