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THE EFFECT OF PROJECT-BASED LEARNING MODEL ON STUDENT LEARNING OUTCOMES IN PRODUCTIVE SUBJECTS CLASS XII TKJ AT SMK NEGERI 1 REJOTANGAN

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ABSTRACT
This research is motivated by the low learning outcomes of students in class XII of SMKN 1 Rejotangan. The purpose of this study was to determine the effect of the use of PJBL learning model on the learning outcomes of XII grade students of SMK Negeri 1 Rejotangan. The research design used a quantitative approach with a research design of Quasi Experiment Nonequivalent Pretest-Posttest Control Group Design. The experimental class was taught using a project-based learning model and the control class used a conventional learning model, namely using a lecture learning model. The learning outcome test obtained shows that the average value of the experimental group is 72.56 and the average value of the control group is 58.84. Based on the hypothesis test, the sig value = 0.000 at a significant level of α = 0.05. This means that the sig value is <0.05, which means that the sig value is outside the H0 acceptance area. So it can be concluded that there is an effect of the application of the PJBL learning model on the learning outcomes of XII grade students of the TKJ Department of SMK Negeri 1 Rejotangan.

I. INTRODUCTION

Learning is part of education, which is supported by various elements of learning, including goals, subject matter, infrastructure, learning situations or conditions, learning media, learning environment, learning methods, and evaluation [1]. Through education, it will be able to improve the quality of each individual to become more productive and shape individual attitudes to be better and directed, and be able to overcome the demands and challenges faced [2].

Vocational High Schools (SMK) are a great asset, if the Indonesian nation wants to progress, unemployment is reduced, then SMK needs to be handled professionally [3]. SMK Negeri 1 Rejotangan is one of the vocational schools in Tulungagung Regency. SMK Negeri 1 Rejotangan is a formal education facility that equips students with knowledge, skills and socialization abilities in the community. SMK Negeri 1 Rejotangan is a school that implements the independent curriculum in its learning. The curriculum that has been implemented in Indonesia includes the 2006 education unit level curriculum (KTSP), the 2013 curriculum (KURTILAS) and what is currently still running is the Merdeka curriculum (Merdeka Belajar). Merdeka Belajar is a form of implementation of national character building values starting from revamping the education system and learning methods [4].

The implementation of the independent curriculum is expected to increase student engagement, because this curriculum is basically student-centered. The teacher is only a facilitator and mediator for students, so that students are eager to learn and get good results. As for the subjects that are mandatory in the independent curriculum, one of them is productive subjects. Productive subjects are special subjects that must be followed by students according to their chosen skill competencies. According to [5] productive subjects are all subjects that can equip basic technical knowledge of vocational expertise and certain skills according to their respective expertise programs.

The project-based learning (PJBL) model is a learning model that uses the problem as the first step in collecting and integrating new knowledge based on its experience in real activities [6]. Innovative learning with project-based learning model has many advantages. According to [7] the advantages of project-based learning model are as follows: (1) making students motivated to learn in making projects, (2) making students creative and innovative in learning and problem solving, (3) increasing collaboration between students, (4) fostering scientific attitudes such as honesty, thoroughness, responsibility, and creativity. According to [8] using a project-based learning model is a

model that is preferred by students in improving quality in addition to student control over their learning, making the experience of acquiring knowledge more valuable.

Learning outcomes are the achievement of a form of ability obtained by students from the cognitive, affective, and psychomotor domains [9]. Learning outcomes are an important factor in the teaching and learning process, an important factor in achieving teaching success is the learning model. One way to improve the quality of learning can be achieved by applying various appropriate learning models [10]. According to [11] during the learning process, student activeness is very important, one of which is activeness in exploring learning, but a boring learning process can make students pay less attention to learning and tend to be passive.

Student activeness is an activity that is both physical and mental, namely doing and thinking as an inseparable series [12]. Activeness is an important element supporting student success in the learning process and getting maximum learning results [13]. During the learning process, student activeness is very important, one of them is activeness in exploring learning, but a boring learning process can make students pay less attention to learning and tend to be passive [14].

