

THE IMPLEMENTATION OF STUDENT WORKSHEETS BASED ON PROBLEM-BASED LEARNING TO IMPROVE STUDENT'S SCIENCE PROCESS SKILL

Dhamik Yalyn, Dhita Ayu Permata Sari, and Wahono Widodo*

Department of Science, Faculty of Mathematics and Natural Sciences, Universitas Negeri Surabaya, Indonesia

*Email: wahonowidodo@unesa.ac.id

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Abstract: The study aims to describe the implementation of students' worksheets based on problem-based learning to improve students' science process skills, the activity of students' science process skills, and the student's responses. The research used is pre-experimental with one group pre-test post-test research design using one experiment class. The research is conducted at junior high school 6 Gresik with a sample of one class, namely VII-G, consisting of 30 students. The data collection method used are observations, written tests, and questionnaires. The data analysis technique used is quantitative descriptive. The result of the study shows that the learning implementation for three meetings got the average criteria carried out well. The science process skills observed are formulating problems, formulating hypotheses, identifying variables, interpreting data, making conclusions, and communicating. The average N-gain score obtained is 0.88 in the high category, which indicates that the students' science process skills have increased. The learning process also responds positively, with an average response of 93% with very effective criteria. Based on the description above, it can be concluded that learning by using students' worksheets based on problem-based learning can enhance students' science process skills on environmental pollution material.

Keywords: *Student Worksheet, Problem Based Learning, and Science Process Skill.*

INTRODUCTION

The 2013 curriculum emphasizes learning using a scientific approach, where students are expected to improve scientific activities and science process skills [1]. The Ministry of Education and Culture stated that Science Learning in Junior High Schools emphasizes learning that provides a direct learning experience to students through the development of process skills and scientific attitudes [2]. Science process skills can be interpreted as fundamental skills that learners must possess [3]. The importance of KPS in the learning process is to develop educational knowledge and the quality of student learning, both theory, and experimentation skills [4].

The 2013 curriculum is supported by the emergence of 21st-century skills [5]. The National Education Association has identified 21st-century skills as the skills of the 4Cs". The 4Cs include communication, collaboration, critical thinking, problem-solving, and creativity skills. However, science learning is still theoretical and does not develop students' thought processes [6].

The results of an interview conducted by researchers with four science teachers at the state junior high schools in Gresik stated that students lack thinking in reviewing and solving a problem. Students are not given examples of problems related to the material provided, and learning has emphasized more the aspect of remembering the materials given. One of the efforts that can be made is the provision of teaching materials using a learning model that can improve students' skills to solve a problem, namely Problem-Based Learning-based Student Worksheets [7].

Worksheets of Students who are by the demands of the 2013 Curriculum must be able to develop various student science skills in the learning process based on a Scientific approach [8]. Therefore, this study applies Problem-Based Learning-based Student Worksheets. Problem Based Learning is a learning model that involves students solving real problems related to learning materials [9]. Problem Based Learning-based Student Worksheets have five stages, namely student orientation to problems, student orientation to group learning, guiding group investigations, developing and presenting work results, and analyzing and evaluating the problem-solving process [10].

Research proves that the problem-based learning model assisted by student worksheets affects students' science process skills. The study suggested that student worksheets contain images or information that is interesting and related to the material provided [11]. In addition, there is another research on student worksheets based on problem-based learning that proves student worksheets based on problem-based learning are very feasible as a science learning teaching material that requires students to be active during learning [12].

The Problem Based Learning based Student Worksheet that will be applied is a student worksheet based on Problem Based Learning about environmental pollution material. Environmental pollution is one of the science materials often encountered in everyday life. Many problems can be discussed in learning activities. Raising problems or issues of daily life in the learning process can improve students' science process skills

[13]. Science Teacher at junior high school 6 Gresik stated that in the school, there had been no research focusing on environmental pollution material using student worksheets based on Problem-Based Learning. In fact, many problems in the school environment can be analyzed to increase students' understanding of the problems in the environment and solve them.

The difference between this research and the previous research is that in the problem-based learning-based Student Worksheet. Some problems exist in the area where students live, such as problems regarding water resources that is used daily is still cloudy, so students can solve and provide solutions to problems that exist in the environment. Adding the latest information about the problems and problems taken from problems in the surrounding environment can make it easier for students to understand the observations or experiments carried out [14].

