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APPLICATION OF CRITICAL THINKING TO IMPROVE STUDENT LEARNING OUTCOMES KNOWLEDGE OF LATHE MACHINERY IN TURNING

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Abstract

Education is closely related to learning both in class and outside the classroom, especially practicum. Lathe machining practicum as a practical lesson cannot be separated from students' knowledge, skills, and critical thinking in completing the practicum. This study aims to determine the effect of critical thinking on lathe machining practicum and test the results of increasing student learning outcomes of lathe machining practicum on critical thinking instrument models. Using the true-experimental design method with a pretest-posttest control group design. The research subjects were students of the Mechanical Engineering Education Study Program, The Faculty of Engineering, Semarang State University for the 2019/2020 academic year consisted of 84 students which were divided into an experimental group and a control group with 42 students in each group, then used a sampling technique in the form of cluster sampling. He gave test questions and questionnaires to each group at the beginning and end (pretest and posttest) and discussed and analyzed the workpiece design from the learning videos for the experimental group while the control group was not given any treatment. The results showed that the critical thinking level of lathe machining practicum students in the experimental group was higher than that of the control group and there was an increase in learning outcomes in the application of critical thinking. Using the discussion method in the learning process can increase the level of critical thinking of students so that students can solve problems better. The discussion method in learning can be applied to other learning models to improve student's critical thinking and student learning outcomes.

Keywords: 21st Century Learning Model, Critical Thinking, Learning Outcomes

INTRODUCTION

Towards the 21st century, there are many challenges to be faced. According to Syarifah"The challenge in the 21st century in the form of fulfilling quality Human Resources (HR) can be done through education." Education is a means of learning knowledge and skills that are channeled and conveyed to a group of people through teaching, training, and research to develop good potential.

This 21st-century learning continues to develop and is classified into 4C (Communication, Collaboration, Critical Thinking, Problem-Solving, Creativity, and Innovation) as the Industrial Revolution 4.0(Arifin, 2017: 93). Research incorporated in ATC21S (Assessment and Teaching of 21st *Century Skills*) grouping the four categories one of which is the ability to think critically. According toArifin (2017), Sasson, Judah, and Malkinson (2018), "Critical thinking is divided into two, namely low-level critical thinking skills (Low Order Thinking Skills) which are based on conveying and applying simple knowledge information and high-order critical thinking skills (High Order Thinking Skills) which are based on developing and encouraging the advancement of knowledge to encourage development of a cohesive society.

Speech fromSlameto (2017), said "The advantage of critical thinking is the effect of cognitive activity by using reasoning to obtain information, decision making, analysis, and evaluation as well as integrating several abilities such as persuasion, assessment, observation, and decision making". In addition, critical thinking can be a measuring tool for educators to determine students' critical thinking skills. The need to develop critical thinking to increase student knowledge and information can be done in several ways such as applying discussion learning methods, lectures, problem-solving, etc. According to Changwong, Sukkamart, and Sisan (2018: 41), "There are several indicators in critical thinking, namely: (1) Describing, (2) Reflecting, (3) Analyzing, (4) Critiquing, (5) Reasoning, (6) Evaluate".
The development of learning methods such as the lecture method can produce learning outputs for students in the form of learning outcomes. Different learning methods in each study also affect student learning outcomes.

In addition, infrastructure, good teaching human resources, and a supportive environment can improve student learning outcomes. Nanda Saputra (2019), said "HR/SARPRAS and individual students are part of the learning outcomes that have not been optimal". This is due to internal factors that are outside the individual, external factors contained in the individual, and learning approach factors.

These two factors, namely internal factors and external factors, are the main things that influence learning outcomes. On the internal factors that come from within the learner, psychological aspects affect the learning process such as attitudes, interests, self-adjustment, and self-concept. Whereas external factors originating from outside individual students can be in the form of discipline, learning environment, infrastructure, and even interactions between educators and students.

Learning carried out by educators with students produces a learning outcome in the learning process. Egok (2016), explained "That learning outcomes can be correlated with critical thinking skills because the higher the critical thinking, the higher the learning outcomes in various ways such as problem-solving in learning, decision making, analytical skills, and scientific research".Rerung, Sinon, and Widyaningsih (2017), "Learning results must be improved to achieve the minimum completeness criteria (KKM) because it has an impact on psychomotor, affective and cognitive aspects". This can be seen in the learning outcomes of students only reaching 52% of the 25 students. By applying a good learning model and process it is hoped that it can improve student learning outcomes. Submission of material that is not maximal can result in the creation of bad human resources. Research results from Ibaraki said, "Whether or not the human resources achieved can be judged from the three components of the assessment, namely the value of knowledge (cognitive) by 40%, the value of skills (psychomotor) by 40%, and the value of attitude (affective) by 20%".

