



THE EFFECTIVENESS OF PROJECT BASED LEARNING (PjBL) WORKSHEET TO IMPROVE SCIENCE PROCESS SKILL FOR SEVEN GRADERS OF JUNIOR HIGH SCHOOL IN THE TOPIC OF ENVIRONMENTAL POLLUTION

Cindy Paramita Citradevi[✉], Arif Widiyatmoko, and Miranita Khusniati

Science Education Study Program,
Faculty of Mathematics and Natural Sciences,
Universitas Negeri Semarang (UNNES), Indonesia

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Abstract

The science learning process is not only learn how to remember the materials, but also capable in science process skill and apply knowledge in scientific work. Through science process skill in learning science, the study is no longer focused on the end result, but also on the process. Project activity is one of learning activities which is appropriate to develop science process skill, through a project students can be actively involved in learning and able to understand the concepts. Project activities can be facilitated by teaching material in the form of worksheets because its more practical in its use. The purpose of this study was to determine the effectiveness of the use of project based learning worksheet on pollution in enhancing science process skills and understanding of the concept of students. This study was an experimental with the type of quasi-experimental research design. The experiment was conducted in Junior High School 7 Magelang with research subjects students of grade VII. The results showed the average percentage of science process skills students experimental class was 91% with good criteria once the fourth meeting, with the average percentage the first meeting was 39% with a sufficient criteria. Class control has an average percentage of science process skills of students is 45% with not good criteria on the fourth meeting, with the average percentage the first meeting is 36%. Understanding the concept of experimental class students have increase in average the value of N-gain of 0.46. As well as the experimental class has an average value of understanding the concept of a higher grade than the control based on the calculation of the t test with $t_{count} \geq t_{table}$ ($4.80 \geq 1.67$). Thus, project based learning worksheet on pollution effectively used to improve the understanding of the concept and science process skills of students.

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[✉]Corresponding author:
Cindy Paramita Citradevi
Science Education Study Program,
Faculty of Mathematics and Natural Sciences,
Universitas Negeri Semarang (UNNES),
Kampus Sekaran Gunungpati Semarang, Central Java, Indonesia 50229
E-mail: arif.widiyatmoko@mail.unnes.ac.id

INTRODUCTION

According to Pusat Kurikulum Balitbang Depdiknas Indonesia, by science education, hopefully students not only learn the science information about fact, concept, principle, or law in declaratively, but also learn about how to get those information, science method, and technology in procedural skill. It involves a scientific working habit by applying the science method and attitude. Science education not only learn how to remember the materials but also master the science process skills and apply it in scientific work (Jeenthong *et al.*, 2014).

Science process skills in learning science belongs to the important category because by improving students' science process skills, learning process doesn't only focus on the final result but also during the process (Fikriyah *et al.*, 2015). Students can understand the materials that has taught because they are involved actively in the learning process. Thus, the indicators of science process skills are also improved.

According to the observation taken in SMP Negeri 7 Magelang, it shows that teacher still guide students conventionally. The mean of conventional is by using the method of lecturing, discussing and conducting question and answer session. Those conventional method do not improve students' science process skills indicators. One of the indicators that has not improved in science learning process is students' skill of asking where generally only one or two students ask in each class. Students' skill of communication when they are having a presentation also still low because many students have not able to explain the result of their activity. Besides that, students have not been able to explain what will be happen in a condition which has not analysed yet in an experiment activity. This point belongs to the indicator of prediction in science process skills.

Looking at the students' cognitive result in the Mid-term test in odd semester, from 32 students in each class, generally only 12 students that pass the minimum standard score, where the minimum standard score for science subject is 76. In this case, teacher becomes one of factor that has important part in the teaching and learning process. For example, a teacher who infrequently conduct lab work although the tools in the laboratory has already completed.

Suratno (2010) said that the selection of learning strategy in improving the quality of learning process is important to be done in order to make the students understand about what teacher has taught easily. Learning strategy that can improve students' science process skills is a strategy that involve students actively in learning process (Ningsih, 2015).