The importance of the research that will be carried out is in line with the demands of needs in the 21st century, where in the 21st-century students are required to be accustomed to solving problems in the surrounding environment and have skills known as 4C, namely communication collaboration, critical thinking, and creativity [15]. Therefore, the classroom learning process is expected to make students more active during the learning process so that students can solve real problems in the surrounding environment, balanced with the science process skills that students must have. It is necessary to conduct this research by implementing student worksheets based on Problem-Based Learning on environmental pollution materials at junior high school 6 Gresik. The aim is to improve students' science process skills, improve student science process skills activities and find student responses after carrying out these learning activities.

RESEARCH METHODS

This study used a pre-experimental design model. The research design used is a one-group pre-test and post-test design. In this study, there are limited samples and time constraints owned by researchers. The subjects used were students of class VII junior high school 6 Gresik. The sample used in this study was class VII-G, with 30 students consisting of 10 male and 20 female students. The methods used in this study are the observation method, the written test method, and the questionnaire method.

Procedure

Research data was obtained using learning implementation sheets, student science process skills activity sheets, pre-test and post-test test sheets, and student response questionnaires. Learning implementation sheets were filled out by

three observers. Then students' science process skills activity sheets were filled out by researchers. Students filled out pre-test, post-test sheets, and Student response questionnaire sheets.

Instruments

The instrument used in this study applies instruments from the research, which have been validated by validators [14]. The learning implementation instrument consists of 31 points of a statement covering the preliminary aspects of 7 items, the core aspects of 18 items, and the closing aspects of 6 items. The student's science process skills activity sheet instrument consists of 6 aspects of science process skills, namely (1) formulating problem formulations; (2) formulating hypotheses; (3) identifying variables; (4) interpreting the data; (5) drawing conclusions; and (6) communicate. On the pre-test and post-test test sheets, six questions are in accordance with the six aspects of science process skills. As for the questionnaire, student responses are present in the form of statements. The questionnaire indicators used correspond to Table 1.

Table 1. Student Response Questionnaire Indicators

Indicator	Number
student response to the learning process	1,2,3,4,5
students' response to students' science process skills abilities after learning	6,7,8,9,10,11

Data Analysis

Data analysis of learning implementation using Problem-Based Learning-based Student Worksheets is used to analyze the implementation of learning during the learning process. Data on the implementation of learning are analyzed based on the calculation of the assessment score from the answer "Carried out" or "Not Carried Out ."The "Carried out" answer has a score value of 1, and the "Not Carried out" answer has a score value of 0. The results of the learning implementation percentage are converted into scale interpretation with the criteria for assessing the implementation of learning, shown in Table 2 [16].

Table 2. Criteria for the percentage of questionnaire answers

Percentage (%)	Criteria
$k \geq 80\%$	Carried out
$70\% \leq k < 80\%$	quite carried out
$60\% \leq k < 70\%$	less carried out
$k < 60\%$	Not carried

Student activity analysis is used to analyze student activity in every aspect of science process

skills. The percentage of student activity results are converted into scale interpretation with the criteria for assessing the implementation of learning, shown in Table 3 [17].

Table 3. Student Activity Criteria

Percentage (%)	Criteria
86-100	Very good
76-85	Good
60-75	Enough
55-59	Less
54-0	Very lacking

Using N-gain, analysis of pre-test and post-test data on students' science process skills. N-gain is used to determine how much the result increases between the pre-test and post-test. Then the scores obtained by students are converted by adjusting the criteria as follows [18]:

Table 4. N-gain Criteria

Index N-gains	Criteria
$0.7 < (<g>) \leq 1.0$	High
$0.3 < (<g>) \leq 0.7$	Medium
$0.0 < g \leq 0.3$	Low

Data analysis of the completeness of each aspect of students' science process skills by assessing six aspects of science process skills, namely: (1) formulating problem formulations; (2) formulate hypotheses; (3) identifying variables; (4) interpreting the data; (5) draw conclusions; and (6) communicate. Then the scores obtained by students are converted by adjusting the following criteria [19].

