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The Effect of Implementation Project-Based Learning Model on Vocational Students' Machining Learning Outcomes

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ABSTARCT: This study aims to analyze the improvement of the learning process, competencies achieved by students, and student learning outcomes in the implementation of the Conventional Lathe Machining Technique learning process with a sample of class XI TM 4 Mechanical Engineering Department of SMK Negeri 3 Yogyakarta through the treatment of implementing the Project-Based Learning learning model. This research uses the Classroom Action Research (CAR) method. This research will be conducted in two cycles; the first cycle will include one meeting, and the second cycle will consist of two sessions to evaluate learning to determine the learning process results. The cycle of PTK stages rotates from one cycle to the next. It begins with planning (plan), action (action), observation of the action taken, and reflection (reflection). The results showed that the quality of the learning process before being given action was only 48.33% still in the "Fair" category and the learning outcomes in pre-cycle activities the average student score was 66.51 with 18.75% classical completeness which was still relatively low. After the implementation of the project-based learning model, there was an increase in cycle I where the results of the observation of the learning process with a percentage of 75% were in the "Good" category and student learning outcomes also experienced an increase in the average student score of 78.86 with 75% classical completeness. Furthermore, in the learning process of cycle II, there was an increase with a percentage of 91.66% which was included in the "Very Good" category, and at the end of cycle II, the average score increased to 86.05 with classical completeness reaching 100%. Thus, student learning outcomes in cycle II have met the indicators set in this study, namely more than 75% of the students obtained scores above the minimum score, which is ≥ 76.00.

KEYWORDS: Classroom Action Research, Learning Outcomes, and Project-Based Learning

I. INTRODUCTION

Vocational High School (SMK) is an educational unit that aims to improve knowledge skills, personality, noble character, and skills to live independently and follow further education following their vocations. According to Law No. 20 on the national education system, vocational education is secondary education that aims to prepare competent workers in certain fields. As a skills training institution, SMK has a strategic role in national development efforts, especially in creating skilled workers who can compete according to the needs of the industrial world. (Rahmat et al., 2016).

However, based on data from BPS (Central Bureau of Statistics) in 2022 in terms of education level, it was found that the unemployment rate from SMK was 9.42%, still dominating among other education levels. This is due to the low level of expertise or competencies required by the business world and the industrial world, but this case is not found in SMKs whose educational quality has been tested. One way to bridge the industrial world with the world of education is to improve students' ability to think critically, think creatively, and work together. Therefore, the learning model chosen and applied must be carefully considered. The importance of improving the quality of learning processes and outcomes, to master product-oriented declarative and procedural knowledge by implementing project-based learning (Arief & Mukhayyaroh, 2018).

The purpose of SMK is to prepare students to be able to; (1) work as a competent workforce following their skills; (2) work independently by creating their jobs; (3) develop themselves through higher education (Putra & Indrawan, 2023). To achieve its goal as a vocational education institution, SMK must be implemented through continuous planning to produce graduates who are competent in certain fields. Vocational education providers must pay special attention to improving the competence of graduates to meet the needs that exist in the industrial world. The learning process in SMK must be interesting and appropriate to the needs to produce graduates who are competent in their fields (Prayogo et al., 2022).

Based on the results of pre-research observations at SMK Negeri 3 Yogyakarta, there are still several problems that occur in the learning process in conventional machining subjects, namely, the low ability of students to understand the subject matter provided by the teacher, and there are still some students who do remedial if they have not met the predetermined standards. This is certainly homework for teachers and schools as the frontline that can play a role in overcoming existing problems and there needs to be an

effort to solve these problems. Various efforts that can be made to overcome problems related to improving student competence require systematic and continuous efforts. According to the 2014 Permendikbud on education in Indonesia which explains that learner skills are obtained through observing, questioning, trying, reasoning, presenting, and creating activities. To form these competencies, one of the efforts that can be made is through the application of learning models that can produce work from students.

However, at this time the learning process is still centered on the educator. This affects students because in this learning model, students feel less excited and less active in participating in the learning process, which has an impact on decreasing student achievement. So as to minimize the problems that occur, a learning model strategy is needed to be applied in the learning process. The learning strategy that can be applied when learning is the application of a learning model that can increase student competence. (Putra & Indrawan, 2023). One of the learning models that can be applied to improve students' competence is the Project Based Learning (PjBL) model. The application of PjBL can improve student learning outcomes in knowledge, skills, and attitudes. Because it directs students to systematic and standard work procedures to make or complete a product. In PjBL, students are accustomed to solving problems in the field of machining, and then making a "product" consisting of machining aids (jigs and fittings) used to grip rotating workpieces. (Sudjimat, 2014).

The application of the Project Based Learning model in learning conventional machining techniques, aims to increase student interest and interest in the learning process in the classroom and workshop. This will harmonize the state of SMK vocational education institutions with PP number 19 of 2005, concerning process standards. Therefore teachers need to create an interactive, inspiring, fun, and challenging learning environment so that students are actively involved. The learning process can improve the development of students' talents, interests, psychology, and activeness in the learning process. (Rizkiana et al., 2023). Based on the facts described above, project-based learning is expected to bridge the gap in students' knowledge and skills in improving competencies following the world of work and industry, so the researchers formulated the title of this study, namely "The Impact of Project Based Learning Model Implementation on Conventional Machining Learning Outcomes of Vocational Students".