One of ways that can be used to involve students to be active in class is through lab work, project, or other activities which can assist students to find the concept of the materials (Putra *et al.*, 2015). These activity can be applied in the use of media or teaching materials which can facilitate students to improve science process skills, for example students' worksheet.

According to Prastowo (2012) students' worksheet is one of teaching materials in the form of sheet of papers which consists of materials, summary and instructions of students' work which must to be done by students and refers to the basic competence.

Based the research taken by Prasetyo (2011) stated that there is significant influence among scientific work, scientific attitude, and worksheet to the students' achievement of science subject. In line with the previous point, the research that was taken by Arafah *et al.*, (2012) also stated that worksheet can improve students' achievement.

According to the analysis through worksheet which is used in SMP Negeri 7 Magelang, worksheet only serve materials' summary and exercises, therefore, it can't improve students' worksheet. The worksheet doesn't involve activities that involve students actively in the learning process to experience it directly. So that students' science process skills has not been improved.

One of alternative way which can help learning process and involve students actively is using project based learning worksheet. Project based learning worksheet is worksheet that is arranged based on the project based learning. This worksheet uses a project as the materials to find knowledge that is needed by students.

Worksheet is arranged with project based learning because using the learning method, students can be involved directly in the learning process because there is a project that finished individually or in a group. According to Widiyatmoko & Pamelasari (2012), each student has different learning style, so that project based

learning give chance to students exploring the materials by using any meaningful ways and do the lab work collaboratively. The project can be one of the activities that can help students revise their learning activity. This point has been in line with the argument from Rose & Prasetya (2014), project based learning give chance to students learning and cooperating in solving problem and then present the result of the activity in front of the audience. Many simple projects that can be done by students, so that students are more active in learning process and able to solve problem in daily life which has relation to the materials (Deta *et al.*, 2013).

The previous point also stated by Sumarni (2013), learning activity in the model of project based learning that refers to finding, design and anything that can improve students' activity in minds-on and hands-on so that it raises students' effort to build the complex memory and rich of experience. The process of the project based learning make students easier to understand the materials because students directly apply the knowledge into a project they are arranged (Ong, *et al.*, 2016). The project will make students easier to remember the concept that they got before. Project based learning is one of alternative learning that can be use not only measure cognitive aspect but also to show students' work (Hayati *et al.*, 2013).

The existance of project based learning worksheet in teaching and learning process, students are motivated in learning, so that they are able to improve their science process skills. The purpose of this study is to know the effectiveness of project based learning worksheet to skill of students' science process skill in the topic of environment contamination and to know the effectiveness of project based learning worksheet to students' cognitive achievement in the topic of environmental pollution.

METHODS

This study is an experimental research which use quasi-experimental design-nonequivalent

control group design. In this design, the experimental group and control group are not decided randomly. The design is in the picture below.

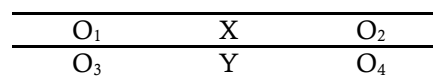


Figure 1. Nonequivalent Control Group Design

Information :

O1: pre-test of experimental group

O2: post-test of experimental group

O3: pre-test of control group

O4: post-test of control group

X : experimental group learn using Project-based learning worksheets

Y : control group learn using verification worksheets

The method that used in this study is observation, test, and questionnaire. Observation sheet is used to know students' science process skill. It uses Linkert scale where each of the aspect has 1-3 score. The test that taken in collecting the data are pre-test and post-test using objective questions. Questions instrument arranged based on the aim and indicators of the learning activity. While questionnaire is used to know teachers' and students opinion to the effectiveness of the use of project based learning worksheet in the topic of environmental pollution.

RESULTS AND DISCUSSION

This study aims to know the effectiveness of project based learning worksheet in the topic of environmental pollution. It means by the improvement of students' science process skill and students cognitive achievement. The experimental group and control group were given the same materials. However the media and the teaching materials are different. Experimental group used project based learning worksheet and control group used verification worksheet.

