

Improvement of Vocational Skill of Students Through Discovery Learning Method

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Abstract - The objective of this research is to investigate the vocational skill of students to analyze and to measure units of electricity in basic electronic circuit. This research uses two classes, one class for experiment with discovery learning method and the other class for control that uses lecture learning method. Quasi Experimental Design is used to compare the vocational skill of students on both classes. The vocational skill of students in psychomotor domain is tested through a performance test such as work samples. The vocational skill of students in cognitive domain is tested through paper and pencil. Anova 2 ways is used to analyze the vocational skill of students toward learning outcomes and interaction between them.

Index Terms - discovery learning, vocational skill, performance test, learning outcome

1. Introduction

Nowadays, the progress of science and technology has grown rapidly. Humans, as the main focus in developing of the science and technology, are required to always evolving anyway. One of the elements that can help human development is through education. Because education can build human character to face the future challenges. As we know, the competition even more competitive in every sector, day by day. Therefore, each country in the world is required to prepare itself to develop its human resources through good education.

Vocational High School is an educational institution that prepares its graduates to be workers ready and skilled. Vocational High School is an education in secondary education that promotes the development of the students' ability to be able to work in a particular field, the ability to adapt in the workplace, see job opportunities, and develop them in the future. Preparing students to achieve a good job, it requires the inclusion of academic knowledge, workplace skills and practical vocational experience [1]. Therefore, an action is required in order to be able to increase students learning outcomes. The improvement of students learning outcomes can be known by increasing of vocational skill of students and student activities. While the vocational skills of students can be enhanced by creating a learning environment that is attractive, fair competition, and increasing student activity in learning [2]. These criteria are appropriate to the discovery learning method that emphasizes students to seek knowledge for themselves according to their needs [3]. Beside that, discovery learning offer a real alternative in that can promote the students' problem solving ability, self-efficacy and motivates learning [4].

Vocational skills is the ability of students to skilled professionals and creative, and able to overcome and solve

problems faced quickly and precisely because it has a scientific background [5],[8]. Vocational skills of the students cover basic skills and occupational skills. Vocational skills and interests of students affect students learning outcomes. Because, vocational skills of students continue to develop and enhance the students' ability to think. Vocational skills have implemented in the life skill to improve better life for society. Reference [6] stated that how learning of basic technical skills has empowered groups of youths and adults in establishing alternative identities for their slums and improving the environment for better deliveries of public services. In addition, vocational skills also to reducing the dependence on aid by providing practical skills so that youths can earn a living and live productive lives. This low level vocational training presents opportunities for overcoming poverty and despair [7].

Technical and vocational skills can help to development in economic and social dimensions. Reference [8] stated that for the planners is concerned with the links between skills and poverty reduction, skills and competitiveness, skills and employment, and skills and social cohesion must attend to what kind and quality of skills people are learning. This research examines the vocational skill of students and activities of students of SMK Negeri 3 Jombang - Indonesia, with competency standards Measure unit of Electric in Electronics circuit.

2. Methods

A. Discovery Learning Method

Discovery Learning is a learning process to discover something new in the teaching and learning activities. Learning through discovery learning method can work well when teachers prepare in advance various materials to be delivered. Then the teacher can make the process of finding their own important issues related to the difficulties in learning. In the learning process, the teacher is not directly present lesson material in final form, but students are given the opportunity to seek and find themselves with a problem-solving approach in order to develop the potential and skills possessed. A teacher should strive to provide motivation and stimulation for the student to be able to solve a complicated problem considered. Furthermore, students are asked to conclude a problem that has been discussed as a material assessment, analysis and research procedures, as well as the final assessment in learning. Thus, students will be motivated to think solution-based, innovative, and practical to conclude on the matters discussed. The goals of the discovery learning method for students are as follows [9]: a. Developing Creativity, b. Getting the Jump Experience in Learning, c. Developing the ability to think rationally and

critically, d. Increasing the activity of students in the learning process, e. Learning to solve problems, f. Acquiring innovation in the learning process

