ATLANTIS PRESS

Advances in Social Science, Education and Humanities Research (ASSEHR), volume 201

International Conference on Indonesian Technical Vocational Education and Association (APTEKINDO 2018)

The Application of Problem-Based Learning Model to Increase Students' Activity and Learning Outcomes in Basic Process of Metal Treatment

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***Abstract*— Based on the researcher survey, it appears that many students were passive, daydreaming, and busy with cellphone and non-related activities during the learning process. The purpose of this research is to improve learning activities and learning outcomes through the implementation of Problem-Based Learning model. This study is a classroom action research consists of two cycles. Each cycle consists of two meetings. The data were collected using observation to see the changes in learning activities and test was utilized for measuring students' learning outcome. Based on the observations, the average learning activities of the first and second cycles were 61.93% and 80.0%. Students' learning outcomes were also increased classically. In the first cycle, 59.25% or 16 students have achieved the minimum criteria of mastery, and in the second cycle, 81.84% or 22 students have achieved the minimum criteria of mastery. This means, the implementation of Problem-Based Learning method can increase student activities and learning outcomes in the basic process of metal treatment subject.**

Keywords—classroom action research, learning activity, learning outcome, problem based learning, basic process of metal treatment subject.

I. INTRODUCTION

Students educated for the world of the 21st century must develop habits of thinking, researching, and problem solving to succeed in a rapidly changing world. In the era of globalization, traditional education system is losing its relevance. [1]. Education plays a role in preparing quality human resources. In the education process, there are three elements that determine the teaching process that are teachers, students and the curriculum used. Vocational High School is an educational institution that prints beginner level work institute, towards skilled level labor in certain field. The main purpose of the learning process at Vocational High School is to demand the students succeed in applying the theoretical and practical abilities. This is in line with the objectives of the Vocational High School which is to produce middle-skilled workers in their fields supported by satisfactory learning outcomes. Learning outcomes can be viewed as one measurement of students' success in schooling and are taken into consideration in determining students' abilities.

The Basic Process of Metal Treatment is one of the eyes of productive training with theory learning. This course aims to provide knowledge to students about the science of metal starting from elements, properties, to the manufacture and metal processing. Based on a survey conducted at Vocational High School Muhammadiyah 1 Padang, it appears that in the learning process students were less active and less attentive to teaching materials presented by teachers, many students were passive, daydreaming, playing cellphone, noisy, and busy themselves with the activities. The result of this student activity was reflected in the learning result obtained at the Basic Metal Treatment Process Training, the Minimum Criteria score specified in Vocational High School Muhammadiyah 1 Padang is 80. Students' learning outcomes in the eye of the process The Basic Process of Metal Treatment has not met the Criteria of Minimum Completeness, as shown in the following table.

TABLE I. MID SEMESTER II GRADE OF CLASS X STUDENTS AT BASIC PROCESS OF METAL TREATMENT AT VOCATIONAL HIGH SCHOOL MUHAMMADIYAH 1 PADANG 2016/2017

Students of class X	**Mid Semester II Grade of Class X**		
	Students with value average ***≥ 80***	*Students with* **value average** ***< 80***	***Students do not follow exam***
27	10 (37.04%)	13 (48.15%)	4 (14.81%)

Table I shows the total of 27 students of class X of Engineering Department of Engineering in the Basic Process of Metal Student Process in Vocational High School Muhammadiyah 1 Padang academic year 2016/2017, as many as 10 students (37.04%) achieved the basic learning process of metal treatment sufficient to graduation requirements. Meanwhile, 13 students (48.15%) did not meet the standard of graduation and 4 other students (14.81%) did not take the test.

The low learning outcomes obtained by students is thought to be the result of the teaching method used by the teacher. The teaching method used by the teacher, in this case, is only centered on the teacher (teacher-centered). According to [2], this learning strategy quickly spurred the students' boredom to learn, making it difficult for teachers to see changes in students' activity in learning and can lead to low learning outcomes due to the use of more focused learning time to complete learning materials.

In response to the above conditions, it is necessary to improve the quality of learning in terms of the basic process of metal treatment through the application of a model of

learning that can stimulate the level of students' activeness and focus attention on training. One of the learning models used in improving the quality of learning on the subject of basic metal treatment process is the Problem Based Learning (PBL) model.