II. METHOD

This research uses the Classroom Action Research (CAR) method. This research will be conducted in two cycles; the first cycle will include one meeting, and the second cycle will consist of two meetings to evaluate learning to determine the learning process results. The cycle of PTK stages rotates from one cycle to the next. It begins with planning (plan), action (action), observation of the action taken, and reflection (reflection). Pre-cycle action was conducted to identify problems before cycle I. This study used the classroom action research model of Kemmis & McTaggart. The research time was carried out for two months, namely from August to September 2024 for four meetings using cycle I and cycle II. However, if the indicators of activity and learning outcomes have not been achieved, it will be continued in the next cycle. The sample of this research is class XI TM 4 students of SMK Negeri 3 Yogyakarta in the academic year 2024/2025 who take Conventional Lathe Machining Technique subjects.

III. RESULT AND DISCUSSION

This study aims to see the improvement of student learning outcomes in the learning process of Conventional Lathe Machining Technique with a sample of class XI TM 4 Mechanical Engineering Department of SMK Negeri 3 Yogyakarta with the treatment of applying the Project Based Learning learning model. The data in this study were obtained through test results, questionnaires of competencies achieved by students and observations of the implementation of the learning process in the classroom then the data were analyzed and interpreted to answer the problem formulation in this study.

A. RESULT

The results of this study present data and facts in the field obtained from classroom action research in each cycle consisting of Pre-Cycle, Cycle I and Cycle II. The following are the results and description of the research conducted in class XI TM 4 Mechanical Engineering Department SMK Negeri 3 Yogyakarta:

1. Pra-Siklus

Pre-Cycle activities were carried out on August 27, 2024. The purpose of pre-cycle activities in this research is to see the learning activities that take place and measure student learning outcomes before the implementation of Cycle I and the next Cycle.

a. Stage of Observation (Observation) in Pre-Cycle Activities

This stage was carried out by researchers with the aim of observing the learning process that took place in the classroom in pre-cycle activities. The following are the results of observations in the pre-cycle learning process:

The score criteria are as follows:

1= Less Good,
2= Fair,
3= Good,
4= Very Good

Table 1. Observation Results on Pre-Cycle Activities

No	Components Observed	Score			
		4	3	2	1
1.	The teacher conveys the learning objectives clearly when starting the learning process		✓		
2.	The teacher explains what is needed in learning well and correctly		✓		
3.	The teacher conveys the material from the teaching module clearly and easily understood.		✓		
4.	The teacher explains the project-based learning procedure (Syntax) clearly.			✓	
5.	Learners are asked to form study groups according to the instructions from the teacher.			✓	
6.	The teacher asks the students to discuss to find ideas about the product to be made with the guidance of the teacher.				✓
7.	Students are asked to design a project design in groups according to the teacher's instructions.				✓
8.	Students explain the project design design in groups in front of the class properly and correctly.				✓
9.	Students are asked to make work steps and project work estimates in groups according to instructions.				✓
10.	Students work on projects that have been designed in groups accompanied by the teacher			✓	
11.	The teacher monitors the project process so that it can run well.		✓		
12.	Students present the results of projects made in groups properly and correctly.				✓
13.	The teacher asks the students to share any learning difficulties they have experienced.			✓	
14.	The teacher helps students provide solutions related to difficulties in learning properly and correctly.			✓	
15.	The teacher explains the results of the learning process clearly and easily understood by the students.			✓	
Total Actual Score		**29**			
Total Ideal Score		**60**			
Percentage		**48,33%**			
Category		**Enough**			

Based on the table of observation results of the pre-cycle learning process above, it can be described as a whole that the pre-cycle learning process or before being given action is only 48.33% still in the “Enaugh” category which refers to the benchmark percentage category (Jakni, 2017). This can be seen in the components of the implementation of learning activities that have not gone well.

b. Questionnaire of Competencies Achieved by Students in Pre-Cycle Activities

At this stage the researcher wants to see the extent of the competence achieved by students after the pre-cycle activities related to learning outcomes. The following are the results of the competency questionnaire achieved by students in pre-cycle activities:

Table 2. Results of Competency Questionnaires Achieved by Students in Pre-Cycle Activities

No	Category	After Pre Cycle
1	Very good	0,0%
2	Good	46,87%
3	Fair	53,13%
4	Deficient	0,0%
5	Very poor	0,0%

Based on the table above, it shows that at the beginning of the research implementation or precycle stage, the percentage of students having competency achievements classified as sufficient, which is 53.13% of the total number of students. While the percentage of students having competency achievements classified as good, namely 46.87% of the total number of students. From the results of student competency achievement in pre-cycle activities, there are still many students who are classified as sufficient and must be improved. However, the results showed that there were no students who had poor and very poor competency achievements both before and after the pre-cycle.