Based on the results of observations made by researchers on November 1 to 30, 2022, problems were obtained that caused the low learning activeness of students in class XII Computer Network Engineering at SMK Negeri 1 Rejotangan. Teachers use lecture methods that are less varied and students are less actively involved in exploring, assessing, interpreting, in learning activities. The learning process causes a lack of student activeness in productive subjects, resulting in students tending to be passive in learning, lack of respect for the teacher, and lack of understanding of the material presented.

Based on data on the tracking of student learning outcomes in class XII Computer Network Engineering productive subjects, it shows that there are several students who have not reached the KKM score set by the school, which is 78. XII Computer Network Engineering students who complete learning or meet the KKM are only 59%. The data on learning outcomes is obtained from the UTS scores of productive subjects in the even semester of the 2022/2023 academic year class XII Computer Network Engineering SMK Negeri 1 Rejotangan.

Based on the description above, it is necessary to conduct educational research with the title: "The Effect of Project Based Learning Model (PJBL) on Student Learning Outcomes in Productive Subjects at SMK Negeri 1 Rejotangan". With the application of this learning model, it is hoped that students will get good learning outcomes and passive students can become active both for themselves, teachers, friends and the learning environment.

II. METHODS

The research used in this study is a quasi-experimental. The quasi-experimental design used in this research is nonequivalent pretest-posttest control group design, which is a design that provides a pretest before being subjected to treatment, as well as a posttest after being subjected to treatment in each group. The class used as research is a class that has the same initial ability.

TABLE I.
NONEQUIVALENT PRETEST-POSTTEST CONTROL GROUP DESIGN

Class	Pretest	Perlakuan	Posttest
Experiment (A)	O_1	X_1	O_2
Control (B)	O_1	X_2	O_2

[15]

Description:
A: Experimental class
B: Control class
X_1: Project based learning model
X_2: Lecture learning method
O_1: Initial test (pretest)
O_2: Final test (posttest)

The research instrument used is an objective test in the form of multiple choice questions to measure cognitive aspects. According to [16] a test is a set of stimulus given to someone with the intention of getting answers that can be used as the basis for determining scores or numbers. This test was conducted to obtain data on student knowledge before and after the learning process so that the difference in pre-test and post-test scores could be obtained, then the average student learning outcomes using the PJBL model and the learning model used by teachers at SMK Negeri 1 Rejotangan could be seen.

According to [15] population is a generalization area consisting of objects or subjects that have certain qualities and characteristics set by researchers to study and then draw conclusions. The following is a table of the population size of this study:

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TABLE II.
TOTAL POPULATION OF CLASS XII STUDENTS OF SMKN 1 REJOTANGAN

No	Class	Total
1	XII Computer Network Engineering 1	37
2	XII Computer Network Engineering 2	37
3	XII Computer Network Engineering 3	38
	Total	112

According to [15] the sample is part of the number and characteristics possessed by the population, in other words, the sample is a method in a study conducted by taking a portion of each population to be studied. The following is a table of the number of samples in this study:

TABLE III.
NUMBERS OF SAMPLES

No	Class	Total
1	XII Computer Network Engineering 1	37
2	XII Computer Network Engineering 2	37
	Total	74

Sampling in this study using purposive sampling technique. According to [17] purposive sampling tehcnique is a sampling technique based on the researcher's or evaluator's judgment about which samples are most useful and representative. In this study, researchers took samples from XII Computer Network Engineering 1 class students and XII Computer Network Engineering 2 class students. Researchers chose the class because it had the same initial ability, this was supported by the results of the average UTS score. The following is a table of data on the average UTS scores of class XII TKJ SMK Negeri 1 Rejotangan:

TABLE IV.
AVERAGE TEST SCORE

No	Class	Average
1	XII Computer Network Engineering 1	59,1
2	XII Computer Network Engineering 2	59,0

Data analysis is an important step in research, because data analysis helps to determine the results of research. Data analysis can be done through the following steps:

1. Instrument Test

The instrument test used is as follows:

a. Validity Test

According to [15]a valid instrument means that the measuring instrument used to obtain data (measure) is valid. The validity test on each question if rcount> rtable at the significant level ($\alpha = 0.05$) then the instrument is considered valid and if rcount < rtable then the instrument is considered invalid. This validity test calculation uses SPSS version 22.0 of windows 10.

b. Reliability Test

Reliability test is carried out to increase the level of fixity of the data collection tool (instrument used). The reliability test in this study used SPSS version 22.0 of windows 10 with the Cronbach alpha test technique. The criteria for reliability testing are:

1) If the Cronbach's alpha value $\alpha >= 0.05$ then the instrument has good reliability in other words the instrument is reliable or reliable.