Project based learning worksheet before it is used in experimental group, it needs validation by the expert. The result of validation analysis can be seen clearly in table 1.

Table 1. Validation Scores Analysis Projects-based Learning Worksheet

Components	Judgments of the Expert		Average Percentage	Criteria
	1	2		
Eligibility Contents	93%	100%	96.5%	Very Good
Presentment	70%	100%	85%	Very Good
Graphical	75%	92%	83.5%	Very Good
Compliance with the syntax-based projects	79%	100%	89.5%	Very Good
Average Overall	79.25%	98%	88.6%	Very Good

Students' science process skills are measured using observation sheet by the observer. The indicators of science process skills which is measured in this study are 6 indicators. It involves observing, interpreting data, asking questions, communicating, using the tools, and doing an experiment. Indicators of science process skills that was measure analysed in each meeting during the learning activity. The result score conversed in the form of diagram. The average of science process skills score that is found for about 4 meetings can be seen in Figure 2.

Figure 2 shows that there is significant different average score between experimental group and control group. This study uses descriptive analysis where the result score of science process skills is conversed in the form of score, the it is tranfered in the form of percentage. In the experimental group, there is an improvement in each meeting. It means that the use of project based learning worksheet is effective in improving students' science process skills. The science process skills score got in each meeting are

elaborated in the form of table. In the first meeting, the average score of science process skills is displayed in Table 2.

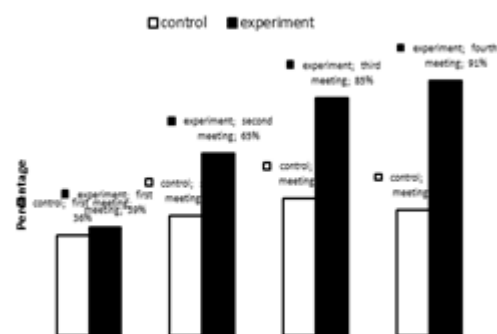


Figure 2. Diagram of science process skills indicators' improvement experimental group and control group in general.

Table 2. Average Score Students Science Process Skills in the First Meeting

Science Process Skills	Control Class (VII D)		Experiment Class (VII C)	
	Average Score	Criteria	Average Score	Criteria
Observing	42%	Not Good	43%	Not Good
Interpreting the data	33%	Not Good	42%	Not Good
Asking questions	38%	Not Good	42%	Not Good
Communicating	33%	Not Good	39%	Not Good
Using Equipment and Materials	33%	Not Good	33%	Not Good
Experimenting	33%	Not Good	33%	Not Good

The average score of students' science process skills both experimental group and control group are in the position of not good category. This problem exists because in the first meeting students only given the materials about environmental pollution, so that the most prominent indicator is observing. Skill of observing is the basic skill, how to observe the object and phenomenon using the five senses (Dimiyati & Mudjiono, 2009).

In experimental group, communicating is higher than control group because each group present the project in form of clipping which would be made in the following meeting. While in

control group students only listen what teacher said to them. According to Sumarni's (2013) argument, project based learning help students improve their communication skill in front of the class, delivering idea and explaining in front of the other students.

In the second meeting, science process skills from the observer in experimental group and control group involve in Table 3.

Table 3. Average Score of Students' Science Process Skills Second Meeting

Science Process Skills	Control Class (VII D)		Experiment Class (VII C)	
	Average Score	Criteria	Average Score	Criteria
Observing	52%	Good Enough	69%	Good
Interpreting the data	39%	Not Good	66%	Good Enough
Asking questions	37%	Not Good	61%	Good Enough
Communicating	60%	Good Enough	61%	Good Enough
Using Equipment and Materials	33%	Not Good	70%	Good
Experimenting	33%	Not Good	61%	Good Enough

The students' science process skills average score is starting to rise in the second meeting because there is project assignment in experimental group and discussion activity in control group. The skill of asking also shows its improvement. Asking is considered as teachers' activity to support, guide, and assess students' thinking ability. Spontaneous questions which delivered, stimulate students to think, discuss, and predict (Khusniati, 2012). In experimental group, the existence of project makes students to be more motivated and enthusiastic in learning.

