USING PROJECT-BASED LEARNING WORKSHEET WITH WASTE WATER TREATMENT THEME TO PRACTICE STUDENT' PROBLEM-SOLVING SKILLS

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Abstract

This study aimed to describe the use of a Project-Based Learning worksheet for grade VII students in order to facilitate practicing problem-solving skills. The research design of this study was one group pretest-posttest design. The worksheet was distributed to 30 students at Junior High School 18 Surabaya. The research method used the test method that is a pretest-posttest, in the form of essays that include indicators of problem-solving skills. Based on the results of research from the students' pretest and posttest scores, the average value of the increase in N-gain of all students was 0.67 with the medium category. Meanwhile, based on the results of the average value of the increase in N-gain of all indicators of students' problem-solving skills obtained results of 0.67 with a high category. Based on the results of the study, it can be concluded that develop worksheet Project-Based Learning for students to practice problem-solving skills was effective.

Keyword : *Worksheet, Project-Based Learning, Problem-Solving Skills*

INTRODUCTION

The nature of Natural Science is a science that consists of four main elements covering attitudes, processes, products, and applications (Widodo, Rachmardiati, and Hidayati 2016). Science as a process is a procedure for training aspects of student skills in solving a problem through scientific methods (Umroh, 2018). Problem-solving skills (Holyoak, 1995) are the most important manifestations of human thought. The goal of solving the problem itself is finding a solution. The solution in question is a series of things that become the final destination as expected. Problem-solving (Temel & Morgil, 2012: 59) is seen as a process where someone can overcome a challenge and then find what the target of achievement is. In the process, there are systematic stages in the series of problem-solving.Thus the concept of science can be obtained through the process of skills in solving a problem.

The importance of practicing problem-solving skills for these students is also a requirement of the 2013 curriculum for junior high school students, namely in KD 4 aspects of skills. For example, basic competencies 4.8 class VII, "Making writing ideas about solving environmental pollution problems based on observations." Therefore, in science, learning strongly emphasizes aspects of student skills, especially aspects of problem-solving skills, according to the demands of the 2013 curriculum.

However, in the field, it is proven that the problem solving of students is still low. TIMSS (Trends in International Mathematics and Science) is still low. According to Martin (2015), three aspects consider TIMSS, namely knowing which includes aspects of knowledge, facts, concepts, and procedures that students must know. Apply approved applications to students who use the knowledge and understand concepts to solve problems or questions. Reasoning skills are resolved in non-routine problem solving, complex contexts, and performing many problems solving steps.

In this TIMSS study, Indonesia ranked 35 out of 49 countries in 2007, with a score of 427 in the field of science. However, the results of the 2011 TIMSS study have decreased scores in the field of science by 21, and Indonesia is ranked 40 out of 42 countries (Tjalla, 2010). In 2015 Indonesia also included the students in TIMSS, the average score obtained by Indonesia was 397 and Indonesia was still ranked low, which is 44 out of 49 countries (Hadi, 2019). The low ranking of Indonesia in the TIMSS study has made the government update the curriculum to 2013 Curriculum which was adapted through KTSP with a background to improve students' ability to observe, ask, reason and communicate after learning (Anwar, 2014).

In addition, the problem-solving skills of students in-state junior high school 18 Surabaya are also still low. Based on the test results of students' problem-solving

abilities, the indicator formulates the problem by 10%; the second indicator is making a hypothesis of 1.1%; the third indicator is analyzing data by 58%; the fourth indicator provides a solution of 57%; and concludes the observation table of 17 %. The results of the pre-research facts concluded that students' problem-solving skills are still low. That is because the teacher has not trained students' problem-solving skills in learning, as expressed in the results of interviews with science teachers.

The results of interviews with science teachers at Junior High School 18 Surabaya showed that teachers had never practiced problem-solving skills in students. Worksheets provided by teachers also refer to books from the government and have never used worksheets that refer to making projects, especially wastewater management projects.

Other facts can also be seen from the results of student response questionnaires about the science learning process at Junior High School 18 Surabaya. The survey was for learning information about learning science in the classroom. The results of the survey showed 74% of students did not experiment in a laboratory, 62% of students stated that teachers only use blackboard and power points in learning, 74% of students indicated that they had never made an experiment report, media or natural products such as a liquid waste management tool.

According to Faridah & Ramlah et al. (2016), learning that takes place in class is one of the factors that can affect student activity and skills. The learning model that can support the training of students' problem-solving skills and the involvement of students to be active, creative, and productive as expected by K13 is the Project Based Learning (PjBL). The aim of this PjBL is to orient learning to overcome problems raised through the project. This was also supported by Fajarwati, Susilo, and Indriwati (2017), who stated that project-based learning could increase motivation, problem-solving skills, and increase the achievement of learning objectives effectively.

