AUGMENTED REALITY BASED LEARNING MEDIA AS INTERACTIVE LEARNING INNOVATION TO ENHANCED VOCATIONAL SCHOOL LEARNING OUTCOMES

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Abstract— **Progress in the industrial world has reached industry 4.0, in this progress it has led to the development of education as well as entering the era of education 4.0. One of the advances in the era of education 4.0 is the Augmented Reality learning media. The purpose of the study was to test the effectiveness of the effects of Augmented Reality Learning media that are in line with the needs of current and future students, the ARTorque application product as an interactive learning innovation to improve the learning outcomes of SMK students. The Quasi Experiment research design with steps: Determination of the experimental and control class, Instrument Testing, The experimental class was given the treatment of Augmented Reality learning media and the control class was not given treatment and used conventional learning. Output results obtained are normality test, homogeneity test and t test results.**

Keywords—(Impact, Learning Media, Augmented Reality, Learning Outcomes)

I. INTRODUCTION

Students in the 21st century face new challenges with high complexity in various aspects of life. Changes that are increasingly uncertain at an increasingly fast pace are an inseparable part of life in this era. People who are unable to keep up with the changing times, will be left far behind even become victims. Changes also occur in the world of work, which has different characteristics from the previous era. The competencies needed in this century, continue to experience a shift in values if we do not know and have them, many will not have decent jobs, even losing their jobs. Learning innovation is the target of SMK revitalization [1]. In the progress of the Industrial 4.0 era, the production process will be encouraged to increasingly interconnect information based on real time and certainly far more efficient [2]. Although Industry 4.0 is a popular topic in the manufacturing industry, many schools do not implement Industry 4.0 which results in many teachers using traditional approaches, teaching with old methods that are not creative and lack of enthusiasm from students which results in boring classroom conditions. Thus the school is expected to have the potential for the next step on the way to Industry 4.0 and what needs to be done is to enable schools to develop towards Industry 4.0 [3]. Currently the development of learning innovations in the Industrial 4.0 era in the world is highly developed and attracts the attention of many researchers, due to some competencies that must be mastered by students, and the adjustment of learning media. Learning media must have components that must encourage the empowerment of digital skills to carry out learning, encourage virtual collaboration between teacher and students and students and students, and empower Augmented Reality for learning media [4]. While the development of learning innovations in Indonesia, namely the 2013 curriculum which is one of the government's efforts to achieve the excellence of the nation's community in the mastery of science and technology has the advantage of using a natural approach and character-based 2013 curriculum. Because of continuous learning innovation, a learning innovation appears, namely e-learning, the definition of e-learning itself, namely learning through computing devices and the internet. This allows students to learn at their own time, so they have their own pace and in their chosen space [5]. Based on observations made by researchers at Vocational High School 6 Malang on October 21, 2019, according to Mr. Sarwi, S.T., as a teacher of heavy equipment engineering Powertrain, in the process of learning the method used using the lecture method assisted by learning media modules and powerpoints. The reason for choosing the basic competency of the Torque Converter material is because it has developed limited media. This means that when the learning process takes place, Mr. Sarwi, S.T does not use learning media such as Augmented Reality to support learning. In this case, Mr. Sarwi does not have the competence to create a learning media product in the form of Augmented Reality due to limited time and energy. So the impact caused by this problem is the teacher is less creative and innovative in using learning methods that can improve the quality of the material. The learning pattern is what makes students passive due to quickly saturated which results in a lack of understanding of the material.

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II. METHODS

This research is a quasi-experimental study (quasi-experiment) using the results of t-test. The study began with the determination of the experimental group and the control group. The experimental group that was given treatment of Augmented Reality learning media and the control group was not given treatment and learning was carried out with conventional learning.