Score percentage in control group also improved from the previous meeting. However, there is no significant improvement for the indicator of using tools and materials and doing an experiment because in this second meeting, students only discuss about certain phenomenon and then present the result by presentation in front of the class. Therefore, the skills of using tools and materials and doing experiment has not been improved.

In third meeting, the average score of students' science process skills indicator which measured by the observer is presented in Table 4.

Table 4. Average Score of Students Science Process Skills Third Meeting

Science Process Skills	Control Class (VII D)		Experiment Class (VII C)	
	Average Score	Criteria	Average Score	Criteria
Observing	53%	Good Enough	82%	Good
Interpreting the data	44%	Not Good	84%	Good
Asking questions	44%	Not Good	86%	Good
Communicating	66%	Good Enough	86%	Good
Using Equipment and Materials	43%	Not Good	84%	Good
Experimenting	48%	Not Good	88%	Very Good

Students' science process skills score in the fourth meeting in experimental group has significant improvement. It because the existence of simple project, it is the making of simple water filter to reduce environmental pollution, particularly water pollution. In control class, some of indicators also has improvement although it is

not significant. The cause is students only doing simple observation around their school environment about several kind of rubbish and how to manage it well.

In the fourth meeting, the data from each indicator present in Table 5.

Table 5. Average Score Students Science Process Skills Fourth Meeting

Science Process Skills	Control Class (VII D)		Experiment Class (VII C)	
	Average Score	Criteria	Average Score	Criteria
Observing	56%	Good Enough	89%	Very Good
Interpreting the data	44%	Not Good	88%	Very Good
Asking questions	45%	Not Good	89%	Very Good
Communicating	61%	Good Enough	91%	Very Good
Using Equipment and Materials	33%	Not Good	92%	Very Good
Experimenting	33%	Not Good	94%	Very Good

The percentage of students' science process skills score average in the last meeting shows that in experimental group there is significant improvement where the average science process skills' criteria that students got in the very good category. It because the existence of project that activate students in class, so that science process skills' indicators can be improved. While in control group, some indicators has reduction because students feel bored and unenthusiastic because the method in learning is only discussion and presentation.

In a project, students work collaboratively in class, so that it exercise them to cooperate in their group between the group member. The skills that improved by team collaboration makes learning activity to be more active where each individual has various skill. Thus, each of them try to show their skill in the group work. Active learning can guide students to improve scientific work (Kemendikbud, 2014; Warapsari & Saptorini, 2015).

The highest science process skills indicator in experimental group is the indicator of doing an experiment, while in control group is in the indicator of communicating in front of the class. It because in the experimental group students actively do their project assignment, so that there is an activity that activate learning hands-on and minds-on. The active students has good skill of science process because they pay attention and listen to the teacher carefully during the learning process (Winarti & Nurhayati, 2014).

This study not only measures students' science process skills but also look at the project based learning worksheet whether it is effective to improve students' cognitive achievement. The test that used in this study is n-gain test where the used data is pre-test and post-test from experimental group and control group that had already analysed the normality. Normality test aims to know whether the data has normal distribution or not to determine the statistical calculation. The result of the normality test shows that the data has normal distribution, thus the statistics that used is parametric statistics.

N-gain test aims to know the quantities of the students' comprehension improvement before and after receiving the treatment. The result of the improvement of the comprehension average between experimental group and control group can be seen in Table 6.

Table 6. Gain Results Experiment Class and Control Class

Class	Pretest	Posttest	Gain	Criteria
Control	55.12	64.12	0.20	Low
Experiment	55.62	76.00	0.46	Medium

The data according to table 6 shows that gain score for experimental group is 0.46 where it is on the middle category. While in the control group, the score is 0.20 where it is in the low category.