One of the teaching materials that can be used in helping project-based learning is the Student Worksheet (Novita, Darmawijoyo & Aisyah, 2011). Student worksheets are sheets that contain instructions and steps that students must work on during learning (MONE, 2008). With the students' worksheet based on PjBL, students can be guided to practice skills according to the directions in this students' worksheet project-based learning. Creative, innovative, and productive learning models such as PjBL are learning models based on constructivism theory (Realia, 2016). Constructivist learning is the development of new knowledge undertaken by students themselves through stimuli from the real world that are relevant to the problems students must solve (Mudjiman, 2008). Constructivism learning teaches students to build their knowledge, and this is following the characteristics of PjBL. Therefore, the students' worksheet as a student guide in carrying out project assignments to solve this problem is based on the theory of constructivism.

Relevant research that has been carried out regarding the relationship of the PjBL model and this problem-solving skill has good results. Research by Fajarwati, Susilo and Indirwati (2017) which shows that the level of problem-solving skills of experimental class students using PjBL is higher than the control class, the experimental class of problem-solving skills of students is 31.27% while the control class is only 15.17%.Research by Astuti (2015) states that project-based worksheets can increase student activity and concern for the environment, enhance student creativity and enhance student skills in managing waste.

However, from a relevant research related to this project-based learning, there are no studies that practice problem-solving skills, used the PjBL model with the theme of waste water treatment for grade VII students, especially in the water pollution sub-material with student worksheet aided. From the information above, the researcher wants to know the effectiveness of the PjBL-based student worksheet to practice problem-solving skills in the water pollution sub material for grade VII junior high school students.

METHOD

This study used one group pretest-posttest which was conducted on 30 students at Junior High School 18 Surabaya.
Design ofOne Group Pretest-Posttest

$$ \boxed{O_1} \quad X \quad \boxed{O_2} $$
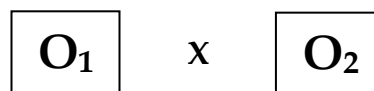
(Sugiyono, 2018)

Explanation :
O_1 : pretest is a test given to student before being treated
X : Treatment of the students worksheet based on PjBL
O_2 : Post-test is a test given to student after being treated

Data collection methods in this study used the test method. Test methods in the form of pretest and posttest are used to assess students' problem-solving skills. The form of the questions given is an essay question containing questions following the indicators of problem-solving. Pretest will be done before students get learning using project-based learning worksheet, and posttest will be done after students get learning using project-based learning worksheet.

The data analysis technique in this research is the analysis of problem-solving skills. Test results will be analyzed with the analyze gain by seeing an increase in scores from the pretest and posttest. using the formula below:

$$ g = \frac{Sr - Si}{Smax - Si} \tag{1} $$

(Hake, 2002)

Explanation:

g = gain score

Sr   = posttest score
Si   = pretest score
S max   = maximum score

After obtaining the gain score then it converted in Table 1:

Table 1. Gain Criteria

Gain range	Gain category
$g > 0,7$	High
$0,3 \leq g \leq 0,7$	Medium
$g < 0,3$	Low

(Hake, 2002)

Based on the N-gain interpretation criteria table, the worksheet was approved as an effective result from the students' pretest and posttest after being analyzed using N-gain, the range of results was ≥ 0.3 in the medium minimum category.

RESULT AND DISCUSSION

Based on the results of students 'pretest and posttest, which is analyzed using gain analysis showed that the problem-solving skills of each student have increased after learning used students' worksheet project-based learning. This is in line with research by Fajarwati, Susilo, and Indirwati (2017), stating that in the control class that implements students' problem-solving skills increase by 15.17% while the experimental class by applying the PjBL model is 31.27%. The results of improving students' problem-solving skills through pretest and posttest can be seen in Figure 1.
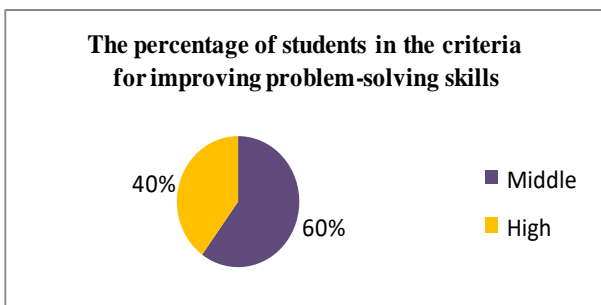

Figure 1. The percentage of students in the criteria for improving problem-solving skills