Table 5. Completion criteria for each aspect of science process skills

Percentage (%)	Criteria
0-20	Very Low
21-40	Low
41-60	Medium
61-80	High
81-100	Very High

Data from the student response questionnaire analysis will be analyzed based on the calculation of the assessment score, namely the answer "Yes" or "No". The "Yes" answer includes a positive response that is agreed, and the "No" answer includes a negative response that disagrees. The "Yes" and "No" scales were used in this study to obtain a firm answer regarding the effect of applying problem-based learning-based student worksheets on students' science process skills [20]. The learning process using Problem Based

Learning based Student Worksheets is very effective if the student's response reaches a score of $\geq 81\%$.

RESULTS AND DISCUSSION

Learning using Student Worksheets on environmental pollution material was applied during three meetings in class VII-G at UPT JUNIOR HIGH SCHOOL 6 Gresik. Learning using student worksheets is spread with a Problem Based Learning-based learning model. During the learning process, observations were made regarding the implementation of learning. The average results of learning implementation using student worksheets based on Problem-Based Learning are presented in Figure 1.

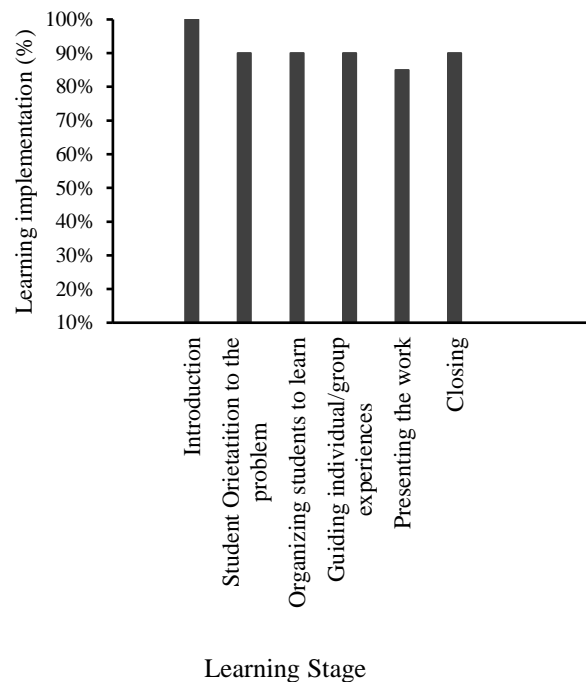


Figure 1. Implementation of Learning using student worksheets based on Problem Based Learning

Figure 1 shows the average percentage of learning implementation using student worksheets based on Problem-Based Learning on Environmental Pollution material, which consists of three stages: preliminary, core, and closing. Learning is carried out with a Problem Based Learning model contained in the core activities. In the preliminary activities and presented, the work obtained the highest percentage of implementation, which is 100% with the category of Carried out. The preliminary activities and the work results are carried out very well. At the same time, the lowest percentage is the activity of presenting works of 85% with a sufficient category of being carried out. The activities carried out by students during learning that leads to students' science process skills have increased at each meeting. The data from the observation of student activities are presented in Table 6.

Table 6. The analysis results of student science process skills activities use Problem-Based Learning based Student Worksheets.

Assessed Aspects	P1	P2	P3
Formulating the problem	51%	76%	94%
Formulating hypotheses	49%	74%	92%
Identifying variables	49%	75%	91%
Interpret data	50%	75%	93%
Drawing conclusions	50%	74%	93%
Communicate	47%	73%	90%

Description: P1 = Meeting 1, P2 = Meeting 2, P3 = Meeting 3.

Table 6 shows that students very well carry out all the activities expected by researchers during learning using student worksheets based on Problem-Based Learning on Environmental Pollution material. It is evidenced by the increasing percentage of average student activity in each aspect of science process skills at each meeting. The activity of the student who obtained the highest percentage of the three meetings was the aspect of formulating the problem. Meanwhile, the activity that gets the lowest percentage is communicating.

The application of learning using Problem-Based Learning-based Student Worksheets can improve students' science process skills. Science Process Skill is trained to students during learning activities using student worksheets based on Problem Based Learning, namely analyzing and finding solutions to several problems regarding environmental pollution. Data on improving students' science process skills were obtained from the results of the Pretest and Posttest of students'

overall science process skills, which were then analyzed by calculating the N-gain score, as presented in the descriptive statistical data in Table 7.