The university as one of the educational facilities and infrastructure to improve students' learning outcomes and critical thinking is an advanced-level educational institution that focuses on one area of technological development, especially Mechanical Engineering. Good theoretical and practicum learning in the learning process can produce competent, skilled, innovative, and creative human resources according to industry requirements. One of the skills developed in the Mechanical Engineering department is lathe machiningRahman (2020), "A lathe is a machine tool that is used to cut objects by rotating them". The use of lathes is important in industries that aim to create an item that is needed. Good skills are needed to achieve the criteria for the results of goods that are by the standards. There are several basic competencies from the basis of a lathe, namely what is a lathe, the functions and parts of a lathe, and the operating techniques of a lathe.

RESEARCH METHODS

This study aims to determine the effect of applying critical thinking to student learning outcomes in lathe machining practicum using a true-experimental quantitative approach research method with one form of true-experimental design, namely pretest-posttest control group design.

The subject of this study was the critical thinking skills of 84 students majoring in Mechanical Engineering Education for the 2019/2020 academic year using the cluster sampling technique according to ethics, "Random sampling with a population class that has the same homogeneity as the sampling technique in this study." In this study, the subjects were divided into an experimental group consisting of 42 students consisting of classes 1 and 2, and a control group consisting of 42 students consisting of classes 3 and 4. The experimental group was given treatment with discussion and results of video analysis of the average turning process learning and designing and planning the work process independently, whereas the control group only by being given a learning video of the flat turning process by the lecturer.

Data collection is used to collect technical explanations and reasons and then arranged to form a good research instrument. This study uses the documentation method which is used as a complement to the observation data and the test method which uses a pretest and posttest in the form of a questionnaire to find out the development of critical thinking in lathe machining practicum students and tests in the form of multiple choices to measure student learning outcomes in lathe machining practicum.

Making a good instrument can refer to several indicators that have been made, one of which is that apart from these indicators, according to Enies (in Wartono, Muhammad, and John (2017) five indicators are used as a reference for making instruments, namely: (1) simple explanation (elementary clarification), (2) develop basic skills (basic support), (3) draw conclusions (inference), (4) provide a further explanation (advanced clarification), and (5) implement strategies and tactics. has been tested empirically to obtain information on the validity and reliability of each of 0.70 and 0.91. The following presents the percentage of critical thinking criteria according to(Wiyoko, 2019):

Table 1. Percentage of Critical Thinking Criteria

Criteria	Percentage
Very high	80% < P ≤ 100%
High	60% < P ≤ 80%
Average (moderate)	40% < P ≤ 60%
Low	20% < P ≤ 40%
Very low	0% < P ≤ 20%

To determine the value criteria for students, the percentage formula for student value criteria is used as follows:

$$\frac{Total\ score}{Total\ Value} \times 100\%$$

The use of pretest and posttest control group design learning designs in this study aims to determine whether there are significant changes in the development of critical thinking on the learning outcomes of lathe machining practicum. Three data can be analyzed from this study, namely: (1) Normality test to find out the normality of the data used using the Lilliefors test (Kolmogorov-Smirnov), (2) Homogeneity test to find out whether the variants of the two groups are the same or different using the Levene's test if the data is normally distributed, and (3) the average increase test (N-gain) to test the difference between pretest and posttest values and use the T-test (Independent sample t-test). The n-gain test can also be calculated using SPSS for Windows 15.0. According to classificationNasution et al. (2020) as follows:

Table 2. N-Gain Values

Large N-gain Value	Classification
G ≥ 0.7	High
0.3 ≤ g < 0.7	Currently
g < 0.3	Low

RESULTS AND DISCUSSION

This research was conducted to analyze the effect of the application of critical thinking on student learning outcomes in the Mechanical Engineering Education Study ProgramSemarang State University for the 2019/2020 Academic Year in the Lathe 1 Machining Practicum course using instruments in the form of learning achievement tests and critical thinking questionnaires.

Data on pretest and posttest learning outcomes for the experimental group were obtained using a test consisting of 30 questions and a total of 42 students as follows:

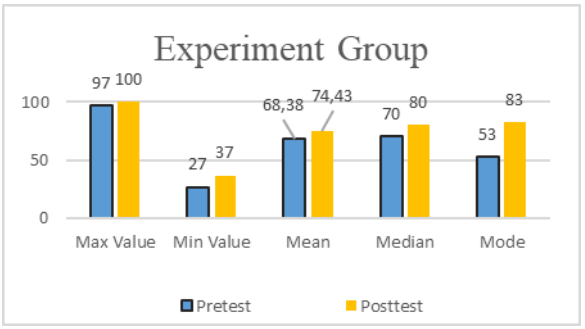

Figure 1. Pretest and Posttest Data on Learning Outcomes of the Experiment Group

Based on these values, the mean, median, and mode values in the posttest were higher than those in the pretest, so in the experimental group there was an increase in learning outcomes.