c. Student Learning Outcomes in Pre-Cycle Activities

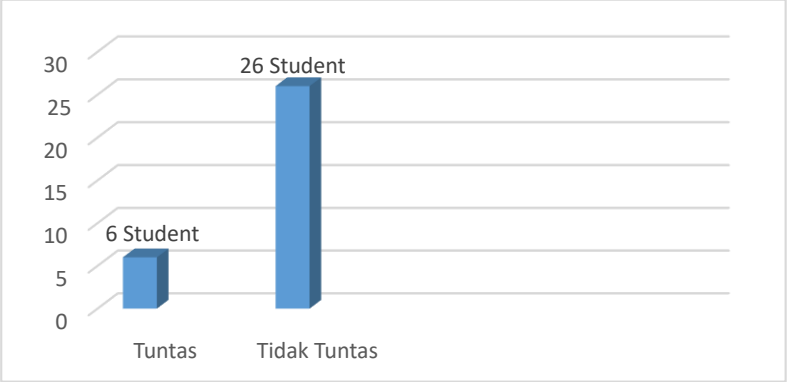
At this stage the researcher aims to measure student learning outcomes after pre-cycle activities.
The following are student learning outcomes after pre-cycle activities:

Table 3. Student Learning Outcomes in Pre-Cycle Activities

No	Achievements	Pre-Cycle
1	Highest Score	80,00
2	Lowest Score	57,00
3	Average Score	66,51
4	Number of Students Completed	6 Student
5	Percentage of Classical Learning Completeness	18,75%

From the table above, it can be explained that student learning outcomes in pre-cycle activities with an average score of 66.51 are categorized as “Fair”. While the completeness of learning outcomes from 32 students who completed only 6 students and 26 students were categorized as incomplete. The increase in student learning outcomes can be seen in the following diagram;

Table 4. Diagram of Student Learning Outcomes



2. Cycle I

Cycle I activities were carried out on September 3, 2024. The purpose of conducting cycle I activities in this study is to see how optimal learning activities are given the action of Project Based Learning in order to measure the competencies achieved and student learning outcomes. Cycle I began after the pre-cycle stage was declared complete, analyzed, and collected reflection results. The reflection results from the precycle stage will be used as the basis for carrying out activities in cycle I.

a. Observation Stage of Cycle I Activities

This stage was carried out by researchers with the aim of observing the learning process in cycle I activities. The following are the results of observations in cycle I activities:
The score criteria are as follows:

1= Less Good,
2= Fair,
3= Good,
4= Very Good

Table 5. Observation Results on Cycle I Activities

No	Components Observed	Score			
		4	3	2	1
1.	The teacher conveys the learning objectives clearly when starting the learning process		✓		
2.	The teacher explains what is needed in learning well and correctly	✓			
3.	The teacher conveys the material from the teaching module clearly and easily understood.		✓		
4.	The teacher explains the project-based learning procedure (Syntax) clearly.		✓		
5.	Learners are asked to form study groups according to the instructions from the teacher.		✓		
6.	The teacher asks the students to discuss to find ideas about the product to be made with the guidance of the teacher.			✓	
7.	Students are asked to design a project design in groups according to the teacher's instructions.		✓		
8.	Students explain the project design design in groups in front of the class properly and correctly.		✓		
9.	Students are asked to make work steps and project work estimates in groups according to instructions.			✓	
10.	Students work on projects that have been designed in groups accompanied by the teacher		✓		
11.	The teacher monitors the project process so that it can run well.		✓		
12.	Students present the results of projects made in groups properly and correctly.		✓		
13.	The teacher asks the students to share any learning difficulties they have experienced.		✓		
14.	The teacher helps students provide solutions related to difficulties in learning properly and correctly.	✓			
15.	The teacher explains the results of the learning process clearly and easily understood by the students.		✓		
Total Actual Score		**45**			
Total Ideal Score		**60**			
Percentage		**75%**			
Category		**Good**			

Based on the table of observation results above, it can be described that the learning process of cycle I or after being given action gets a percentage of 75% which is in the "Good" category referring to the benchmark percentage category (Jakni, 2017). However, there is still a need for improvement in several components or aspects that have not gone well.

b. Questionnaire of Competencies Achieved by Students in Cycle I Activities

At this stage the researcher wants to see the extent of the competence achieved by students after the first cycle activities related to learning outcomes. The following are the results of the competency questionnaire achieved by students in the cycle I activities:

Table 6. Results of Competency Questionnaires Achieved by Students in Cycle I Activities

No	Category	After Pre Cycle	After Cycle I
1	Very good	0,0%	18,75%
2	Good	46,87%	81,25%
3	Fair	53,13%	0,0%
4	Deficient	0,0%	0,0%
5	Very poor	0,0%	0,0%

