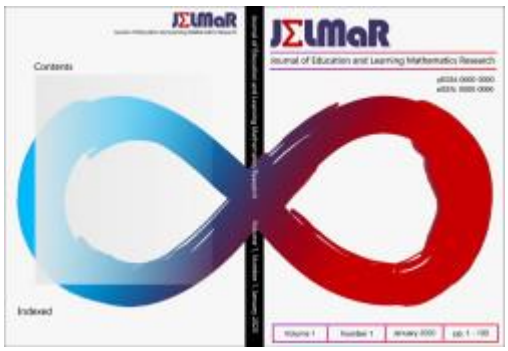

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The Influence of the Project Based Learning Model on Students' Learning Outcomes in Statistics

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***Abstract**: Based on the preliminary study conducted by the researchers in the field, there has been a decrease in students' learning outcomes at SMA Kartika Surabaya due to the prolonged implementation of online learning. Therefore, this research aims to enhance understanding by investigating the influence of the Project Based Learning Model on students' learning outcomes in statistics. The research employs a quantitative statistical analysis. The sampling where twelfth class of natural science 1 as the experimental group and twelfth class of natural science 2 as the control group. The data were collected using test based on students' learning outcomes and analysed for normality, homogeneity, and hypothesis testing. The results showed that the average learning outcomes of students taught using the Project-Based Learning Model are higher than those taught using the conventional model. The results of the hypothesis test using the independent sample t-test with a significance value (sig.) of 0.004 < a = 0.05, indicating H_0 was rejected and H_1 was accepted. Based on the research findings, it can be concluded that there is an influence of the project-based learning model on students' learning outcomes in statistics for twelfth class of natural science at SMA Kartika IV-3 Surabaya.*

Keyword: Learning outcomes, Project Based Learning (PBL), Statistics,

INTRODUCTION

Mathematics is taught starting in elementary school to help students develop logical, analytical, systematic, critical, and creative thinking skills, as well as collaborative skills. Mathematics, according to Ismayani and Tamansiswa (2016), is a discipline that can strengthen a person's reasoning skills and provide reasons to support or challenge others' perspectives about mathematical problem-solving, both in daily life and at work. It also aids in the advancement of science and technology. As a result, the process of learning mathematics should be given substantial consideration by developing a learning model that maximizes learning outcomes.

Students struggle to achieve the appropriate learning outcomes in mathematics. As a result, teachers must be creative in their class delivery by employing relevant learning methods. Because the teaching technique used at SMA Kartika IV-3 Surabaya is teacher-centered, students mathematics learning outcomes are generally low. This issue arises because students never try or practice directly, resulting in students relying solely on textbook exercises without developing their own abilities. According to Susanto (2018), learning outcomes are changes that occur in students as a result of and evaluation of learning activities, involving cognitive, emotional, and psychomotor elements. Learning outcomes are defined by Rifa'i and Sartika (2018) as the knowledge mastery achieved by a student after undergoing a learning process for a specific period, usually stated numerically based on the skills offered by the teacher. Learning outcomes are the abilities that students

acquire through a sequence of learning processes that involve changes in knowledge, attitudes, and relatively stable skills.

Efforts to improve students' learning outcomes include using a learning model that allows students to develop their own knowledge in order to improve learning results. PBL with a scientific approach is one ideal learning strategy for mathematics education. PBL learning methods that actively include students, according to Sahtoni et al. (2017), can be utilised to improve students' overall competence. Similarly, Berhitu et al. (2020) believe that the PBL paradigm has significant potential to create more attractive and relevant learning experiences, hence improving learning outcomes. According to Thabroni (2021), the PBL model is student-centered, and its syntax comprises the following: 1) Determine the critical questions (start with a critical question), 2) Design the project, 3) Create a schedule, 4) Monitor the students and project progress, 5) Assess the output, and 6) Evaluate the experience.

Pratiwi and Gita (2019) used this model in their research and found the following: 1) The impact of the PBL model on students' mathematical communication skills; 2) Differences in the impact of auditory, visual, and kinesthetic learning styles on students' mathematical communication skills; and 3) There was no interaction between the Project-Based Learning (PBL) model and learning styles on students' mathematical communication skills. The emphasis of influence, the test tools employed, and the distinct subject matter are the variations in this study.

Based on the difficulties highlighted, a problem with students low learning results has been found. As a result, the researcher used the Project Based Learning (PBL) model to conduct study at SMA Kartika IV-3 Surabaya. As a result, the researchers are is interested in conducting a study with the title "The Influence of the Project Based Learning Model on Students' Learning Outcomes in Statistics."

METHOD

The research design used in this study was a non-equivalent posttest-only control-group design. The experimental group was taught using project-based learning model, while the control with conventional learning model. In this study, the data collected consists of students' mathematics learning outcomes through a posttest. The research design is illustrated in the following table:

Tabel 1. research design

Class	Treatment	*Posttest*
Experimental	X	O_1
Control	-	O_2

Description:
O_1 : experimental group's post-test result
O_2 : control group's post-test result
X : treatment

The population used for the study consists of of students enrolled in SMA Kartika IV-3 Surabaya during the Academic Year 2022/2023. The sampling method used was simple random sampling. The study population included students enrolled in the twelfth class of natural science 1 and twelfth class of natural science 2 lesson at SMA Kartika IV-3 Surabaya for the Academic Year 2022/2023. The instrument used in this research is an essay test, which is designed to gather data on students' learning outcomes. The post-test instrument, comprising 6 items, has been tested by experts and deemed suitable and valid for assessing reliability. The study conducted a reliability test using the Kuder-Richardson (KR-20) formula through SPSS version 26. The resulting Cronbach's

Alpha value of 0.853 indicates that the test items are highly reliable and suitable for implementation in the post-test.