Problem-based learning is an ideal learning approach that can be used to help students determine solutions to non-routine problems [3]. PBL encompasses "active learning with particular relevance to the learning objectives (as opposed to the traditional passive spoon-feeding rote learning based on teacher-designed didactic lectures and instruc¬tions) [4]. During the PBL process, students can work together to find solutions to complex problems [5]. Therefore, constructivist theories refer to student-centered learning. PBL includes student-centered learning for problem solving [6] and students are exposed to complex problems [7]. Thus, the PBL model is a learning approach that teachers can use to help students solve problems they face either individually or in groups.

PBL Model is "a method of instruction that develops learners' knowledge and problem-solving skills through real-world problems" [8]. Problem-based learning is both problem-centered and learner-centered in a dynamic process whereby students are actively involved in posing and solving problems related to the content and context under investigation. Students are no longer passive learners, but active participants in their learning. The PBL model is also a student-centered approach, thus actively develop knowledge and skills in solving problems. This has been supported by [9] who stated that "educational research demonstrates that active learning is the most effective technique for students to learn, apply, integrate, and retain information".

The results of research conducted by [10]-[11] noted that Problem Based Learning can improve the students' learning independence, interests and achievement. Sari and Mukhadis obtained the results of the research achievement of the PBL model was better than the one after the use of Expository learning. This means the PBL model is an effective technique for enabling students in learning and simultaneously influencing their learning outcomes. In the learning process, students need to understand the nature of learning. Davis (2000) stated that the essence of learning is the willingness of students to learn not only based on what is given by the teacher alone [12].

II. METHOD

The type of research the authors do is classroom action research [13-15]. This study consists of two cycles. In each cycle, there are four stages in the implementation, namely planning, action, observation and reflection. This study was conducted in two cycles for 4 weeks, which in 1 cycle consists of 2 meetings and in 2 weeks, 2 times face-to-face meeting.

This research was conducted to increase the activity and learning outcomes of X Class students of Mechanical Engineering of metal treatment basic process through applying Problem-Based Learning model. The study was conducted by observation and collective assessment of the students' activities in the learning stages to see the increase of activity and the students' learning outcomes after the implementation of this problem-based learning model. Test results of learning at each end of the cycle in the form of objective tests were conducted first analysis of items to determine the level of difficulty and distinguishing power problem as well as looking for grain validity and reliability value. Observation aspects of students' activities used in the observation sheet are as follows.

TABLE II. ASPECT OF STUDENTS ACTIVITY OBSERVATION SHEET

Students' Activity Observation Sheet			
No	***Indicator***	***Sub Indicator***	***Item***
1	Students follow the lesson well	Students sit in groups immediately after the group is divided	1
		Students pay attention when the teacher explains learning / giving direction	2
2	Students identify problems given by the teacher	Students read the Student Worksheet provided by the teacher	3
		Students can work with their group's friends to find answers to the given Student Worksheet	4
3	Students record the concepts used in problem solving	Students create problem-solving reports of their discussion results	5
4	Students look for various information needed in problem solving	Students read the handouts given by the teacher	6
		Students ask if there is anything that is not understood in working the Student Worksheet	7
5	Students deliver problem solving results	Students dare to present the results of their discussion to be presented and other students listen to the presenter's students during the presentation	8
6	Students actively respond to problem-solving results by respecting and accepting other people's opinions	Students dare to raise their hands and responding to the results of the discussion of the presenter or presenter group trying to answer other group questions	9
		Students speak politely when expressing their opinions or questions	10
		Students can defend their opinions for logical reasons or can accept the presenter's answer	11
7	Students record the result of problem solving that has been concluded together	Students record the conclusions of problem-solving results in the notebook	12

The data on the observation sheet of students' learning activity were analyzed by quantitative means resulting in percentage form. To see the percentage of student activity each cycle used the following formula:

$$P=\frac{\Sigma X}{\Sigma Y} \; x \; 100\,\% \qquad (1)$$

Description:
P: Percentage of activity observed at each meeting
ΣX: Total student activity score
ΣY: Maximum number of activity scores

Furthermore, the percentage information obtained was used as an interpretation of assessment students activity that was guided by the following categories [16].

TABLE III. ASPECT OF STUDENTS ACTIVITY OBSERVATION SHEET

No	Interval	Category
1	≥ 75,6 %	Active
2	59,6 % - 75,5 %	Quite active
3	≤ 59,5 %	Less active

Meanwhile, to obtain the percentage of assessment of learning outcomes, the formula below was used:

1) Individual mastery

$$NI = \frac{T}{SM} \; x \; 100\% \quad (2)$$

Description:
NI = complete learning individually
Q = Scores obtained by students
SM = The maximum score of the test

This individual learning mastery refers to the provisions set in the Muhammadiyah 1 Padang Vocational High School curriculum that is equal to 80.