Based on the table above, it shows that after cycle I activities, there was an increase in the percentage of students who had competency achievements in the "Good" category, which initially 46.87% to 81.25% of the total students. Meanwhile, the percentage of students having competency achievements classified as "Very Good" which was initially 0.0% to 18.75% of the total students. From the results of student competency achievement in cycle I activities, there are still not many students who are classified as "Very Good". So that the learning process in the next cycle must be further optimized.

c. Student Learning Outcomes in Cycle I Activities

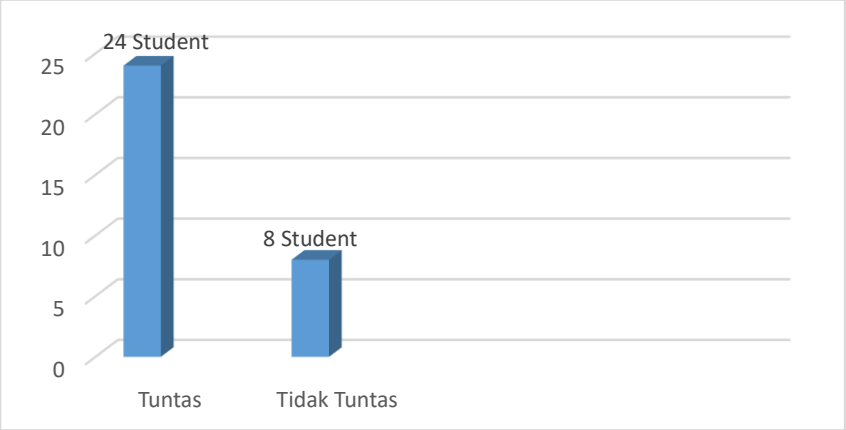
At this stage the researcher aims to measure student learning outcomes after cycle I activities. The following are student learning outcomes after the cycle I learning process:

Table 7. Student Learning Outcomes in Cycle I Activities

No	Achievements	After Pre Cycle	After Cycle I
1	Highest Score	80,00	87,00
2	Lowest Score	57,00	67,00
3	Average Score	66,51	78,86
4	Number of Students Completed	6 Student	24 Student
5	Percentage of Classical Learning Completeness	18,75%	75,00%

From the table above, it can be explained that student learning outcomes in pre-cycle activities with an average score of 78.86 are categorized as "Good". The completeness of learning outcomes in Cycle I of 32 students who completed only 24 Student and 8 students were categorized as incomplete. The complete data can be seen in Appendix 9. The completeness of student learning outcomes can be seen in the following diagram;

Table 8. Diagram of Student Learning Outcomes Completion Cycle I



3. Cycle II

Cycle II activities were carried out on September 10, 2024. The application of the project-based learning model in cycle II was carried out in the hope of changes or improvements according to the results of reflection on the actions when cycle I had taken place. The activities carried out in cycle II are aimed at optimizing the implementation of the project-based learning process that has been implemented previously. The following are the steps of the learning process in Cycle II;

a. Observation Stage of Cycle II Activities

This stage was carried out by researchers with the aim of observing the learning process in cycle II activities. The following are the results of observations in cycle II:

The score criteria are as follows:

1 = Less Good,
2 = Enough,
3 = Good,
4 = Very Good

Table 9.Observation Results on Cycle II Activities

No	Components Observed	Score			
		4	3	2	1
1.	The teacher conveys the learning objectives clearly when starting the learning process	✓			
2.	The teacher explains what is needed in learning well and correctly	✓			
3.	The teacher conveys the material from the teaching module clearly and easily understood.		✓		
4.	The teacher explains the project-based learning procedure (Syntax) clearly.	✓			
5.	Learners are asked to form study groups according to the instructions from the teacher.	✓			
6.	The teacher asks the students to discuss to find ideas about the product to be made with the guidance of the teacher.		✓		
7.	Students are asked to design a project design in groups according to the teacher's instructions.	✓			
8.	Students explain the project design design in groups in front of the class properly and correctly.	✓			
9.	Students are asked to make work steps and project work estimates in groups according to instructions.		✓		
10.	Students work on projects that have been designed in groups accompanied by the teacher	✓			
11.	The teacher monitors the project process so that it can run well.	✓			
12.	Students present the results of projects made in groups properly and correctly.	✓			
13.	The teacher asks the students to share any learning difficulties they have experienced.		✓		
14.	The teacher helps students provide solutions related to difficulties in learning properly and correctly.		✓		
15.	The teacher explains the results of the learning process clearly and easily understood by the students.	✓			
Total Actual Score		**55**			
Total Ideal Score		**60**			
Percentage		**91,66%**			
Category		**Very Good**			

Based on the table above, the learning process of cycle II or after being given optimized action gets a percentage of 91.66% which is included in the "Very Good" category referring to the percentage category benchmark (Jakni, 2017). This can be seen in all components of learning activities that have gone very well.

b. Questionnaire of Competencies Achieved by Students in Cycle II Activities

At this stage the researcher wants to see the extent of the competence achieved by students after cycle II activities related to learning outcomes. The following are the results of the competency questionnaire achieved by students in cycle II activities:

Table 10. Results of Competency Questionnaire Achieved by Students in Cycle II Activities