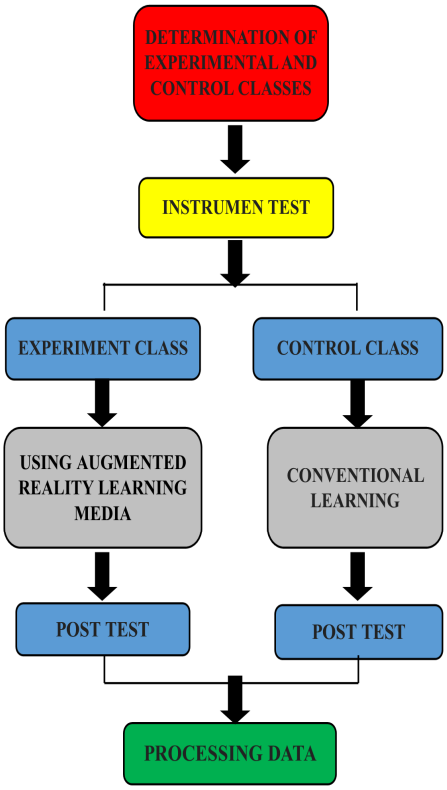

Figure 1. Research Method

III. RESULTS

The product being tested is Augmented Reality learning media. The product must be tested on a large scale field through experiments to determine the value of the posttest after the treatment of Augmented Reality learning media. The subjects of this large group trial study were students of class XII TAB 2 and XII TAB 1 Powertrain Subjects with basic competencies Applying the Way of Work of Torque Converter which was divided into two large groups namely the experimental class and the control class. Augmented Reality learning media were tried out in the experimental class, while the control class used the learning method used today. The results of large-scale field trials include the results of the posttest assessment, normality test, homogeneity test and hypothesis test.

a. Descriptive Statistics of Posttest Assessment Results

The results of the posttest assessment were analyzed using SPSS version 24.0. Posttest assessment results data were divided into

Table 1. Descriptive Statistics SPSS Output

Descriptives				
	kelompok		Statistic	Std. Error
hasil	EKS	Mean	80,4734	1,71306
		Median	80,0000	
		Std. Deviation	10,13462	
	CTR	Mean	73,7000	2,44815
		Median	76,6600	
		Std. Deviation	12,72096	

SPSS output analysis Table 1 concludes the posttest score of the experimental class: mean = 80.47; median = 80.00; and standard deviation = 10.13. As for the control group posttest score variable: mean = 73.70; median = 76.66; and standard deviation = 12.72. Based on data processing Posttest Assessment Results using SPSS version 24.0. The mean difference between the two groups is 6.77. Based on the difference from the posttest results it can be concluded that the value of the Experiment Group is better than the value of the Control Group. The conclusions of the results of the posttest trials of large groups can be seen in the chart below. The conclusions of the results of the posttest trials of large groups can be seen in the chart below.

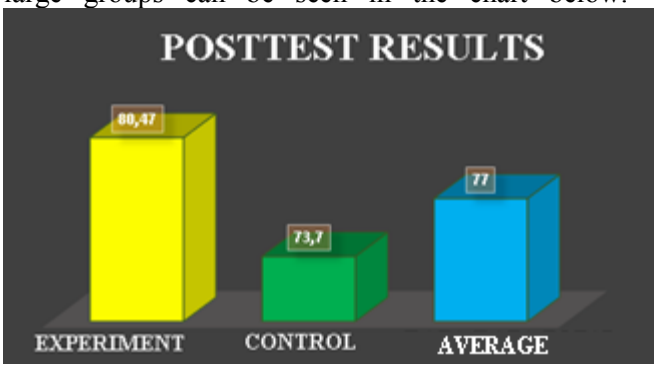

Figure 2. Posttest results

b. Normality Test Data Assessment Results

Data Normality Test uses SPSS version 24.0 to test the following hypothesis:

1) H0: Data are from normally distributed research subjects (> 0.05)

2) H1: Data originating from research subjects that are not normally distributed (<0.05)

Normality Test data of the assessment results cover the experimental class posttest score and the control class posttest score. The results of the normality test are exposed in the following table.

Table 2. SPSS Output Normality Test

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	kelompok	Statistic	df	Sig.	Statistic	df	Sig.
hasil	EKS	.139	35	.087	.947	35	.093
	CTR	.117	27	.200*	.953	27	.248

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Based on the SPSS output the normality table can be presented that the processing of the normality test results using SPSS version 24.0. Obtained Test Results Normality of the posttest assessment results of the experimental group obtained a value of 0.087> from 0.05 & the control group obtained a value of 0.2> of 0.05. This can be interpreted by the two data from the posttest assessment results of the group being normally distributed.

c. Homogeneity Test Data Assessment Results

Homogeneity test data using SPSS version 24.0 to test the following hypothesis:

1) H0: Data comes from homogeneous data distribution (> 0.05)

2) H1: Data derived from non-homogeneous data distribution (<0.05)

Homogeneity test of the assessment results covered the posttest scores of the experimental class and the posttest scores of the control class. The results of the homogeneity test are exposed in the following table

Table 3. SPSS Output Homogeneity Test

Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
hasil	Based on Mean	3.822	1	60	.055
	Based on Median	3.267	1	60	.076
	Based on Median and with adjusted df	3.267	1	59.771	.076
	Based on trimmed mean	3.749	1	60	.058

Based on the SPSS output Homogeneity table can be presented that the processing of Normality Test Data using SPSS version 24.0. Homogeneity Test Results obtained from the posttest assessment results of the experimental and control groups obtained values of 0.055> from 0.05. It can be interpreted that the two data from the group's post-test assessment results from homogeneous data distribution.

d. Hypothesis Test Data Assessment Results

To test the hypothesis used t-test. The results of the t-test analysis are presented in the following table.

Table 4. SPSS Output T-test Test

Based on the SPSS output T test table can be presented that the processing of Normality Test Results data uses SPSS version 24.0. Obtained output data on SPSS, t value = 2.336 with degrees of freedom

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	Sig. (2-tailed)	Mean Difference	Std. Error Difference
hasil	Equal variances assumed	3,822	0,055	0,023	6,77343	2,90160
	Equal variances not assumed			0,028	6,77343	2,98798

= 60 and p-value (2-tailed) = 0.023. Because p-value = 0.023 is smaller than 0.05, H0: $\mu 1 = \mu 2$ is rejected. So it can be concluded that there is a significant difference between the posttest of the experimental group and the control group.

IV. DISCUSSION

The effectiveness of Augmented Reality to improve competency in Applying How to Work Torque Converter has been tested using the ARTorque application. Testing is done in the experimental and control class. The results of trials in large groups get that the value of the Experiment Group is better than the value of the Control Group. This value comparison supports the theory of asserting that Augmented Reality technology can help students to understand learning material [6]. Students who can use Augmented Reality as learning material are very easy and can be used again. Students will not face serious difficulties when using Augmented Reality technology. Students will enjoy using Augmented Reality technology. So as to get the results of teaching using the Augmented Reality learning media make a positive contribution to student achievement and attitudes. Comparison of the values above proves the hypothesis that there is a significant difference between the experimental group's post-test and the control group. This statement is supported by Fernando et al, who put forward In industrial operations, AR has been presented as a powerful tool for increasing the flexibility and efficiency of processes [7].

3D objects as one of the media in teaching and learning, shows a positive impact. Interactive multimedia can help teachers / instructors know a new approach that can be used to increase the effectiveness of learning and attract learning interest. Learning using multimedia Augmented Reality to stimulate students to think critically using their imagination, attitude and develop further and give birth to creativity this statement is supported by the theory that Augmented Reality Technology has a positive impact on outcomes related to vocational high school student learning [8]. Therefore, this media is one alternative to overcome the

decline in learning. Students can use this media to increase their creativity in the process of understanding the contents of teaching so that it becomes more memorable and easier and therefore the Augmented Reality learning media was chosen because it is the most well-known application type and has a very rapid development in industry 4.0 [9].

V. CONCLUSION

1. The results of the experimental research show that the results of the descriptive statistical analysis test of 36 students in the experimental class indicate that the average score of learning outcomes is 80.47 descriptive statistical analysis test results of 27 students in the control class indicate that the average score of learning outcomes is 73.7, and based on the results of the SPSS output in Table 4.13 above it appears that the probability value of Sig. 0,000 <0.05. This means it can be concluded that there are significant differences between the two data of the control class and experimental learning outcomes.
2. The results of research and development of ARTorque application products show several product advantages including: a) learning media using Augmented Reality technology adapted to the development of learning media in the era of education 4.0 where the educational management process related to planning, implementation, and evaluation can be carried out as effectively and efficiently as possible , b) Overcoming the limitations of distance and time, because educators can convey material only by sharing applications with students (2) can be repeated to increase the clarity of the material, (3) Develop students' minds and imagination, (4) Provide a realistic picture, because the display from the torque converter it can be seen in 3D (5) the messages conveyed are fast and easy to remember, (6) foster interest and learning motivation.

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