2) If the Cronbach's alpha value $\alpha < 0.05$ then the instrument being tested is not reliable.

c. Level of Difficulty Test

A good question is a question that is not too easy or not too difficult [18]. The number that indicates the ease or difficulty of a problem is called the problem difficulty index. In determining the index of item difficulty between 0.00-1.00, with the following classification:

1) If the P value <0.30, then the item is included in the category of questions with a difficult level of difficulty.

2) If the value of $0.30 < P < 0.70$, then the item is included in the category of questions with a medium / sufficient level of difficulty.

3) If the value of P> 0.70, then the item is included in the category of questions with the level of difficulty is long easy.

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In this study, the level of difficulty test was used to measure the level of difficulty of the test instrument in the form of multiple choice questions.

d. Distinguishing Power Test

Item distinguishing power is the ability of items to distinguish which respondents have high abilities and which respondents have low abilities [18]. The analysis used the help of Microsoft Excel 2019 to find the differentiating power of the questions. According to [11] the test of differentiating power is calculated by the following formula:

$$D = \frac{BA}{JA} - \frac{BB}{JB} = PA\text{-}PB$$

Description:

1) D = number of test takers
2) JA = the number of upper group participants
3) JB = number of lower group participants
4) BA = the number of upper groups who answered the question correctly
5) NB = the number of lower groups who answered the question correctly
6) PA = BA/JA = the proportion of upper group participants who answered correctly
7) PB = BB/JB = proportion of lower group participants who answered correctly

The interpretation of the differential power of the items is as follows:

1) 0.70 - 1.00 = Excellent (Used)
2) 0.40 - 0.69 = Good (Used)
3) 0.20 - 0.39 = Fair (May be used with improvement)
4) 0.00 - 0.19 = Poor (Should not be used)

In this study, the analysis of power difference is used to determine the ability of the question in distinguishing students who are classified as capable (high achievement) with students who are classified as less capable (weak achievement). That is, when the question is given to capable students, the results show high achievement and when given to weak students the results are low. The test is said to have no differentiating power if it is tested on weak students who get higher results. Or when given to both categories of students the results are the same.

2. Prerequisite Test

The prerequisite tests used are as follows:

a. Normality test

The normality test is used to determine whether or not the distribution of research data is normal, the normality test is carried out on the pre-test and post-test scores using the Kolmogorov Smirnov formula which is carried out with the Symp. Sig or p value at the alpha siginificant level of 5% if p> 0.05 then the data is normally distributed. This normality test calculation uses SPSS version 22.0 of windows 2010.

b. Homogeneity test

Homogeneity test is conducted to determine whether the samples taken have homogeneous variants or not and to determine the initial ability to be the same. The homogeneity test uses the Levene test. In this study, the homogeneity test used the help of the SPSS 22.0 from windows 2010 program with the Levene test. The test criteria are if the sig value (significance) or probability value <0.05 then the data comes from populations that have unequal variances, while if the sig value (significance) or probability value> 0.05 then the data comes from populations that have the same variance.

3. Hypothesis Test (t test)

The hypothesis test which is the Independent Sample T-Test is used to compare the means of two groups directly and determine whether the differences are significantly different. This test focuses on the difference between two independent groups. Independent Sample T-Test Test decision making method:

1. H0 is rejected if the significance value <0.05 (the level of significance used).
2. H0 is accepted if the significance value is >0.05 (the level of significance used).

III. RESULT AND DISCUSSION

RESULT

A. Presentation and Research Results

The tests used in this study were a pretest of 12 items, a posttest of 13 items. The test test was carried out in class XII TKJ 3 SMKN 1 Rejotangan. After the test was carried out and the results were known, then the research

was carried out. The research data was processed with SPSS 22.0 For Windows. The following are the average pretest and posttest scores of the experimental and control classes.