2) Classical Mastery

$$NI = \frac{T}{SM} \; x \; 100\% \quad (3)$$

Description
NT = Mastery learning classically
ST = Number of students who mastery the study
N = Number of all students in one class

The mastery learning classically was achieved when the classical completeness grade value has reached the percentage value of 80%.

This research can be said to be successful and can be stopped if it has reached the desired indicator. The indicator of the successful implementation of the action to improve the quality of learning can be determined by the teacher, in this case is the researcher himself, according to students' ability and the level of improvement to be achieved. The criteria of success in improving the quality of learning in research through the application of problem-based learning are: (1) Learning activities: (a) In the first cycle, students' learning activities reached a percentage of 60%, and (b) In the second cycle, students' learning activity reached a percentage of 80%, (2) Learning outcomes: (a) In the first cycle, students' learning outcomes reached a percentage of 50%, and (b) In cycle II, students' learning outcomes reached a percentage of 80%.

III. RESULT AND DISCUSSION

This study was conducted in 2 cycles consisting of 2 meetings in each cycle. Based on the action that has been done in cycle I it was known that the activity and student learning outcomes have achieved the success indicator of action in cycle I. Where students activeness was taken through activity observation sheet with the percentage value of 61.93% and classical classical completeness value taken based on the test at the end of the first cycle of 59.25%.

The weakness found in cycle I was at meeting 1 where the group division process was rowdy and lasts long enough for 15 minutes. This is because the group divided in the learning meeting was not prepared before by the teacher as a researcher so that time consuming lessons caused the presentation can not be held at meeting 1. Presentation conducted in cycle I provided a short enough time for each group to do question and answer i.e only for 5 minutes for each group with a total of 5 groups. In addition, the presence of 2 new students at the presentation stage led to the unfavorable understanding of the students on teaching materials in cycle I so that the students' activity was classified as less active and the results of the students' learning test have not fulfilled the Minimum Criterion of Mastery which was set at 80.

To improve the learning process in order to increase the students' activity in the next cycle and increase the activity in the observation aspect, especially the aspect belonged to the less active category in order to achieve the success indicator in the next cycle, the result of the student learning test at the end of cycle I was used to divide the students into several groups were heterogeneous in order not to re-take the time of discussion and group presentation. Meanwhile, the actions taken in cycle II have been able to increase learning activities and students' learning outcomes of the basic metal treatment process. This was evidenced by the increase in student activity to 80.03% and students' learning completeness classically increased to 81.48%.

Here is a discussion or analysis of the action learning using problem-based learning model.

A. Increased Students Learning Activity

Learning activities are activities undertaken by students in learning process [17]. Learning activity of the training of metal basic treatment process in this case is the activity done by the students in the learning process in the eye of the basic metal treatment process. In the learning process, activity is a very important principle, because learning will never exist without learning activities. As a rationality it also received recognition from various educational experts.

Rosseau explained that in the learning process, all that knowledge must be obtained by self-observation, self-experience, self-inquiry, by self-employment, with self-created facilities, both spiritually and technically. Learning activities are efforts or ways to enhance and optimize the learning activities of students in the learning process. Learning activities are basically an effort to develop all the potential that exists in students, both spiritually potential and physically potential. Without any activity, learning process is impossible. Thus, students' activity is very necessary in the learning process.

The implementation of learning cycle I obtained the average activity of students in quite active category which then increased in cycle II into active category. From cycle I to cycle II, students seemed more active in the discussion process and sought answers from the given Student Worksheet. When students did not understand the material, students started to ask the teacher and responded to the existing questions in a better way and read the handouts well to find the results of problem solving on the Student Worksheet. Visible students began to work together in the process of discussion and dared to present the results of discussion.

