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The Influence of Project-based Learning Model on mechanical Engineering Drawing Learning Outcomes

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Abstract

Learning activities are measured by acquiring the final results obtained by students. Based on the assessment carried out at SMK N 1 Padang class X machining engineering in mechanical engineering drawing lessons, it was found that the dominant student's final exam scores had not obtained scores limited by minimum criteria passing grade, it was known that the significance of student learning to learn to draw machine engineering was not following the achievements. A project-based learning model in coveted research can increase learning outcomes and student response. The experimental study used in this research included two classes X majoring in machining engineering, which was divided into a practical course with a population of 35 students to be applied to the project-based learning model was then observed by two observers, and the control class as a comparison subject of 36 students. The results obtained from the post-test in both categories have increased, but only the experimental class that reached classical completion or minimum criteria passing grade is 75, which has an average of 85.50 above the control class, which is only 71.46. The activeness in the experimental class assessed by two observers received an assessment percentage of 87.50% which was categorized as very good. So the conclusion obtained is that project-based learning impacts learning outcomes and activeness during the mechanical engineering drawing learning process.

Keywords: Learning Models, Learning Outcomes, Project-based Learning, Technical Drawings

Introduction

Education is the most critical process in life, allowing students to learn how to develop their skills (Fitri, 2021; Oktavia et al., 2021; Pristiwanti et al., 2022). The purpose of education must be achieved, and then education is considered successful. Education's purpose is to broaden student's horizons, change their way of thinking for the better, and realize or achieve the goals of education itself (Izza et al., 2020; Sujana, 2019). There are stages of the process that need to be passed, namely the learning process. Educational activities are educational processes to develop expertise in students(Akbar & Noviani, 2019; Sista & Azhari, 2022).

Vocational and technical education is one of the most vital institutions capable of answering all challenges and functioning as a productive society (Efronia & Mukhaiyar, 2020; Utari & Mukhaiyar, 2020). Vocational high schools provide vocational education to help students develop their abilities, skills, and expertise following their fields of study (Nande & Irman, 2021). Vocational education is designed to develop vocational secondary schools as producers of workers with skills in their respective areas (Ritonga, 2022).

Technical drawing techniques are necessary because a drawing engineer can design an object that will be made, analyzed, and design something that will be useful later. Technical drawing, including learning, is challenging to learn and understand (Arendra, 2021). Technical drawing material makes students participate more actively in the learning process. Simple education is carried out through theory only but also includes practice to maximize technical drawing skills(Ramadhan et al., 2022). Students who prepare to work in

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mechanical engineering know their mechanical drawing skills because, in the industrial world, drawing is a means of expressing the ideas and ideas of engineers. Technical drawing is often conveyed as the "language of engineering." Technical drawing is the formation of thoughts about systems, working methods, processes, structures, circuits, diagrams, and guidelines for reference(Syahril et al., 2021).

Learning to draw pictures aims to guide students to have the ability to know what must be considered and understood to be included in the criteria according to standards in its implementation. There is guidance from teachers who can realize it all with a suitable learning model. The teacher is a critical component of the educational process because the teacher is the primary weapon related directly to students being the object and subject of learning.

Based on observations from mechanical engineering teachers at SMK Negeri 1 Padang, the results of learning machine drawings of class X students are deficient, so the realization of graduation standards according to minimum criteria passing grade has not been able to materialize, it can be seen that there are still many students who carry out remedial after conducting this training eye exam. Many aspects, such as learning systems, infrastructure, learning environment, etc., cause low learning outcomes. Teachers never facilitate students to collaborate and exchange ideas with their classmates. Judging from the learning process, productive subjects, where the teaching and learning process takes place entirely in the classroom until students experience boredom listening to the teacher's reception. Based on this process, SMK students practice more in the workshop. Therefore, it is necessary to adopt a guided learning model in which students actively participate in the learning process. Improving student performance and learning outcomes with learning models, strategies, tactics, and approaches are just a few steps in learning. Sharing with students in the classroom fosters interest and insight into learning (Mungzilina et al., 2018). Thus, a learning model is needed to build students' critical thinking skills in building tangible renewable products through project-based learning, especially for students doing projects with experience and acquiring skills from project assignments carried out by individual and collective students(Dwiantoro & Basuki, 2021; Le et al., 2022).

The project-based learning model is learning given to students by conducting case studies and building assignments by completing projects shared by educators throughout the class. Project-based learning is a learning model focused on students, individuals, and teams and can integrate problems that arise accurately and quickly (Winaya, 2020). Thanks to the project-based learning model, students are more cooperative and participate actively, alone or in groups, in carrying out projects by finding real problems that are outplayed to learning. Based on this, a project-based learning model will be applied to technical drawing learning, fostering learning outcomes and active student participation.

Methods

Types of Research

Quasi-experimental research was used in this study. A quasi-experiment does not require an actual control group but only a comparison group. In this case, the comparison group can be interpreted as receiving a different treatment, such as applying traditional learning methods (Mahera et al., 2022).

Research Subjects

During the research, the object of study becomes an obstacle that requires the number of people, objects, or other things as research variables (Arikunto & Suharsimi, 2013). The researchers of this study were X mechanical students A and B in mechanical design subjects totaling 71 students. The research was conducted in the odd semester of 2022/2023 at SMK N 1 Padang in Class X of Mechanical Engineering in the Mechanical Engineering Drawing lesson.