B. Vocational Skills of Student

Increased vocational skills of students are a target to be achieved in the discovery learning method. Increased vocational skills will greatly influence the students' interest and learning outcomes of students to continue to develop and improve the ability to think. Vocational skills education is a concept that emphasizes the self development of students to face the challenges of life is increasingly complex and competitive. Vocational skills have a purpose not only preparing skilled workers and creative, but also preparing students to be able to address and resolve problems, because vocational skills have a scientific background [8]. Thus, the development of vocational skills is required to be applied to vocational schools as an effort to create a skilled and productive worker in the world of work [10]. Vocational skills of students are divided into two as follows: 1. Basic vocational skills include doing basic motion using simple tools in manual work (such as hammers, screwdrivers and pliers) and proficiency in reading simple drawing. In addition, basic vocational skills include aspects attitudes consistent, precision, accuracy and timely that lead to productive behavior, 2. Occupational skill is the ability of a person taken in accordance with the field that he/she has learned (such as a person's ability in the field of electronics engineering, hospitality, or machining)

C. Discovery Learning Method for improving Vocational Students Skills

In the application of the discovery learning method, it takes an important stage of the stages that must be passed by the student prior to the discovery process is demonstrated by the teacher. A stage of important stages is the research capacity. The research capacity is one of the successful applications of discovery learning in improving students' vocational skills. With the research capacity, students can examine and observe a problem to obtain the required data or facts on the learning process.

In addition, the ability of students to solve problems in a discovery learning method is one of the steps to improve the vocational skills of students. With these capabilities, students can think solution-based, creative and innovative and be able to draw conclusions from the results of the speed of perception to a concept or theory in the learning activities.

D. Quasi Experimental Design

This research uses research technique Quasi Experimental Design with type Static Group Comparison with the formula as follows [11]:

$$\begin{array}{cc} X_1 & O_1 \\ X_2 & O_2 \end{array}$$

Description: X_1 = Treatment in the control the class; X_2 = Treatment in the experimental class; O_1 = Class treated by lecture methods; O_2 = Class treated by discovery learning methods. This research is conducted to determine whether there is an increase in vocational skills of students who are taught by using discovery learning method is better than the students who are taught by using lecture learning method in

the competency standard "measuring the unit of electricity in electronic circuits".

E. Research procedures

This study is divided into three phases: preparation, implementation, and analysis of research results.

1) Preparation stage

In this stage, the research activities consist of: a. Survey to the school to be a place of research, in order to determine the problem and the sample to be studied. b. Develop learning instrument and research instruments: (1) Syllabus, (2) Lesson Plan, (3) Student Worksheet, (4) Instruments. c. Validate learning instruments and research instruments.

2) Implementation Stage

In this stage, we have two classes, namely the experimental class and the control class. The experimental class is TEI2 class that uses the discovery learning method. Meanwhile, in the control class is TEI1 class that uses the lecture learning method. Both classes are in 10th class in Vocational High School in Jombang, East Java. The research is conducted as many as for 4 times in each class, the experimental class and the control class. With detail, three sessions in teaching and learning activities and one session in the cognitive tests (post-test).

Table 1 shows the Design of Multiple Choice Tests that are used to examine the vocational skills (cognitive domain) of the students after receiving the learning process by using the discovery learning method or lecture learning method. The test items are prepared by first consulted to three validators that consists of two lecturers in the department of electrical engineering - Unesa and one teacher in the study program of electronics engineering industry SMK Negeri 3 Jombang - Jawa Timur. This test is used as post-test to determine the improvement of vocational skills of students after the learning process.

Table 1. Design Of Multiple Choice Tests

Achievement Indicators	Cognitive Levels					
	C1	C2	C3	C4	C5	C6
Explains the terms used in the measurement of electronic circuits		1, 3, 20,25, 34,36, 38	4,33			
Explains the components used in electronic circuits				2, 6, 12,14, 16, 40		
Explaining the steps in the measurement of electrical quantities of electronic circuit	10, 17, 18, 28, 29, 31					21,30
Explaining the problems and basic countermeasures in the measurement				7, 9, 19, 37, 39	11, 13, 15	
Perform standard setting for workshop equipment associated with electronic equipment			5, 8, 22, 24, 26, 27, 32, 35			

The next stage is the measurement of the psychomotor domain as shown in Table 2. It shows the matrix of work assessment of vocational skills students consisting of basic vocational skills and occupational skills. The measurement of psychomotor domain in this research refers [11] that the

measurement skills must be itemized as follows: (1) how to hold, (2) how to lay, (3) how to read numbers, (4) how to restore to its original place, etc.