After the quantities of the students' cognitive improvement, then it is analysed the significance. Significance test of cognitive result uses post-test

score of experimental and control group. This test aims to know the difference of students' cognitive result between experimental group and control group. The statistical calculation is shown in Table 7.

Table 7. Results Significance Test Experiment Class and Controls Class

Class	fd	t_{count}	t_{table}	Criteria
Control	62	4.80	1.67	Accept null hypothesis if $t_{count} < t_{table}$
Experiment				

Table 7 shows that the price level of 5% $t_{count} = 4.80$, while the $t_{table} = 1.67$. Null hypothesis to the significance test that there is no significant improvement in cognitive achievement experimental class and control class after using a project-based student worksheets. Because the price $t_{count} > t_{table}$, then null hypothesis is rejected. The conclusion is there is a significant difference in improvement, where the cognitive learning experimental class is higher than the control class after using a project-based student worksheets. It shows that project based learning worksheet is effective in improving students' cognitive result in the topic of environmental pollution.

Students' science process skills in each meeting in this study has improved for the experimental group, it is the same with the research taken by Nurvitasari (2012), it talked about the project based learning implementation with the report product is the result of project work. The topic is vertebrate animal blood circulatory system. It shows that there is an improvement in students' science process skills.

Improvement of science process skills cause by the use of project based learning worksheet which invite students to be active in the learning process. This point is in line with Permendiknas (2006). It is said that good learning is learning by directly experience the learning, so that students will not be pasive receiving the information from the teacher but they try to find the concept through experiments. Students are easier to understand the materials because the learning process is the result their finding and experience. Thus, it will give deeper impression to students.

Project-based learning is a student-centered teaching model which place teacher as the class facilitator. It is supported by the argument from

Guo and Yang (2012). They said that in project based learning, teacher acts not-only as a resource but also as a guide and a facilitator. During the process of project making, teacher has duty to monitor students activity. Monitoring is done by facilitate students in each process. In other words, teacher acts as a mentor to students activity. Students are trained to do their duty and responsible in their group, so that the learning process runs more effectively.

In this study also wants to know students' response and teacher's response to the learning process using project based learning worksheet. The data is collected by using Linkert scale. The lowest sclae is 1 and the highest scale is 4. The result of the students questionnaire that has benn completed by experiment class and transfered into percentage form has 85% students are very agree to the statement. While teacher's response by interview, the result shows positive response to the learning process using project based learning worksheet in the topic of environmental pollution. The use of project based learning worksheet in science subject has some weaknesses. They are (1) the activities in the learning process is doing projects, so it spend times to make the project while the time allotment sometimes can not cover all the activities. (2) The class environment is not really good because some students still have chatting with their friends next to them.

Those weaknesses can influence science process skills and the students' cognitive result. However, the result of hypohese testing shows that students' achievement in experimental group is better than the control group. The existence of those weaknesses caused by unperfect teaching model. Each teaching model or strategy has its strenght and weaknesses. A teaching strategy is maybe appropriate to be used in other materials. Some solutions to overcome those weaknesses are: (1) before the learning process begins, students must be properly arranged, so that students can unerstand the materials well. Besides that, the project that needs to be arranged also can be finished well. (2) Teacher should pay attention to the time allocation. It must be appropriate with the projects that will be arranged in class during the learning process. Thus, the time will be effective and students can follow the learning process well.

CONCLUSION

According to the result of the study, it can be conclude that; (1) project based learning worksheet in the topic of environmental pollution can improve students science process skills in each meeting. Students are able to construct their knowledge through project they arranged. It is shown by the result of the study where the percentage of science process skills' average in experimental group is higher than the control group. (2) the use of project based learning worksheet can improve students' cognitive result. It is shown by the average score in experimental group is higher than the control group. The improvement of students achievement also can be seen from gain score in experimental class is higher (0.46) than control group (0.20).

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