Based on the results of the study, the average value of the experimental class pretest results was 68.92, while the experimental class posttest obtained an average value of 72.56. It can be concluded that the value category produced in the experimental class pretest is still not good. While the posttest in the experimental class the resulting value category is good.

Based on the results of the study, the average value of the control class pretest results was 82.84 while the average value of the control class posttest results was 67.92. Based on the data from the pretest and posttest results of the control class, it can be concluded that the resulting value category is still not good. This is evidenced by the fact that there are still many student scores that are below the KKM.

B. Data Analysis and Hypothesis Test

1. Instrument Test

a. Validity Test

An instrument is said to be valid if it is able to measure what is desired and can reveal data from the variables studied precisely.

The following are the results of the validity test calculation:

TABLE V.
PRETEST VALIDITY TEST

No. Item	r_{hitung}	r_{tabel}	Criteria
1	0,268	0,320	Invalid
2	0,347	0,320	Valid
3	0,137	0,320	Invalid
4	0,387	0,320	Valid
5	-0,018	0,320	Invalid
6	0,323	0,320	Valid
7	0,430	0,320	Valid
8	0,396	0,320	Valid
9	0,400	0,320	Valid
10	0,145	0,320	Invalid
11	0,445	0,320	Valid
12	0,403	0,320	Valid
13	0.104	0,320	Invalid
14	0,376	0,320	Valid
15	0,034	0,320	Invalid
16	0,154	0,320	Invalid
17	0,561	0,320	Valid
18	0,388	0,320	Valid
19	0,353	0,320	Valid
20	0,076	0,320	Invalid

TABLE VI.
POSTTEST VALIDITY TEST

No. Item	r_{hitung}	r_{tabel}	Criteria
1	0,219	0,320	Invalid
2	0,347	0,320	Valid
3	-0,025	0,320	Invalid
4	0,339	0,320	Valid
5	0,521	0,320	Valid
6	0,236	0,320	Invalid
7	0,349	0,320	Valid
8	0,591	0,320	Valid
9	0,102	0,320	Invalid
10	0,431	0,320	Valid
11	0,205	0,320	Invalid
12	0,450	0,320	Valid
13	0,495	0,320	Valid
14	0,442	0,320	Valid
15	-0,251	0,320	Invalid
16	0,377	0,320	Valid
17	-0,287	0,320	Invalid

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18	0,459	0,320	Valid
19	0,381	0,320	Valid
20	0,575	0,320	Valid

Based on the results obtained from the pretest validity test, it can be seen that there are 12 questions that are declared valid, for the posttest it can be seen that there are 13 questions that are declared valid.

b. Reliability Test

Reliability tests are used to measure instruments against the consistent accuracy of a test in measuring the same symptoms at different times and occasions. The formula used to measure reliability researchers use the Cronbach's Alpha formula. This Cronbach's Alpha calculation was carried out with the help of SPSS 22.0 For Windows software. How to write the output by comparing $rhitung$ with $rtabel$. If $rhitung > rtabel$, then the data is said to be reliable.

The following are the results of the reliability test calculation:

Table VI.
Pretest Reliability Test Results

Cronbach's Alpha	rtabel	N *of Items*
0,603	0,320	12

Table VIII.
Posttest Reliability Test Results

Cronbach's Alpha	rtabel	N *of Items*
0,721	0,320	13

The results of the reliability test values are known to be all greater than > $rtabel$, which means that the reliability test results meet the criteria.

c. Level of Difficulty Test

A good question is a question that is not too difficult and not too easy. To test the level of difficulty, researchers used the help of SPSS 22.0 For Windows software. This study used pretest and posttest questions, namely 12 questions for the pretest and 13 questions for the posttest.