Table 2. Matrix of Vocational Skills

No	Skills	Assessment Scores					Item scores
		1	2	3	4	5	
	Basic Vocational Skill						
1	Preparing tools needed in the experiment						
2	Capable to prepare the necessary materials in the experiment						
3	Knowing the procedure of the use of the tool in the experiment						
4	Performing the calibration before use tools						
5	Identifying the amount of electricity that will be measured in accordance with work instructions						
6	Identifying a simple circuit that will be made						
7	Diligent in working						
8	Using time effectively						
9	Paying attention Work Safety						
10	Capable of cooperating						
	Occupational Skill						
11	Identifying electronic measuring devices such as multimeter analog and digital are used in the measurement						
12	Preparing the operation of multimeter analogue and digital to measure the electrical quantities in electronic circuits						
13	Measuring the voltage in an electronic circuit using multimeter analog and digital						
14	Measuring the current in an electronic circuit using multimeter analog and digital						
15	Measuring resistance in an electronic circuit using multimeter analog and digital						
16	Performing power measurements on electronic circuits						

Scoring criteria as follows: Score 1 = Unable to do practical; Score 2 = Can do practical work in accordance aspect that is measured and less true; Score 3 = Can do practical work in accordance aspect that is measured and true enough; Score 4 = Can do practical work in accordance aspect that is measured and true; Score 5 = Can do practical work in accordance aspect that is measured and very true

3) Analysis of research results stage

In this final stage, carried out the data analysis and statistical tests. To test for differences between groups of data derived from two or more independent variables, therefore analysis of variance factorial two ways is used. This research compares between students learning outcomes who are learning using discovery learning method in the experimental class with students learning outcomes who are

learning using lecture learning method in the control class, as well as the level of vocational skills of students who are classified in the high and low vocational skills. The auxiliary tables in the data analysis as shown in Table 3.

Table 3. Anova 2 ways		
Vocational Skill Levels (B)	Learning Method (A)	
	Discovery	Lecture
High	O ₁	O ₂
Low	O ₃	O ₄

Description: O₁ = students who have high vocational skill with the discovery learning method; O₂ = students who have high vocational skill with lecture learning method; O₃ = students who have low vocational skill with the discovery learning method; O₄ = students who have low vocational skill with lecture learning method.

The Hypothesis for the research are:

- Testing the effect of vocational skills toward learning methods (H₁); H₀: $\mu_1 = \mu_2$; H_a: There is an effect of vocational skills toward learning methods
- Testing the effect of learning outcomes toward vocational skill level (H₂); H₀: $\mu_1 = \mu_2$; H_a: There is an effect of learning outcomes toward vocational skill level
- Testing the interaction between learning methods toward vocational skills (H₃); H₀: $\mu_1 = \mu_2$; H_a: There is an interaction between learning methods toward vocational skills

3. Results and Discussion

A. Analysis of Vocational Skills Tests

The test of vocational skills of students is conducted through psychomotor activities in the learning process. Similarly, the assessment of student activities is through observation of the student activity sheet. Meanwhile, to measure cognitive knowledge of students, post test is conducted to measure students' knowledge of the material that has been given to students. The entire testing performed is implemented in both classes both in the experimental class and the control class. There are two categories of interpretation in vocational skills of students. The categories are students who have high vocational skills and students who have low vocational skills.

Table 4. Distribution of Frequency from Post-Test Experimental Class

No	Interval Value	Frequency	Percentage
1	67.62 – 71.62	4	22%
2	72.62 – 76.62	4	22%
3	77.62 – 81.62	3	16%
4	82.62 – 86.62	6	33%
5	87.62 – 91.62	1	5%
Total		18	100%

The test results show that students who have high vocational skill total are 11 students and students who have low vocational skills are 7 for the experimental class. While for the control class, the test results show that students who have high vocational skill total are 10 students and students

who have low vocational skills are 8 students, as seen in Table 4 and Table 5.