No	Category	After Cycle I	After Cycle II
1	Very good	18,75%	87,50%
2	Good	81,25%	12,50%
3	Fair	0,0%	0,0%
4	Deficient	0,0%	0,0%
5	Very poor	0,0%	0,0%

Based on the table above, it shows that after cycle II activities, there was an increase in the percentage of students having competency achievements classified as "Very Good" which initially was 18.75% to 87.50% of the total students. Meanwhile, the percentage of students who had competency achievements in the "Good" category, which was initially 81.25%, became 12.50% of the total number of students. From the results of students' competency achievements in cycle II activities, many students were classified in the "Very Good" category. So that the learning process in the next cycle does not need to be continued anymore.

c. Student Learning Outcomes in Cycle II Activities

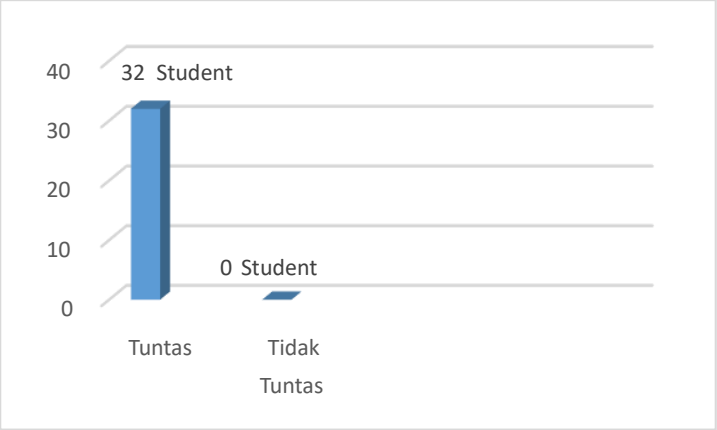
At this stage the researcher aims to measure student learning outcomes after cycle I activities. The following are student learning outcomes from cycle II activities:

Table 11.Student Learning Outcomes in Cycle II Activities

No	Achievements	After Cycle I	After Cycle II
1	Highest Score	87,00	94,00
2	Lowest Score	67,00	79,50
3	Average Score	78,86	86,05
4	Number of Students Completed	24 Student	32 Student
5	Percentage of Classical Learning Completeness	75,00%	10,00%

From the table above, it can be explained that student learning outcomes in cycle I activities with an average score of 86.05 are categorized as "Very Good". The completeness of learning outcomes in Cycle II of 32 students who were complete as many as 32 Student and 0 students were categorized as incomplete. The complete data can be seen in Appendix 9. The completeness of student learning outcomes can be seen in the following diagram;

Table 12. Diagram of Student Learning Outcomes Completeness Cycle II



4. Improved Student Learning Outcomes

After applying the project-based learning model, there was an increase in student learning outcomes. In the pre-cycle activities, the average student score was 66.51 with 18.75% classical completeness. The average student score increased after cycle I activities which amounted to 78.86 with 75% classical completeness, and at the end of cycle II, the average score increased to 86.05 with 100% classical completeness. Thus, students' learning outcomes in cycle II met the indicators set in this study, namely more than 75% of the total number of students in the class obtained scores above the minimum score, which is ≥ 76.00. Based on the data obtained from pre-cycle, cycle I, and cycle II student learning outcomes, there is an increase which can be seen in the table below:

Table 13: Improvement in student learning outcomes

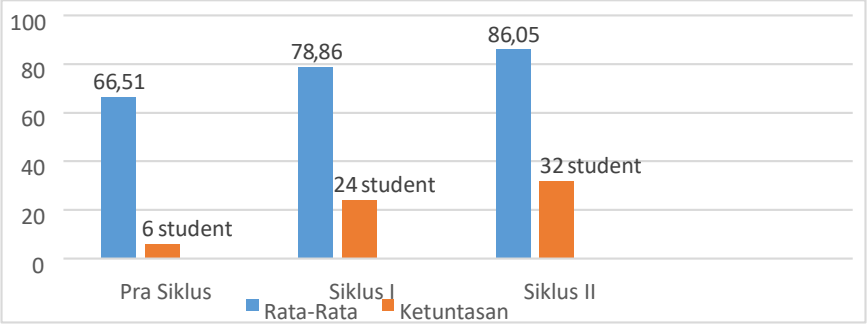
No	Achievements	Pre-Cycle	After Cycle I	After Cycle II
1	Highest Score	80,00	87,00	94,00
2	Lowest Score	57,00	67,00	79,50
3	Average Score	66,51	78,86	86,05
4	Number of Students Completed	6 Student	24 Student	32 Student
5	Percentage of Classical Learning Completeness	18,75%	75,00%	10,00%

From the table above, it can be concluded that there has been an increase in learning outcomes where precycle activities with an average value of 66.51 completed students were 6 Student, while in cycle I with an average value of 78.86 completed students were 24 Student, and in cycle II with an average value of 86.05 completed students were 32 Student. A recapitulation of student learning outcomes can be seen in the following table:

Table 14. Recapitulation of Student Learning Outcomes

Student Number	Pre-Cycle	After Cycle I	After Cycle II
1	72,00	83,00	88,00
2	61,50	81,00	84,00
3	65,50	82,00	86,00
4	62,50	81,50	85,00
5	57,00	68,00	82,00
6	61,50	80,00	82,00
7	62,00	70,00	83,00
8	79,00	85,00	92,00
9	63,50	82,00	87,00
10	64,00	81,50	86,00
11	78,00	82,00	88,00
12	73,50	81,00	86,00
13	61,00	69,00	83,00
14	80,00	87,00	94,00
15	68,00	82,00	88,00
16	62,5	80,50	85,00
17	70,00	83,00	89,00
18	64,00	81,50	84,00
19	62,50	83,50	87,00
20	61,50	82,50	87,00
21	79,00	84,00	92,00
22	66,00	67,00	84,00
23	65,50	83,00	88,50
24	58,00	67,50	79,50
25	66,50	81,50	85,00
26	57,00	68,50	81,50
27	65,00	71,00	83,00
28	58,00	67,50	80,00
29	67,50	82,00	87,00
30	59,50	77,00	86,00
31	79,00	84,00	92,00
32	78,00	84,50	89,00
Highest Score	**80,00**	**87,00**	**94,00**
Lowest Score	**57,00**	**67,00**	**79,50**
Average Score	**66,51**	**78,86**	**86,05**
Total Completion	**6 Student**	**24 Student**	**32 Student**

Table 15: Diagram of Recapitulation of Student Learning Outcomes



Based on the table and diagram above, it can be concluded that there is an increase in student learning outcomes when viewed from the average score obtained between pre-cycle activities and cycle I by 12.35 points with a percentage of 12.35%. Meanwhile, between cycle I and cycle II, the increase in learning outcomes was 7.19 points with a percentage of 7.19%. This states that there is an increase in student learning outcomes through the implementation of the Project Based Learning learning model in the subject of Conventional Lathe Machining Techniques in class XI TM 4 at Yogyakarta State Vocational High School 3 in the 2024/2025 school year.

5. Hypothesis Testing

The requirement in this test is if the significance value (sig) <0.05 and the t-count> t-table value, then the hypothesis is accepted, which means there is a difference in learning outcomes between the control class and the experimental class.

Table 16. Paired Sample t-Test Paired Samples Test

		Mean	Std. Deviation	Paired Differences Std. Error Mean	95% Confidence Interval of the Difference		t	df	One-Sided p	Significance Two-Sided p
					Lower	Upper				
Pair 1	Pre-Cycle Score (Before given action) - Cycle1 Score (After given PjBL action)	12.3437	5.74377	1.01537	14.41460	10.27290	12.157	31	,001	,001
Pair 2	Cycle1 score (after given PjBL action) - Cycle2 score (after given optimized PjBL action)	7.1875	4.04959	.71587	8.64753	5.72747	10.040	31	,001	,001

Based on the table above, it can be seen that the sig value in this study is 0.001 <0.05, and in pair 1 testing between pre-cycle values and cycle 1 values the t-count value is 12,157> 1.689 t-table.

in pair 2 testing between cycle 1 values and cycle 2 values the t-count value is 10,040> 1.689 t-table. Then H0 is rejected and Ha is accepted, this shows that there is an impact on learning outcomes between pre-cycle activities with cycle 1 and cycle 2 activities after being treated with the implementation of the Project Based Learning learning model.

B. DISCUSSION

In the teaching and learning process, it is expected to create conditions that encourage students to be active in learning. The interaction between teachers and students not only takes place continuously, but also aims to achieve certain results. Therefore, teachers need to design learning models that are effective and appropriate to the context at hand, so that learning objectives can be achieved optimally. One indicator of learning quality can be seen from student learning outcomes.The current curriculum management system requires teaching and learning activities that empower the potential of students to achieve the expected competencies. Therefore, researchers applied a project-based learning model to improve learning outcomes and student activeness in learning Conventional Lathe Machining Techniques, especially for class XI TM 4 students of SMK Negeri 3 Yogyakarta in the 2024/2025 academic year. This research is designed with a class action research model, which aims to improve the learning process.

Project-based learning model is one of the simple approaches. This method utilizes projects or activities as learning media. In this process, students conduct exploration, assessment, interpretation, synthesis, and processing of information to produce various forms of learning outcomes. Project-based learning uses problems as the first step to integrate new knowledge based on real experiences. In implementing the project-based learning model, students are divided into groups of 5-6 Student. These groups are not formed based on grades, so there are students with diverse abilities - good, medium and weak. This allows each student to feel comfortable with each other, as well as communicate and work together. Through this approach, students are expected to improve their ability to think critically, creatively, and develop a high social sense.