The following are the results of the calculation of the level of difficulty test:

TABLE IX.
PRETEST LEVEL OF EQUIVALENCE TEST RESULTS

No	Difficulty Level	Item Status
1	0,74	Easy
2	0,55	Medium
3	0,82	Easy
4	0,32	Medium
5	0,71	Easy
6	0,79	Easy
7	0,68	Medium
8	0,66	Medium
9	0,68	Medium
10	0,66	Medium
11	0,84	Easy
12	0,39	Medium

TABLE X.
POSTTEST LEVEL OF EQUIVALENCE TEST RESULTS

No	Difficulty Level	Item Status
1	0,82	Easy
2	0,45	Medium
3	0,76	Easy
4	0,84	Easy
5	0,68	Medium
6	0,71	Easy
7	0,74	Easy
8	0,63	Medium
9	0,24	Difficult
10	0,84	Easy

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11	0,68	Medium
12	0,71	Easy
13	0,79	Easy

Based on the table above, it is known that for pretest questions there are 5 items in the easy category and 7 items in the medium category. For posttest questions, it is known that there are 8 items in the easy category, 4 items in the medium category and 1 item in the difficult category.

d. Distinguishing Power Test

Differentiating power examines items with the aim of knowing students who are classified as capable (high achievement) with students who are classified as weak or (less achievement). The test is said to have no differentiating power if the test, if tested on children with high achievement, the results are low, but when given to weak children, the results are higher. Or when given to both the results are the same. To test the differentiating power of questions, researchers use the help of SPSS 22.0 For Windows software.

The following are the results of the differentiation test calculation:

TABLE XI.
PRETEST POWER DIFFERENCE TEST RESULTS

No	*Corrected Item-Total Correlation*	Interpretation
1	0,446	Good
2	0,438	Good
3	0,375	Good
4	0,386	Enough
5	0,379	Enough
6	0,435	Good
7	0,560	Good
8	0,403	Good
9	0,439	Good
10	0,522	Good
11	0,280	Enough
12	0,493	Good

TABLE XII.
POSTTEST POWER DIFFERENCE TEST RESULTS

No	Corrected Item-Total Correlation	Interpretation
1	0,507	Good
2	0,328	Enough
3	0,549	Good
4	0,356	Enough
5	0,600	Good
6	0,467	Good
7	0,506	Good
8	0,534	Good
9	0,432	Good
10	0,462	Good
11	0,475	Good
12	0,446	Good
13	0,599	Good

Based on the results of the analysis carried out on 12 pretest multiple choice questions and 13 posttest multiple choice questions, it can be seen that for pretest questions 3 items are in the sufficient category, 9

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items are in the good category. For posttest questions, it is known that there are 2 items in the sufficient category and 11 items in the good category.

2. Prerequisite Test
   a. Normality Test

The normality test is intended to show that the data is normally distributed. There are several ways used to test data normality with the Kolmogrov-Smirnov technique, with the help of SPSS. To be able to use the comparative test (t-test), the data must be normal. If there is data that is not normally distributed then testing with the t-test cannot be done. The normality test can be done with SPSS 22.0 for windows, namely by using the Kol-mogrov-Smirnov test using a significance level of 5% or 0.05 and the data is declared normally distributed if the significance is greater than 5% or 0.05.

The data calculation results are presented in Table 13:

Tabel XIII.
Normality of the Final Test Distribution in Experimental and Control Classes

Posttest	
Eksperiment	**Control**
0,092	0,066

Based on the data obtained, it can be seen that the experimental class posttest data Asym.Sig (2-tailed) value is 0.092 and the control class posttest data Asym.Sig (2-tailed) value is 0.066. Because the significance is more than 0.05, the posttest data of the experimental class and control class are declared normally distributed.

   b. Homogenity Test

After the data in the study is declared normally distributed, the next step is to find the homogeneity value. In this study, homogeneity was obtained by conducting a variance homogeneity test. This homogeneity test is intended to test whether the variants of the two research samples are homogeneous or not. Homogeneity test decision making is if the significance> 0.05 then H0 is accepted (the same variant) and if the significance <0.05 then H0 is rejected (different variants).