Table 5. Distribution of Frequency from Post-Test Control Class

No	Interval Value	Frequency	Percentage
1	57.96 – 61.96	1	5%
2	62.96 – 66.96	0	0%
3	67.96 – 71.96	7	38%
4	72.96 – 76.96	5	27%
5	77.96 – 81.96	5	27%
Total		18	100%

B. Analysis of Cognitive Tests

Analyses of students' post-test results are obtained from post-test result in each class. Experimental class is treated by using the discovery learning method while the control class is treated by using lecture learning methods. The results of research are obtained in the form of post-test evaluation results of students in learning activities. The data post-test evaluation results of experimental class and control class are calculated using SPSS 17.0 software as shown in Table 6.

Table 6. Descriptive Statistics of Post-Test Results on Experimental Class and Control Class

	N	Mean	Std Deviation	Min	Max
Experiment	18	78.7111	7.58961	67.62	90.16
Control	18	72.9867	6.14932	57.96	80.50

Table 6 shows the number of students in the experimental class is 18 students, with average scores of 78.7111 and has a standard deviation of 7.58961. While in the control class with the number of students 18 students had a mean value of 72.9867 and a standard deviation of 6.14932. Frequency distribution of post-test can be calculated as follows:

a. Experimental Class

- 1) Data of Post-Test
Maximum Value = 90.16
Minimum Value = 67.62
- 2) Range (R)
 $R = \text{Maximum Value} - \text{Minimum Value}$
 $= 90.16 - 67.62 = 22.54$
- 3) Number of Class
 $K = 1 + 3.3 \log n$
 $= 1 + 3.3 \log 18 = 5.14 \approx 5$
- 4) Length of Class (P)
 $P = R/K = 4.6 \approx 5$

Table 6 shows the distribution of frequency of experimental class. The class consist of five classes with the highest frequency at 6 or at 33 % with an interval value of 82.62 - 86.62.

b. Control Class

- 1) Data of Post-Test
Maximum Value = 80.50

Minimum Value = 57.96

- 2) Range (R)
 $R = \text{Maximum Value} - \text{Minimum Value}$
 $= 80.50 - 57.96 = 22.54$
- 3) Number of Class
 $K = 1 + 3.3 \log n$
 $= 1 + 3.3 \log 18 = 5.14 \approx 5$
- 4) Length of Class (P)
 $P = R/K = 4.6 \approx 5$

Table 6 shows the distribution of frequency of experimental class. The class consists of five classes with the highest frequency at 7 or at 38 % with an interval value of 67.96 – 71.96.

C. Anova Testing

The research compares between the results of student learning using discovery learning method (experimental class) and lecture learning method (control group), as well as the level of vocational skill of students who are classified in HIGH and LOW. Hypothesis test used in this research is the factorial ANOVA 2 x 2 statistical tests. ANOVA test results are shown in Table 7, which is the result of the calculation of descriptive statistics of experimental class and control class that using software SPSS 17.0.

In Table 7 shows the test results of students' vocational skill in the experimental class (discovery learning method) the number of students who have HIGH skill vocational total of 11 students with an average score of 82.5491. In addition, the number of students who have LOW skill vocational amounted to 7 students with average scores of 72.68. In the control class (lecture teaching methods) the number of students who have HIGH skill vocational totaled 10 students with average scores of 72.45 and the number of students who have LOW skill vocational amounted to 8 students with an average score of 73.2013. The total number of students in the experimental class and the overall control class numbered 36 students.

1) Testing the effect of vocational skill toward learning methods (H_1).

Table 6 shows the average value of students learning outcomes in the experimental class at 78.7111 and the average value of the students learning outcomes in the control class at 72.9867. This indicates that students learning outcomes with treatment of the discovery learning method are higher than the results of student evaluations with treatment of method lecture learning.

Table 8 shows the calculation results of the factorial ANOVA 2 x 2 using SPSS 17.0 to determine the effect of discovery learning method toward lecture learning method. The calculations show that the value of the F test = 4,841 and P value = 0.035 which is smaller than the significance level $\alpha = 0.05$. Therefore, it can be concluded to reject the hypothesis H_0 and accept H_a . As we know that H_a = There is an effect of vocational skill toward learning methods.

