Application of Lost Foam Casting Process-based Virtual Laboratory to Improve Students' Understanding

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ABSTRACT
Lost foam casting is a type of metal casting that can be categorized to help minimize the amount of used or unused foam. In contrast to the type of sand casting, the lost foam casting process is more effective in terms of time because there are no pattern-taking stages. To increase students' understanding before doing practicum, learning media is needed that can help provide real insight into the mastery of the processes contained in lost foam casting. The learning media that has been developed is lost foam casting based on virtual laboratory. This study aims to analyze the level of understanding of Vocational High School students in the application of learning media that has been developed. The research method used was a quasi-experimental design with a pretest and posttest control group design. The sampling technique was carried out through purposive sampling. The number of samples in each group is 30 students. The data obtained was then analyzed through an independent sample T-test. The results obtained from these tests were that there were significant differences between students' understanding of the lost foam casting process in the experimental group and the control group.

Keywords: *Lost foam casting, Virtual laboratory, Students' Understanding, SMK.*

1. INTRODUCTION

The presence of Covid-19 has an impact on almost all fields. One of the areas affected is the education sector [1]. Learning activities in schools were hampered, while the solution offered during the pandemic was online learning [2]. This will worsen the competency level of students, especially Vocational High School students during practicum activities in laboratories and workshops. There are various learning media which are then used during online learning including Video Conference Zoom, Hang Out, and Google Meet [3][4].

Mechanical Engineering is one of the expertise programs in Vocational High Schools. In practical learning, students will learn in the laboratory and workshops that have been provided. If this practicum activity is then abolished or replaced with theory, there will be a decrease in student competence. Based on the results of interviews conducted with Vocational High School students with machining engineering expertise programs, it is known that online learning is not very popular due to several factors. The main factor that makes students dislike online learning is the presence of internet network disturbances. This was also emphasized by [5] who stated that online learning through zoom was less effective for practical and field subjects. In addition, [6][7][8] also stated the same thing, that online learning is not liked by students.Regardless of the Covid-19 pandemic, it doesn't mean that the problems with the learning system that will take place offline will be finished. Special treatments are also needed which then try to provide adjustments to student behavior after the Covid 19 pandemic [9]. This effort can be done by providing various forms of learning media that are identical to the use of smart phones.

One of the subjects in Mechanical Engineering is metal casting. [10] classifies the casting process into two main parts, namely disposable molds and permanent molds. Disposable prints are divided into permanent patterns and disposable patterns. It is in this disposable pattern that the lost foam is lost. Categorized as disposable because the pattern made will be destroyed during the metal liquid pouring process.

[11] said that the lost foam casting method has advantages including flexible casting patterns, apart

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from that, metal casting with this method also does not require finishing stages [12]. With these various advantages, casting with the type of loat foam casting also has disadvantages. The slow cooling rate and porosity processes have an impact on low mechanical properties [13][14].

With regard to the importance of metal casting practicum, especially in the lost foam casting method, it is necessary to apply learning media that can be used as an initial understanding as well as casting experience in metal casting subjects. The type of learning media chosen is based on virtual laboratory. The choice of developing virtual laboratory-based metal casting learning media is based on the availability of laboratory equipment that is made in real time when students are doing metal casting practicum. So that the details of the stages when performing lost foam casting can be carried out in a structured manner.

Learning by utilizing a virtual laboratory is very relevant to the 21st century. This is marked by the rapid development of science from various aspects which is accompanied by the development of technology, especially in the field of education. [15] stated that this virtual laboratory provides opportunities for students to carry out real practicum activities through digital simulations. The presence of technological developments in the form of virtual laboratories certainly provides benefits including achieving learning at low costs and time efficiency [16]. However, learning through digital simulation certainly cannot replace the role of practicum. However, this learning can be used as initial knowledge for students before practicum is carried out. So that students during practicum at least have basic insight and experience. In addition, the aspect of human error during practicum

2. METHODS

This research is included in the category of quantitative research. The method used is quasi-experimental. In terms of design, in this study there were two groups, so there was an experimental class and a control class which were then given a pre-test, treatment, and post-test as shown in Figure 1 below.