From the data on the results of observations of the learning process, it can be seen that in the pre-cycle activities, the percentage of observations of the learning process before being given action is only 48.33%, still in the “Fair” category so it needs to be improved. Whereas in cycle I there was an increase in the observation of the learning process with a percentage of 75% which was in the “Good” category but still had to be optimized. Furthermore, in the learning process of cycle II there was an increase with

a percentage of 91.66% which was in the "Very Good" category. In pre-cycle activities, student learning outcomes before the application of projectbased learning, the average value obtained by students was 66.51 with a classical completeness of only 18.75% (6 students). After applying the project-based learning model, there was an increase in student learning outcomes. The average student score at the end of the cycle I test was 78.86 with 75% classical completeness, while at the end of cycle II, the average score increased to 86.05 with classical completeness reaching 100%. Based on the results of the data, it can be concluded that project-based learning method can improve student learning outcomes.

Students' learning behavior and response to learning also showed significant improvement. Students who were initially less enthusiastic did not actively communicate, felt afraid to ask or answer questions, and were passive in finding learning resources are now more enthusiastic and actively involved in the learning process. This shows that in addition to improving learning outcomes, the implemented learning also succeeded in improving the quality of the learning process. The results of this study prove that the proposed hypothesis can be accepted, namely "the application of project-based learning methods can improve student learning outcomes in learning Conventional Lathe Machining Techniques in class XI TM 4 SMK Negeri 3 Yogyakarta".

In cycle I, student learning outcomes did not meet the predetermined indicators, so it was necessary to continue to cycle II to achieve these targets. In cycle II, no significant obstacles were encountered. The increase in learning outcomes in cycle II was due to students' adaptation to the learning model applied by the teacher. Students' courage is increasing, which has an impact on increasing their activeness. This can be seen from the number of students who took advantage of the opportunity to answer questions and express opinions about the material provided by the teacher in cycle II. In cycle II, the teacher had fully conveyed the learning objectives, which motivated students to learn. The teacher's explanation of the steps and the motivation given were very interesting, so students were more enthusiastic in following the learning process. In project-based learning, the teacher's role is more as a facilitator, who provides the necessary direction to students. Student involvement is highly emphasized in this approach. With this increased involvement, it is expected to foster high learning motivation, and ultimately have a positive impact on learning outcomes.

The application of project-based learning methods in learning Conventional Lathe Machining Techniques in class XI TM 4 SMK Negeri 3 Yogyakarta has great potential to improve student learning outcomes. With practical experience gained through projects, students not only master technical skills, but also develop cooperation and problem-solving skills that are needed in the industrial world. Hopefully, this learning model can continue to be applied and refined so that the learning process in SMK can be more effective and relevant to industry needs. From the explanation and data above, it can be concluded that the application of project-based learning trains students to work independently and appreciate the work of others, as well as increase their activeness in the learning process. This explanation shows that the use of a project-based learning model in learning Lathe Machining Engineering in class XI TM 4 SMK Negeri 3 Yogyakarta in the 2024/2025 academic year has succeeded improving learning outcomes with an increase at least 75% students obtaining a score ≥ 76.00.

CONCLUSION

Based on the results of the research and discussion above, the following conclusions can be drawn:

1. In pre-cycle activities (Before being given action), the percentage of observations of the quality of the learning process pre-cycle or before being given action is only 48.33% still in the "Enough" category so it needs to be improved. Student learning outcomes before the application of project-based learning the average value obtained by students is 66.51. Meanwhile, the number of students who reached the minimum score was only 18.75% (6 students).
2. In cycle I (after being given action), there was an increase in the observation of the quality of the learning process with a percentage of 75% which was in the "Good" category but still had to be optimized. Student learning outcomes after project-based learning have increased from the previous average of 66.51 to 78.86. The number of students who reached the minimum score also increased from 18.75% (6 students) to 75% (24 students).
3. In cycle II (after being given optimized action), there was an increase in the quality of the learning process in cycle II getting a percentage of 91.66% which was in the "Very Good" category. Student learning outcomes in cycle II also increased from the average in the previous learning 78.86 to 86.05. The number of students who reached the minimum score also increased from 75% (24 students) to 100% (32 students).

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REFRENCES

1) Abdurahman, A., Sri Afira Ruhyadi, S. G., & Binasdevi, M. (2022). Implementasi Model Project Based Learning (PJBL) Dalam Penerapan Kurikulum Merdeka Belajar Di Kelas Tinggi MI/SD. Al-Ibanah, 7(2), 1–9. https://doi.org/10.54801/ibanah.v7i2.107