Data on pretest and posttest learning outcomes for the control group were obtained using a test consisting of 30 questions and a total of 42 students as follows:

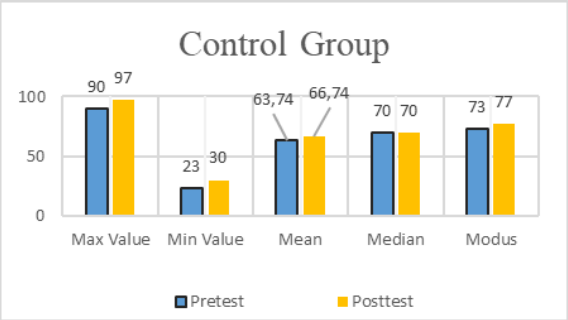

Figure 2. Pretest and Posttest Data on Control Group Learning Outcomes

Based on these values, the mean and mode values in the posttest were higher than those in the pretest but the median value showed the same value in the pretest and posttest of 70.00. The increase still occurred in the control group but was not as significant as in the experimental group

DataThe experimental group's critical thinking was obtained using a questionnaire consisting of 20 statements and totaling 42 students as follows:

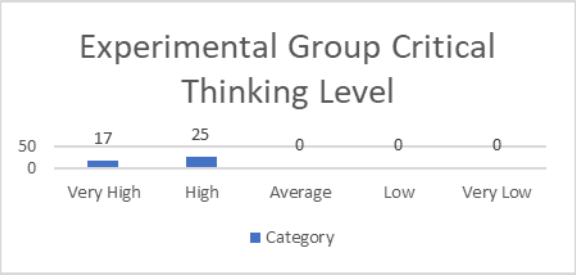

Figure 3. Categories of Critical Thinking Level of Experimental Group Students

The student categories obtained in Figure 3 refer to Table 1. There are 17 students in the very high category and 25 students in the high category with a median of 78.50, a mode of 67, and an average of 77.00. From the results of the data analysis, the experimental group was included in the high category.

The control group's critical thinking data obtained using a questionnaire consisted of 20 statements and a total of 42 students as follows:

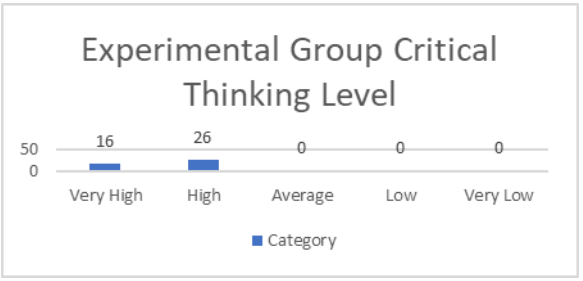

Figure 4. Critical Thinking Level Categories of Control Group Students

The category of students' critical thinking level in Figure 4 refers to Table 1. Of the 42 students, there are 16 students in the very high category and 25 students in the high category with a median of 75.24, a mode of 83, and an average of 75.50. The results of the data analysis, the control group is included in the high category.

Data were collected from the experimental group and the control group on the pretest and posttest and then analyzed to determine the development of critical thinking on the learning outcomes of the lathe machining practicum. Three test data are used to analyze, namely:

1. Normality test

Testing using SPSS 15.0 through the Liliefors test (Kolmogorov-Smirnov) with the test criteria for a significance level of 5% (0.05). If the P-value (sig) ≤ 0.05 then H1 (sample of normal distribution) is rejected and if the P-value (sig) > 0.05 then H0 (sample of normal distribution) is accepted. The following are the results of the pretest and posttest instrument tests and questionnaires for the experimental group and the control group:

Table 3. Normality Test Data for Lathe Machining Practicum

Variable	Signification	Signification Levels	Conclusion
Pretest test	0.130	0.05	Normal
Post-test	0.070	0.05	Normal
Questionnaire	0.200	0.05	Normal

2. Homogeneity Test

Homogeneity testing was carried out to find out whether the variances of the two groups were the same or different. The normality test shows normal results in the instrument test

questionnaire pretest, and posttest in the experimental group and the control group, so the statistical tick test uses the *levene's.* Data on the results of the homogeneity test of the instrument test and questionnaire pretest and posttest of the experimental group and the control group are shown in Table 4.