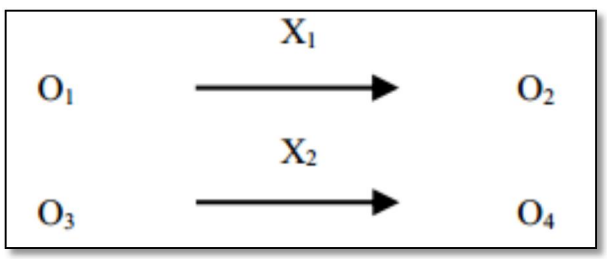

Figure 1 Research Design

Information:
O_1 = Pre-test experimental class before treatment
O_2 = Post-test experimental class after treatment
O_3 = Pre-test control class before treatment
O_4 = Post-test control class after treatment
X_1 = Learning using Virtual Laboratory
X_2 = Learning without Virtual Laboratory

Based on Figure 1, it is known that after students in each class carry out the next pre-test, the experimental class and the control class will receive learning using a virtual laboratory and without using a virtual laboratory. Next, students in each class will be given a post-test.

The sample in this study were Vocational High School students with a machining engineering expertise program in Malang City Vocational High School. The number of samples is 60 students. Data collection techniques use tests that have been tested for validity and reliability. The data analysis used in this research is descriptive analysis and T-test. Before the T-test is carried out, the data that has been obtained must be tested for normality first.

3. RESULTS AND DISCUSSIONS

3.1. Descriptive Analysis

The results of the descriptive analysis were divided into two, namely the experimental class and the control class. The following are the results of the descriptive analysis.

Table 1. Results of Descriptive Analysis Pre-Test.

Statistics			
		Control	**Experiment**
N	Valid	30	30
	Missing	0	0
Mean		73.7333	74.2000
Median		74.5000	76.0000
Mode		72.00	80.00
Minimum		64.00	63.00
Maximum		84.00	82.00

Based on Table 1 it can be seen that the mean, median, mode, minimum, and maximum values of the control class respectively are 73.7; 74.5; 72; 64; and 84. Meanwhile, in the experimental class, a score of 74.2 was obtained; 76; 80; 63; and 82. From the presentation of the results of the descriptive analysis, it can be seen that the pre-test scores in the experimental class are higher than those in the control class.

Table 2. Results of Descriptive Analysis Post-Test.

Statistics			
		Control	**Experiment**
N	Valid	30	30
	Missing	0	0
Mean		77.8333	84.6333
Median		77.0000	84.0000
Mode		76.00	82.00
Minimum		74.00	80.00
Maximum		84.00	90.00

Table 2 is a presentation of data on post-test scores for control and experimental classes. From these data it can be seen that the mean, median, mode, minimum, and maximum values of the control class respectively are 77.8; 77; 76; 74; and 84. Meanwhile, in the experimental class, a score of 84.6 was obtained; 84; 82; 80; and 90. From the presentation of the results of the descriptive analysis, it can be seen that the post-test scores in the experimental class are higher than those in the control class.

3.2. T-Test Analysis

The following will first describe the results of the normality test.

Based on Table 3 it can be seen that the control class has a sig value> 0.05, which is a score of 0.115. Next in the experimental class, it is known that the sig value> 0.05 is obtained by a value of 0.536. Thus it can be concluded that the data is normally distributed.

Table 3. Results of Normality Posttest.

One-Sample Kolmogorov-Smirnov Test			
		Control	Experiment
N		30	30
Normal Parameters[a]	Mean	77.8333	84.6333
	Std. Deviation	3.17407	2.95347
Most Extreme Differences	Absolute	.218	.147
	Positive	.218	.147
	Negative	-.139	-.106
Kolmogorov-Smirnov Z		1.195	.805
Asymp. Sig. (2-tailed)		.115	.536
a. Test distribution is Normal.			

Table 4. T-Test Results.

		Levene's Test for Equality of Variences		t-test for Equality of Means						
		F	Sig	t	Df	Sig. (2-tailed) Mean Difference	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Posttest_Scores	Equal variences assumed	.125	.725	8.590	58	.000	6.80000	.79157	5.21549	8.38451
	Equal variences not assumed			8.590	57.702	.000	6.80000	.79157	5.21532	8.38468

The basis for making decisions on the T test is the value of sig <0. Based on Table 4 it can be seen that the sig value is 0.000 which is less than 0.05. Thus it can be concluded that there is a significant difference in the score of the learning outcomes of the experimental class and the control class.

Learning by utilizing technological developments certainly has an important role in increasing student understanding. This has been tested by the T test which has been carried out on learning the lost foam casting process through a virtual laboratory. This virtual laboratory-based learning media is very well used as an alternative to conventional learning that is identified with explanations / lectures from the teacher. This is supported by [17] which states that student learning outcomes in high school level chemistry classes are more effective using virtual laboratories compared to the lecture method.

4. CONCLUSSION

Based on the research that has been done, it can be concluded that learning lost foam casting at the Vocational High School level through virtual laboratory-based learning has succeeded in increasing students' understanding. Thus the application of virtual laboratory-based lost foam casting learning can be used as initial learning before students carry out practicum in the laboratory.

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