Research Procedure

The syntax of this study consists of design, doing research, observing the results, and then reflecting on it (Arikunto, 2010). This experimental research procedure is divided into two cycles: planning, implementation, observation, and reflection; each cycle carried out pre-test at the end of Cycle I and post-test in Cycle II or after project-based learning is applied to an experimental class.

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Data Collection Methods

Test questions are used in this method of collecting research data, objective test questions totaling 40 questions that have been validated, then tested by pre-test and post-test through both classes, and then activity assessment activities obtained from 2 experimental class observators in cycle II.

Data Analysis Techniques

Data analysis is a stage of data analysis used to conclude. Data is analyzed based on data instruments that have been obtained.

Learning Outcomes

There are 40 questions on the test, where the maximum assessment is 100, which, if calculated, one correct answer question is worth 2.5. To calculate the score on the pre-test and post-test answers, students use the formula:

Value = number of correct answers X 2.5

After the scores of the test questions have been obtained, the next step is to find the average grade using the formula:

$$\text{Average Score} = \frac{\text{Total Student Score}}{\text{Number of Student}}$$

Actions that replace intelligence with students' insight, understanding, and activity in the learning process by developing their skills, creative and critical thinking with everyday problem solving (Imamah & Muqowim, 2020). Student activity is assessed by two observers who are likely to be ranked as a percentage by the formula:

$$\text{Persentase} = \frac{\text{Score sum of observer scores I and II}}{\text{Maximum total score}} \text{X } 100\ \%$$

With the assessment interval of the results of observation of student activities, namely:

Table 1: Student activity criteria and intervals

NO	Value %	Assessment categories
1	76 -100	Excellent
2	51 – 75	Good
3	26 - 50	Good enough
4	≤ 25	Not Good

Results and Discussion

Student Activity Data

The acquisition of monitoring results at students' steps is assisted by monitoring people at one encounter in an excandy class that applies a project-based learning model measured by using questionnaire sheet instruments. While using the project-based learning model, students actively learn by doing the tasks given, which can be seen by students getting an assessment percentage of 87.50%, which is included in the excellent category when viewed from the assessment interval.

Student Learning Outcomes Data

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Student learning data is taken from pre-test and post-test scores from the control and experimental classes. Data practical classes that apply project-based learning have higher scores—the difference between the two classes with significant. From the research carried out, it was revealed that the Application of project-based learning has an effect, namely growing student learning outcomes.

Table 2: Student Pre-Test and Post-Test Scores

Class	Pre-test	Post-test	Average Pre-test	Average Post-test
Experiment	1940	2992.5	55.43	85.50
Control	2007.5	2572.5	55.76	71.46

Homogeneity Test

The homogeneity test reveals that the initial data from the two samples obtained have the same population variance. The SPSS program calculates the homogeneity test: Homogeneity Variance test with one-way ANOVA.

Table 3: Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Result	Based on Mean	1.726	1	69	.193

The test criterion is that if the significance level < 0 > 0.05, then the variance of the data group is equal or homogeneous. Based on the table above, it can be seen that the data obtained has a significant level of > 0.05, namely. H.0.193 > 0.05, so it can be concluded that the variant between the experimental and control classes is the same.

Normality Test

The normality test aims to reveal whether the research material is usually distributed / not. The research used a significance value of 0.05 for the normality test. If the data's significance level produces higher data by 0.05, with the sample is distributed normally and vice versa.

Tabel 4: Tests of Normality

	Class	Shapiro-Wilk		
		Statistic	df	Sig.
Result	Preexperimentation	.977	35	.674
	Postexperiment	.956	35	.178
	Precontrol	.958	36	.186
	Postcontrol	.952	36	.117

Regular measurement table, 95% confidence interval, then α value = 0.05. The normality test using the Shapiro-Wilk method was carried out considering the significance level test <0>0.05, so the sample was usually distributed. Based on Table 4, the significance of the class with project learning (experimental) is 0.178 > 0.05. The post-test value in the course using the old learning model (control) obtained a significance value of 0.117 > 0.05, indicating that the data of both classes were usually distributed. Based on Table 4, classes using the project-based learning model obtained a significance of 0.178 > 0.05. The post-test test in the course using the control learning model received a significance score of 0.117 > 0.05 which stated that the data from both classes was normally distributed.

Hypothesis Test

testing is used in calculating post-test scores with independent samples T-test. From the tests carried out, a significant value of 2-tailed 0.011 <0.05 impacts the project-based learning model on the learning outcomes of mechanical engineering drawings.

Table 5: Independent Samples Test

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		Levene's Test for Equality of Variances		t-test for Equality of Means	
		F	Sig.	t	Sig. (2-tailed)
Hasil	Equal variances assumed	1.726	0.193	8.008	0.011
	Equal variances are not assumed.			8.031	0.021

Conclusion

The Application of the project-based-learning model influences the results and learning activities of the study, which can be seen from the assessment of observers has an average percentage of 87.50%, categorized as very good in intervals, and learning outcomes in experimental classes have a significant increase in scores on Pre-test and post-test: 55.43 < 85.50, which is above the control class which gets the number of pre-test and post-test 55.76 < 71.46.

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Declaration

Author's Contribution

Arifin Adli acts as a researcher and data collection, Ambiyar acts as a supervisor who directs the way and process of making, Refdinal plays a role in evaluating the research data results, and Purwantono plays a role in assessing research.

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Conflict interest

The authors declare no conflict of interest.

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