The data calculation results are presented in Table 14:

TABEL XIV.
HOMOGENEITY TEST OF POSTTEST IN EXPERIMENTAL CLASS AND CONTROL CLASSES

Instrument	Value
Posttest	0,525
Criteria	Homogeneous

Based on table 14, it can be seen that the posttest significance value on the Test of Homogeneity of Variance' is 0.525. Because the significance value is greater than 0.05, H0 is accepted. So it is concluded that the posttest data groups between the experimental class and the control class have the same variance. So the assumption of homogeneity is met.

3. Hypothesis Test (t Test)

The analysis used to test the research hypothesis is the Independent sample T Test analysis. The t-Test test is used to test the average difference of two independent sample groups. In this study, a significant level of 5% ($\alpha = 0.05$) was used.

Data on the results of statistical testing can be seen in Table 15

TABLE XV.
T TEST ON POSTTEST

Instrument	Sig Value
Posttest	0,000

Based on the data in table 15, it is known that the significance value in the final test (posttest) is 0.000. Where 0.000 <0.05 thus H1 is accepted. So it can be concluded that there is an effect of the project-based learning model on the learning outcomes of productive subjects in class XII TKJ SMK Negeri 1 Rejotangan.

DISCUSSION

Based on the pretest, it is known that student learning outcomes are still low and there is no significant difference in results between the two classes. The average value of the experimental class was 69 points, and the average value of the control class was 61 points. For this reason, researchers applied a project-based learning model to the experimental class and the lecture learning method to the control class.

The posttest results obtained after giving treatment to both classes have increased. The average value obtained in the experimental class was 83 and the control class was 68. Based on these values, both classes experienced a high increase in learning outcomes. The increase in scores in the experimental class was higher than the increase in scores in the control class due to the learning model used by the researcher, namely project-based learning, where project-based learning involves a project in the learning process. Projects that students work on can be individual or group projects and are carried out within a certain period of time in collaboration, producing a product, the results of which will then be displayed and presented. The implementation of the project is collaborative, innovative, and unique, which focuses on solving the problem under study.

The posttest results above show that the average value of learning outcomes in the experimental class is higher when compared to the average value in the control class. The difference in value is because the experimental class uses a project-based learning model.

This is in accordance with research [19], namely based on the results of data analysis, the value of t count (3.533) > t table (2.086) was obtained. With these results, it can be concluded that there is a significant difference between student learning outcomes with the PJBL learning model and without the PJBL learning model. The results of research conducted by [19] can be concluded that there is an effect of the Project Based Learning learning model on student learning outcomes and activities. The results of research conducted by [20] can be concluded that the project-based learning model is effective on the mathematics learning outcomes of grade V SDN Banyubiru 05 Semarang Regency. The equation of this research with previous research is using the PJBL learning model and after completing the learning process there is an increase in student learning outcomes.

IV. CONCLUSIONS AND SUGESTION

Based on the calculation results, the average pre-test of the experimental group was 69 and the average post-test was 83, with 37 respondents. The t-test results show that the average score before the test is 61 and after the test is 68. The test analysis shows that the application of project-based learning affects the learning outcomes of students in class XII TKJ SMKN 1 Rejotangan. This is in accordance with the calculations on the SPSS version 22.0 program and the data calculation results in a Sig value = 0.000 then H0 is rejected and Ha is accepted. It can be concluded that the application of the project-based learning model affects the learning outcomes of students in class XII TKJ SMKN 1 Rejotangan.

Suggestions for the progress and successful implementation of the teaching and learning process in order to improve the quality of education, the authors provide the following suggestions:

1. To the Principal
   With the PJBL learning model which is proven to be more effective on student learning outcomes, it is hoped that the principal can make policies that can improve and develop the quality of education, especially in productive subjects in the Computer Network Engineering expertise program so that it can achieve the expected goals.
2. To the Teacher
   In delivering a lesson, especially in productive subjects, it is hoped that a teacher can choose the right learning model. This model must be able to encourage students to be more active in the teaching and learning process activities. Choosing the right learning model can affect the success of the teaching and learning process.
3. To the Next Researcher
   For future researchers who will conduct the same research, it is hoped that they can develop research knowledge related to the use of PJBL learning models and not only on learning outcomes but can develop further.
4. To Students
   By giving the PJBL learning model, it is hoped that students will be more effective and enthusiastic in participating in the teaching and learning process.

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