The data analysis technique used SPSS version 26. This technique involves several steps, including testing the normality of data through the Shapiro-Wilk test, testing homogeneity through the One-Way ANOVA test, and testing hypotheses through the t-test or independent sample t-test.

RESULT AND DISCUSSION

The purpose of this study conducted by the researcher was to determine the effect of the PBL model on students' learning outcomes in statistics for the 12th-grade class in high school. The research procedure involved providing Project Based Learning instruction on statistics to the experimental group, while the control group received conventional instructional methods for statistics. The final stage of the study involved administering a posttest to assess the impact of the treatment on students' learning outcomes in mathematics, specifically in statistics.

Based on the research, the researcher obtained data from the posttest results of students' learning outcomes. The data used in the analysis consisted of the learning outcomes of students from SMA Kartika IV-3 Surabaya in both the experimental and control groups. The descriptive analysis of the posttest results is presented in Table 2 below.

Table 2. Descriptive Analysis of Posttest Results for the Experimental and Control Groups

Descriptive statistics	Class	
	Experiment	**Control**
Number of Students (N)	26	27
Average (Mean)	84,3462	75,00
Highest Value (Max)	100,00	98,00
Lowest Value (Min)	65,00	45,00
Variance	72,875	173,692
Standard Deviation (S)	8,53671	13,17924

Table 2 shows a comparison of students' learning outcomes between the experimental and control groups. The experimental group, which consisted of 26 students, received an average score of 84.3462 on the posttest. The total distribution of the data was represented by a large and significantly divergent variance of 72.875, with a standard deviation of 8.53671. In comparison, the posttest results for the control group of 27 children yielded an average score of 75. The variance was 173.692, with a standard deviation of 13.17924.

Following that, inferential analysis was conducted for normality, homogeneity, and hypothesis testing. SPSS version 26 was used for the analysis in this study. The inferential analysis results are shown in Table 3 below.

Table 3: Posttest Normality Test Results for the Experimental and Control Groups

No	Class	N	Mean	α	Sig.	Remark
1	Experiment	26	84.3462	0,05	0,893	Normal
2	Control	27	75	0,05	0,131	Normal

The researcher used the normality test to determine whether the posttest samples of learning outcomes in the study followed a normal distribution or not. The analysis results for the average scores of the experimental group's posttest yielded a Sig. value of (0.893) >

α (0.05), while for the control group, the Sig. value was (0.131) > α (0.05). This indicates that the posttest results for both the experimental and control groups exhibit a normal distribution.

Table 4. Homogeneity Test of Posttest Results for the Experimental and Control Groups

No	class	Kelas	N	Variants (S^2)	Sig.	α	Remark
1	Experiment	Eksperimen	26	8,53671	0,074	0,074	Humogen
2	Control	Kontrol	27	13,17924			

The Homogeneity Test was conducted to determine whether the two groups were homogeneous or not. The homogeneity test in this study was conducted using SPSS version 26 with the One-Way ANOVA test. The results of the posttest for the experimental and control groups yielded significance values (sig.) of 0.074 and α was set at 0.05. Therefore, it can be stated that the sig. value (0.074) > α (0.05), meaning that H0 was accepted and H1 was rejected, making both groups are homogeneous.

Table 5. Independent Sample t-test (Posttest) for the Experimental and Control Groups

		Lavene's Test for Equality of Variances		**t-test for Equality of Means**		
		F	Sig	t	df	Sig.(2-tailed)
score	Equal variances assumed	3,315	0,074	3,051	51	0,004
	Equal variances not assumed			3,075	44,756	0,004

The results of the hypothesis testing between the experimental and control groups in SPSS version 26 showed a t-value of 3.051 and a sig. (2-tailed) value of 0.004, with set at 0.05. Therefore, it can be concluded that the sig. value (0.004) < α (0.05), indicating the H0 was rejected and H1 was accepted. The hypothesis testing results showed that there was a significant difference, with students taught using the Project Based Learning model having better average posttest scores than students who did not. Thus, it can be concluded that the Project Based Learning model has a considerable impact on student learning results in statistics.

These findings are consistent with earlier research. Pratiwi and Gita (2019) discovered that the PBL model had a significant impact on students' mathematics communication skills. Sutina, Ni Wayan, et al. (2018) found that project-based learning had an impact on students' interest and mathematics learning outcomes. According to Alfian and Sahrul (2017), the usage of PBL has a substantial impact on students' learning results in the field of triangle drawing. These findings back up previous research such as (Guo, P., Saab, N., Post, L. S., & Admiraa, W. (2020); Pratini, A., Maimunah, M., & Siregar, S. (2021); Yunita, Y., Juandi, D., Kusumah, Y. S., & Suhendra, S. (2020).). The difference in this study is due to the effect under consideration, the test instrument used, and the specific learning topic.

CONCLUSION

The study on the influence of the PBL model on student learning outcomes in statistics at SMA Kartika IV-3 Surabaya showed the sig. value (0.004) (0.05), indicating the H0 was rejected and H1 was accepted. Therefore, it can be concluded that there is a significant influence of the Project Based Learning model on student learning outcomes in statistics. Teachers are suggested to evaluate the available time in the teaching and learning process when using the PBL model to ensure effective use of the instructional model. Teachers are encouraged to use a variety of learning media, such as scientific calculators, Geogebra, Desmos, and other technology tools, to help with the learning process. For future researchers, it is recommended to conduct more in-depth studies on the implementation of the PBL model in mathematics classes for grades X, XI, and XII, using different topics such as trigonometry, polynomials, binomial probability, etc., and examining their effects on student learning outcomes, learning interest, or analytical skills.

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