2) Testing the effect of learning outcomes toward vocational skill level (H_2)

Table 7 shows the statistical description of the results of all students vocational skills. The calculation results of SPSS 17.0 show that the average value for the high

category of vocational skills is 77.7400 and the average value for the low category of vocational skills is 73.2013. Therefore, the test results of students' learning with the HIGH vocational skills are superior than students who have LOW vocational skills.

Table 7. Descriptive Statistics for Experimental Class and Control Class Based on Vocational Skills

Dependent Variable: Post-Test				
Vocational Skill	Methods	Mean	Std. Deviation	N
High	Discovery Learning	82.5491	6.64175	11
	Lecture Learning	72.4500	7.16003	10
	Total	77.7400	8.47574	21
Low	Discovery Learning	72.6800	4.49923	7
	Lecture Learning	73.6575	4.99952	8
	Total	73.2013	4.62904	15
Total	Discovery Learning	78.7111	7.58961	18
	Lecture Learning	72.9867	6.14932	18
	Total	75.8489	7.40078	36

SPSS Results in Table 8 shows the calculation results of the effect of learning outcomes toward vocational skill level. The calculations show that the value of the F test = 4.365 and P value = 0.045 which is smaller than the significance level $\alpha = 0.05$. Therefore, it can be concluded to reject the hypothesis H0 and accept Ha. As we know that Ha = There is an effect of learning outcomes toward vocational skill level.

Table 8. the results of the test anova two ways

Tests of Between-Subjects Effects					
Dependent Variable: Post-Test					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	718.055 ^a	3	239.352	6.388	.002
Intercept	197930.306	1	197930.306	5282.776	.000
vocational_test	163.532	1	163.532	4.365	.045
learning_method	181.363	1	181.363	4.841	.035
vocational_test * learning_method	267.437	1	267.437	7.138	.012
Error	1198.947	32	37.467		
Total	209026.944	36			
Corrected Total	1917.002	35			

a. R Squared = .375 (Adjusted R Squared = .316)

3) Testing the interaction between learning methods toward vocational skills (H_3)

SPSS Results in Table 8 also shows the calculation results of the interaction between learning methods toward vocational skills. The calculations show that the value of the F test = 7.138 and P value = 0.012 which is smaller than the significance level $\alpha = 0.05$. Therefore, it can be concluded to reject the hypothesis H0 and accept Ha. As we know that Ha = There is an interaction between learning methods toward vocational skills.

4. Conclusion

Based on the research results can be concluded as follows:

- 1) The average value of students learning outcomes in the experimental class (discovery learning method) at 78.7111 and the average value of students learning outcomes in the control class (method lecture learning) at 72.9867. This indicates that students learning outcomes with treatment of the discovery learning method are higher than the results of student evaluations with treatment of method lecture learning. Moreover, the calculation results of the factorial ANOVA 2 x 2 to determine the effect of discovery learning method toward lecture learning method show that the value of F test = 4.841 and P value = 0.035. The P value is smaller than the significance level $\alpha = 0.05$. For that reason, it can be concluded to reject the hypothesis H0 and accept Ha. So, there is an effect of vocational skills toward learning methods.
- 2) The average value for the HIGH category of vocational skills is 77.7400 and the average value for the LOW category of vocational skills is 73.2013. Therefore, the test results of students' learning with the HIGH vocational skills are superior than students who have LOW vocational skills. The calculation results of the effect of learning outcomes toward vocational skills level show that the value of the F test = 4.365 and P value = 0.045. The P value is smaller than the significance level $\alpha = 0.05$. Therefore, it can be concluded to reject the hypothesis H0 and accept Ha. So, there is an effect of learning outcomes toward vocational skill level.
- 3) The calculation results of the interaction between learning methods toward vocational skills show that the value of the F test = 7.138 and P value = 0.012. The P value is smaller than the significance level $\alpha = 0.05$. Therefore, it can be concluded to reject the hypothesis H0 and accept Ha. So, there is an interaction between learning methods toward vocational skills.

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