Table 4. Homogeneity Test Data for Lathe Machining Practicum

Variable	Signification	Signification Levels	Conclusion
Pretest test	0.768	0.05	Homogeneous
Post-test	0.914	0.05	Homogeneous
Questionnaire	0.403	0.05	Homogeneous

3. Average Improvement Test

The average increase test or normalized gain (N-gain) is used to test the difference between pretest and posttest scores and measure skills and cognitive learning outcomes. The data that has been tested is normally distributed, so use the T-test (Independent sample t-test).

Table 5. Data for Testing the Average Increase (N-gain) of Learning Outcomes

No	Learning outcomes N-Gain Score (%)	
	Experiment	Control
1	0.38	0.09
2	0.59	0.33
3	0.13	0.15
4	0.51	0.18
5	0.39	0
6	0.51	0.09
7	0.30	0.15
8	0.63	0.06
9	0.37	-0.11
10	0	0.11
11	0.86	0
12	0.38	0.70
13	0.37	0
14	0.19	0
15	0.30	0.05
16	0.30	0.82
17	0.26	-0.10
18	0.62	0
19	1.00	0.15
20	0.80	-0.18
21	0	0
22	0.57	0.63
23	0.23	-0.06
24	-0.30	0.15
25	-0.54	0
26	0.57	0.15
27	0	0.15
28	0.60	0.41
29	0.85	0.13
30	0	0
31	0	0.13
32	0.38	0
33	1.00	0.12
34	0.24	0
35	0.26	0.50
36	0.08	0.12
37	0.33	0
38	0	0.09
39	0.59	0
40	0.45	0
41	0.46	-0.08
42	0.18	0.07
Average	0.3530	Maximum
Maximum	1.00	0.82
Minimum	-0.54	-0.18

Analysis of the data shows that we can classify the value of n-gain according to(Nasution et al., 2020)in Table 5. Then the experimental class has an increase in learning outcomes in the medium category because the n-gain value is $0.3 \leq 0.3530 < 0.7$. Whereas in the control class, there is an increase in learning outcomes in the low category because the n-gain value is $0.1191 < 0.3$.

The test was continued by using an independent sample t-test which aimed to find out the critical thinking of lathe machining practicum students in the experimental group and the control group.

Table 6. Independent Sample T-Test Results

Class	Average	Standard Deviation	Significat ion
Experiment	77.00	8,199	0.363
Control	75.24	9,411	

We can conclude from the statement using a significant level of 0.05 that if t-count <t-table then H0 is accepted and H1 is rejected, while t-count > t-table then H0 is rejected and H1 is accepted. The following table results of hypothesis testing.

Table 7. Hypothesis Test Results

	Critical Thinking Hypothesis Test	Learning Outcomes Hypothesis Test
t-count	0.363	0.053
Signification Levels	0.05	0.05
Information	H0 Accepted	H0 Accepted

Table 7 shows that the critical thinking hypothesis test and the learning outcomes hypothesis test have a t-test > 0.05 which is accepted which indicates that there is a difference in the level of thinking and there is an influence on student learning outcomes in the experimental group and the control group in lathe machining practicum.

The use of group discussion learning methods shows that there are differences in the level of critical thinking and there is an influence on student learning outcomes in lathe machining practicum. Research conducted byYudiono (2019) aims to innovate learning models and improve learning experiences and skills for industrial needs by using focus group discussions which show that they meet what is expected of student experience and skills performance for industrial needs on each of its criteria. In line with what was done byChangwong, Sukkamart, & Sisan (2018)regarding the development of critical thinking skills carried out on 69 students who were divided into the experimental group and the control group using one-way multivariate analysis of variance (MANOVA) for 16 weeks it was found that the average score in the experimental group was higher than the control group in the ability to think critically the development of learning materials developed by instructors. In addition, research conducted by Yudiono (2019) shows that the results of evaluating the learning process are not only from the learning process but from competencies that are in line with the industrial sector.

CONCLUSIONS AND SUGGESTIONS

Conclusion

Based on the results of the discussion the following conclusions are drawn:

1. The use of the group discussion method shows a significant influence on the application of critical thinking to student learning outcomes. The results of the analysis using a questionnaire on the level of critical thinking showed that the experimental group was higher than the control group
2. Providing a stimulus to students in the experimental group in the form of learning videos and then analyzing and designing their work shows that the learning outcomes in the experimental group are higher than the control group seen from the learning achievement tests.

Suggestion

1. Learning using the discussion learning model can be a solution to improve student learning outcomes because, with discussions, students can interact with peers so that they will be more active and can analyze and ask questions to solve their main problems during the COVID-19 pandemic.
2. Research on the application of critical thinking needs to be developed in a face-to-face way so that there are real interactions carried out by students by paying attention to health protocols.

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