Table 7. Descriptive Analysis of Student Science Process Skills Test Results

Descriptive Statistics	Pre-test	Post-test	N-gain
Valid	30	30	30
Missing	0	0	0
Mean	31.33	92.07	0.88
Std. Deviation	13.474	6.68	0.100
Variance	181.54	44.61	0.10
Range	56	20	0.34
Minimum	5	80	0.66
Maximum	61	100	1.00

Table 7 shows that the results of the Pre-test of students' science process skills before learning using Problem-Based Learning-based Student Worksheets on environmental pollution materials showed an average score of 31. After applying to learn using Problem-Based Learning-based Student Worksheets, the results of the Post-test of students' science process skills increased to 92. The average N-Gain score obtained from 30 students was 0.88, with the High category. The N-Gain score shows that implementing learners using Problem-Based Learning-based Student Worksheets can improve students' science process skills with a high increase in scores. If science process skills data is present for each aspect of science process skills, the data in Table 8 are obtained.

Table 8. Improvement of each aspect of science process skills

Science Process Skills Indicators	Achievement			
	Pretest (%)	Posttest (%)	N-Gain	Category
Formulating the problem	10	100	1.00	High
Formulating hypotheses	22	96	0.95	High
Identifying variables	43	95	0.91	High
Interpret data	30	84	0.77	High
Drawing conclusions	45	86	0.75	High
Communicate	50	86	0.72	High

Table 9. Recapitulation of Sample Results of Student Responses to Student Worksheets based on Problem-Based Learning

Indicator	Answer		Category
	Yes	No	
Student response to the learning process	99%	1%	Highly Effective
Students' responses to students' science process skills abilities after learning	87%	13%	Highly Effective
Average	93%	7%	Highly Effective

Table 8 shows that the science process skills taught have improved on each indicator. The six indicators of science process skills belong to the high yang category. The lowest percentage increase in class VII-G science process skills is found in the aspect of communicating. Meanwhile, of the six indicators of science process skills that have been trained, formulating problems is the indicator that has increased the most.

Student response questionnaire sheets were obtained on student responses to learning using Problem-Based Learning-based Student Worksheets on Environmental Pollution material. The results of student responses to learning using Problem Based Learning-based Student Worksheets are present in Table 9.

Based on Table 11, students positively responded to learning by using Problem Based Learning-based Student Worksheet. This can be seen, and the average percentage of students who have responded agreed with giving a "Yes" answer of 93% to the questions that were given. It can be said that the student's response stated that the Problem Based Learning-based Student Worksheet was very effective because of the average percentage of achieving a "Yes" answer $\geq 81\%$.

Data from observations of the learning process using Problem-Based Learning-based Student Worksheets on environmental pollution material were observed by three observers. The learning carried out consists of three stages, namely preliminary activities, core activities, and closing activities. Learning activities are carried out with a Problem Based Learning model, which is covered in the core activities. Nasihah (2019) stated that one of the advantages of the Problem Based Learning model is a learning model that presents real and meaningful problems so that students can investigate and find their solutions to problems in groups or as individuals.

In the introduction activity, the percentage of implementation is 100%. It shows that all components in the introduction activities can be carried out very well. Researchers open learning by providing motivation and conveying the learning objectives to be achieved. Toto Ruhimat et al. (2017) stated that preliminary activities in the teacher's learning process must arouse motivation in the form of attention to students so that in the early stages of learning, students have focused on learning activities. Motivating at the beginning of learning is important because it provides motivation aimed at making students carry out learning activities to achieve the learning objectives that have been conveyed by the teacher [21].

The core activities consist of several stages, namely: 1) Orienting learners to Problems, 2) Organizing learners to learn, 3) Guiding Individual or Group Experiences, 4) Developing and Presenting Work Results, and 5) Analyzing and

Evaluating problem-solving processes. This activity begins with researchers presenting a problem in worksheets based on Problem Based Learning about Environmental Pollution. Students are very enthusiastic when asked to do a practicum to find solutions to the problems that have been present on the Learner Worksheet. It is in line with the research results, which states that student worksheets with a problem-based learning model can improve students' science process skills [14]. Learning using Problem-Based Learning-based Student Worksheets makes students more interested in learning, so student learning activities [22]. The implementation of learning applied with the Problem Based Learning model obtained excellent results; in other words, the Problem Based Learning model was carried out properly to support the research data, namely students' science process skills.