In the Problem-Based Learning model, students communicate and cooperate in solving a problem. In

addition, group learning provides an opportunity for students to define joint problem-solving strategies. Each student is expected to be active during the learning process. Based on the research that has been done, it can be concluded that the use of Problem-Based Learning model can increase students' activity. Increased students' activity in this study was evidenced by the increase of students' activity from cycle I to cycle II which has reached the success indicator of action like presented in the table 4 below:

TABLE IV. THE PERCENTAGE OF INCREASING STUDENTS ACTIVITY IN EACH OBSERVATION ASPECT FROM CYCLE I TO CYCLE II

Aspects of Observation	Percentage (%)		
	Cycle I	***Cycle II***	***Enhancement %***
Students sit in groups immediately after the group is divided	54,55	65,25	10,7
Students pay attention when the teacher explains learning / giving direction	54,55	65,25	10,7
Students read the Student Worksheet provided by the teacher	54,55	65,25	10,7
Students can work with their group's friends to find answers to the given Student Worksheet	54,55	65,25	10,7
Students read the handouts given by the teacher	54,55	65,25	10,7
Students ask if there is anything that is not understood in working the Student Worksheet	54,55	65,25	10,7
Students dare to present the results of their discussion to be presented and other students listen to the presenter's students during the presentation	54,55	65,25	10,7
Students dare to raise their hands	54,55	65,25	10,7
and responding to the results of the discussion of the presenter or presenter group trying to answer other group questions	54,55	65,25	10,7
Students can defend their opinions for logical reasons or can accept the presenter's answer	54,55	65,25	10,7
Students record the conclusions of problem-solving results in the notebook	54,55	65,25	10,7
Average Student learning activity	61,93	80,03	18,1

Table IV shows the percentage of each aspect of observation as expected. The results of calculation in cycle II also showed the average activity has met the 80% success indicator.

Based on the research that has been done, it can be concluded that the use of problem-based learning model can increase students' activity. In the table 5 below, the increased students' activity in this study is evidenced by the increased activity of students' activity from cycle I to cycle II which has reached the indicator of the success of the action specified as listed.

TABLE V. ACHIEVING THE SUCCESS OF ACTION RESEARCH FOR STUDENTS' LEARNING ACTIVITIES

No	Cycle	Action Success Indicator (%)	Research Results (%)	Description of Action Success
1	I	60	61,93	success
2	II	80	80,03	success

The findings of this study support the findings of other studies [18] student-centered PBL-it fosters active learning, improved understanding, and retention and development of lifelong learning skills. In addition, PBL is well-suited to help students become active learners since it situates learning in real-world problems and makes them responsible for their learning [19]. Applying problem-based learning increase students' participation in class activities and enhance critical thinking skills [20] . Some researchers found a significant correlation between problem-based learning activities and the critical thinking skills that students will need in the 21st century [21].

B. Improvemenr of Students Learning Outcomes in Basic Process of Metal Treatment

The data has been obtained based on the results of research, it is known that there was an increase in the number of students who achieved the Minimum Criterion of Mastery score of 80. Of the total of 27 students, in cycle I as many as 16 students expressed in learning with the value reached the Minimum Criterion of Mastery and in cycle II, the number of students increased to 22 students, while 3 students who scored 0 were those who never attended from the beginning of the meeting in this study considered as incomplete. Based on the research that has been done, it can be concluded that the use of problem-based learning model can improve students' learning outcomes. The table 6 below shows the improvement of this learning result evidenced by the increase of classical completeness from cycle I to cycle II which has reached the indicator of the success of the action specified.

TABLE VI. ACHIEVING THE SUCCESS OF ACTION RESEARCH FOR STUDENTS' LEARNING ACTIVITIES

No	Cycle	Action Success Indicator (%)	Research Results (%)	Description of Action Success
1	I	50	59,25	success
2	II	80	81,48	success

Based on table 6 it is known that the success indicator for each cycle has been achieved indicating that the action of applying problem-based learning in this research can improve students' learning result of X class of Mechanical Engineering at Vocational High School Muhammadiyah 1 Padang on the basic metal treatment process. The findings of this study support the findings of other studies [20] that by applying the PBL model can improve learning outcomes.

IV. CONCLUSION

Based on the results of data analysis obtained in this study, it can be drawn conclusion as follows: (1) application of problem-based learning model can increase students'

activity. The increase of this activity was evidenced by the increase of students' activity from cycle I of 61.93% with the active enough category to 80.03% in cycle II with active category, and (2) Application of problem-based learning model can improve students' learning outcomes. The improvement of this learning result was evidenced from the increase of classical completeness that was previously in the first cycle of 59.25% with 16 well-completed students in cycle II to 81.48% with 22 students completed from a total of 27 students.

Based on the results of the research, suggestions for teachers in applying the PBL model to be integrated effectively in learning include: clearly define the purpose of doing PBL, hold brainstorming sessions, develop ill-structured problems, refrain from providing information, allow time for collaboration, emphasize depth over breadth, conduct regular assessment, hold class discussions, facilitate peer feedback, and assess authentically.

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