2) Ansyori, A. (2015). Pengaruh Kecepatan Potong dan Makan terhadap Umur Pahat pada Pemesinan Frais Paduan Magnesium. Jurnal Mechanical, 06.(01), 28–35.
3) Arends, R, L., Wenitsky, N, E & Tannembaun, D. (2004). Emploring teaching An introduction To education. Routledge Falmer.
4) Arief, S., & Mukhayyaroh, I. A. (2018). Penerapan project based learning untuk meningkatkan kreativitas, motivasi belajar dan hasil belajar. Economic Education Analysis Journal, 7(1), 1–14.
5) AusAID. (2001). Competency based training from master trainer. West java institutional development project. Indonesia Australia Partnership for Skill Development Program.
6) Daryanto. (2009). Demonstasi sebagai Metode Belajar. Depdikbud.
7) Defianty, M., & Wilson, K. (2024). Using collaborative action research to promote critical thinking pedagogies in ELT in Indonesia. Asia-Pacific Journal of Teacher Education, 52(5), 607–621. https://doi.org/10.1080/1359866X.2024.2410837
8) Peraturan Pemerintah RI No.19 tentang Standar Nasional Pendidikan, (2005).
9) Djohar, A. (2017). Pendidikan Teknologi dan Kejuruan. Dalam Ilmu dan Aplikasi Pendidikan. Pedagogiana Press.
10) Hanafiah & Suhana. (2009). Konsep Strategi Pembelajaran. PT Refika Aditama.
11) Haryati, M. (2007). Model dan Teknik Penilaian Pada Tingkat Satuan Pendidikan. Gaung Persada Press. 12) Jakni. (2017). Penelitian Tindakan Kelas (PTK). Alfabeta.
12) Johannesson, P. (2022). Development of professional learning communities through action research :
13) understanding professional learning in practice. Educational Action Research, 30(3), 411–426. https://doi.org/10.1080/09650792.2020.1854100
14) Joyce dan Weil. (2004). Models of Teaching. A Paper Prepared for the National Council Forthe Social Studies, Boston.
15) Juliyansyah Noor. (2011). Metodologi Penelitian Skripsi, Tesis, Disertasi, dan Karya Ilmiah. Prenada Media Group.
16) Kencana, P. C., & Rifa'i, R. (2021). Perbedaan Hasil Belajar Kognitif Siswa Dengan Menggunakan Model Pembelajaran Project Based Learning (PjBL) dan Inkuiri di SMAN 5 Bengkulu Selatan. PENDIPA Journal of Science Education, 6(1), 233–241. https://doi.org/10.33369/pendipa.6.1.233-241
17) Kunandar. (2012). Langkah Mudah Penelitian Tindakan Kelas sebagai Pengembangan Profesi Guru. Rajawali Press.
18) Li, D., Bliss, L., Henderson, L., Clark, P., Li, D., Bliss, L., Henderson, L., Mar, P. C., Bliss, L., Henderson, L., & Clark, P. (2024). Professional development through collaborative action research for early career academics - a collaborative auto-ethnography during the COVID-19 pandemic. Educational Action Research, 00(00), 1–17. https://doi.org/10.1080/09650792.2024.2333911
19) Mulyasa. (2014). Pengembangan Implementasi Kurikulum 2013. PT Remaja Rusdakarya Offset.
20) Prayogo, D., Hermanto, A. W., Widiatmaka, F. P., Prasetyo, D., & Sugiyarto, S. (2022). The Effect of
21) Practical Experience, Knowledge of Job Opportunities, Teacher Professionalism and Work Motivation on
22) Work Readiness. Jurnal Iqra' : Kajian Ilmu Pendidikan, 7(1), 204–218. https://doi.org/10.25217/ji.v7i1.2062
23) Putra, E., & Indrawan, E. (2023). Pengaruh Pembelajaran Project Based Learning Siswa SMK Negeri 1 Sumatera Barat pada Hasil Belajar Pemesinan Bubut. 5(1), 38–43.
24) Rahmat, M. H., Syaad, P., & Soenar, S. (2016). Pengaruh Model Pembelajaran dan Kemampuan Awal
25) Terhadap Hasil Belajar Teknik Permesinan Frais Siswa SMK. Jurnal Pendidikan: Teori , Penelitian Dan Pengembangan, 1(5), 785–795. https://journal.um.ac.id/index.php/jptpp/article/view/6257
26) Ritonga, A. K. (2022). Pengembangan dan Pembinaan Karir Guru di bidang Pendidikan Kejuruan. 6(2), 3973–3982.
27) Rizkiana, I., Nugraha, R., Supriadi, U., & Iman, M. (2023). Efektivitas Strategi Pembelajaran Project Based Learning dalam Meningkatkan Kreativitas Siswa. 17(1), 39–47.
28) Romiyadi dan Azriadi, E. (2014). Pengaruh Kemiringan Spindel dan Kecepatan Pemakanan terhadap Getaran Mesin Frais Universal Knuth UFM 2. Jurnal Teknobiologi, 1., 31–36.
29) Roseno & Wibowo. (2019). Efisiensi Eksternal Pendidikan Kejuruan di Kota Yogyakarta. 7(1), 15–24.
30) Sudjimat, D. A. (2014). Perencanaan Pembelajaran Kejuruan. Universitas Negeri Malang.
31) Sugiri, et al. (2011). Melakukan Pekerjaan dengan Mesin Frais (Dasar). PT. Pustaka Insan Madani.
32) Sumbodo, W. et al. (2008). Teknik Produksi Mesin Industri Jilid 2. Direktorat pembinaan sekolah menegah kejuruan.
33) Suprijono. (2009). Cooperative Learning. Pustaka Pelajar.