Figure 1 shows a comparison the gain analysis of students who obtained the medium and high categories. Students who do the pretest and posttest are the same students with a total of 30 students. Pretest and posttest questions are also made the same as covering indicators of problem solving skills, therefore it can be seen an increase in students' problem solving skills through gain analysis.Based on the Figure 1 students who get the medium category is 60% and students who get the high category is 40%. This shows that the number of students getting the medium category is higher than the students who get the high category.This result shows that the problem solving skills training for students cannot be done in a short time, but must be practiced repeatedly until the skill is in the minds of students (Umroh,

2018).Improved student problem solving skills are shown in the gain category before and after the project based learning worksheet is applied.

that is because when participating in learning, students not only make projects to solve problems, but also work together in groups, which makes students understand the material because they can exchange opinions with their groups. it is also supported by Vygotsky's Theory, which believes that students' cognitive development arises due to social and environmental interactions. When students interact socially and handle tasks that have not been studied before but are still within the reach of their thinking or the zone of proximal development, students can develop their cognitive well (Novianto, 2016).

So, when students do the project activities in groups, students' can remember the material being learned. According to Jean Piaget's cognitive theory, when students are involved in reading, design, and create, then the material presented will be better understood, this is also supported by Palinscar's (1998) statement that students construct their cognitive structures when they interpret their experiences in certain situations. Jean Piaget's cognitive learning theory also states that cognitive structures are schemata, which means collections of schemas. An individual can remember, understand, and respond to stimuli caused by schemata that develop chronologically, as a result of the interaction of individuals with their environment.

So the learning of this project, which involves the interaction of individuals with their environment, can develop students' potential, especially in problem-solving skills.

Improved problem-solving skills are also analyzed using gain analysis on each indicator of problem-solving skills, which include identifying problems, formulating problems, making hypotheses, analyzing data, providing problem solutions, and making conclusions. Based on the gain analysis shows that students' problem-solving skills seen from each indicator have increased. This can be seen in the following table.

Table 2. Gain analysis of each problem-solving skill indicator

No.	Indicator	Gain	Category
1	Identification of problems	0.90	High
2	Formulate a problem	0.55	Medium
3	Make a hypothesis	0.50	Medium
4	Analyze data	0.43	Medium
5	Provide a solution	0.92	High
6	Make conclusions	0.76	High
	Average	**0.67**	**High**

The results of the gain analysis of each aspect of Problem-solving skills also showed an increase in the gain of students with high categories, which can be seen in Table 3. The results of the gain analysis obtained three indicators with high categories, namely in identifying problems, providing solutions, and making conclusions,

while three indicators other in the medium category are at formulating problems, making a hypothesis, and analyzing data. This is because in formulating the problem, students can only make it with question sentences and contain one variable, but for some other students can make a problem statement well. In the aspect of making hypotheses, there are only a few students who write the hypotheses sentences correctly following the formulation of the problem and contain two variables but, some other students do not write the hypotheses entirely or not following the formulation of the problem.

In the aspect of analyzing data, almost all students are only able to sort and determine groups or categories of data, and students are still unable to analyze data using a complete sentence. This is because when students doing the learning process used PjBL students worksheets at the stage of analyzing data, students are given questions that serve to guide students in analyzing the contents of tables containing water quality before and after processing using a liquid waste management tool. So the form of data analysis conducted by students is different from the questions in the posttest.

Improvement of the three indicators is classified as medium, because students have difficulty finding and linking patterns to the problems faced, so teachers should maximize their role in guiding students to learn new things that are difficult to understand until they can be independent. Bruner (Suyono dan Hariyanto, 2011) explains that students are guided into independent learners through teacher guidance so that they can build their understanding. This theory is then called the scaffolding theory.

The learning process to practice the students' problem-solving skills is also still at the introduction stage, so students still need guidance more often. Because problem-solving skills are included in the high-level thinking category, so repetition is needed for Grade VII students who have recently been introduced to these skills. This is also supported by Prastiwi (2018), who states that each individual's cognitive abilities are different, so students need time, guidance, and direction to dominate a concept.

The results of the posttest problem-solving skills have increased due to the implementation of learning using the worksheet of Project Based Learning to train students' problem-solving skills.

CONCLUSION

The Project-Based Learning student worksheet with the theme of Waste Water Training to practice the problem-solving skills of Grade VII students was declared effective, as indicated by the results of the analysis of the average pretest and posttest gain showing the students' gain had increased. Students in the high category are 43%, and students in the medium category are 57%. The results of the gain analysis of each aspect of problem-solving skills also showed a high category with a gain of 0.67.

The results show that the Project-Based Learning worksheet with the theme of Waste Water Treatment to practice problem-solving skills was effective.

SUGGESTION

For the next researcher, can prepare the tools and materials needed even for demonstrations to students, can manage time better and can condition students when learning. For teachers, Project Based Learning worksheets with the theme of Waste Water Training to practice problem-solving skills for Grade VII students can be used as learning media to train or improve students' problem-solving skills and student activity in solving environmental problems.

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