This study used three student worksheets based on Problem-Based Learning for three meetings. In the Student Worksheet, several activities students must carry out are presented to solve the problems presented in the student worksheet. Students are asked to formulate problems, formulate hypotheses, determine experimental variables, conduct experiments, discuss the data obtained, and communicate the results. Table 6 shows that student activity has increased in every aspect of the science process skills training. It happens because the learning process is carried out properly.

The learning process carried out at the first meeting emphasized the introduction and understanding of students regarding science process skills, so the students' science process skills activities increased at the second and third meetings. Putri, D.A. et al. (2020) stated that problem-based learning student worksheets could improve students' science process skills because, in the worksheet, there are indicators of students' science process skills that are adjusted to experimental activities. Students will be given problems, then asked to formulate problems, formulate hypotheses, identify variables, analyze data, draw conclusions, and provide solutions to these problems. Students' science process skills improve after learning using problem-based learning student worksheets [23].

The activity of students' science process skills increased the most, indicating formulating problems. It happened because the researcher explained the problems in the student worksheet by providing illustrations of these problems. Hamadi (2018) explained that the existence of two indicators could realize indicators of formulating serious problems; students are given an illustration or picture of someone who is doing activities or illustrations of a problem. Students can make

problem formulations correctly based on the illustrations or images given.

The indicator of science process skills that experienced the lowest increase in student activity was communicating. It is because the audience does not pay attention to the students who are communicating the experiment results. Hence, students are less enthusiastic about communicating the results of their experiments. The cause of the low indicators of communication in the indicators of science process skills is that students: who do not feel able to open communication with others first are less able to position themselves as good listeners, lack of concern for explanations from their peers, and still low student empathy attitudes.

The results of the implementation of learning using Problem-Based Learning based on Student Worksheets obtained good results, and student activities at each meeting have increased to support other research data, namely the results of the student science process skills test. Good results from the implementation of student learning and activities supported the increase in students' science process skills from an average of 31 to 92. Students' science process skills improve after applying to learn using Problem-Based Learning based on student worksheets, compared to learning without using student worksheets.

The very high increase in the results of the student science process skills test in class VII-G is also due to the fact that students are given motivation at the beginning of each learning so that students are enthusiastic about learning and easy to understand the material given. Motivation is an internal factor (in students) and the most important thing that every student must have so that students get high learning outcomes.

The effectiveness of learning using student worksheets based on Problem-Based Learning on environmental pollution material can be seen by improving students' science process skills. The results of the student science process skills test show that after learning using student worksheets based on Problem-Based Learning in environmental pollution material, there is an increase in students' science process skills. This is evidenced by the increase in the average value of the Pre-test and Post-test average, with an average N-Gain score of 0.88 with a high category. The data shows that learning using student worksheets based on Problem-Based Learning on environmental pollution materials is effective in improving students' science process skills. It is following previous research on learning using Student science process skills can be trained through direct experience during the learning process using student worksheets based on Problem Based Learning. Learning processes that provide direct experience can develop students' cognitive abilities and science literacy abilities.

Students' science process skills given to students contain six indicators, namely (1) Formulating Problems, (2) Formulating Hypotheses, (3) Identifying Variables, (4) Interpreting data, (5) Drawing Conclusions, and (6) Communicating. The six indicators experienced a fairly high increase. The highest increase of the six indicators of science process skills that have been carried out, formulating problems, is the indicator that has increased the highest by obtaining a percentage of Pre-test scores of 10% and obtaining a Post-test score of 100% with an N-gain value of 1.00. It is because students have obtained information about indicators of formulating problems in previous learning. With the teacher's guidance, students can formulate problems based on the illustrations in the Student Activity Sheet [24]. In addition, if a student gains knowledge from discovery, they can improve their ability to find and solve problems. The teacher can improve students' problem formulating skills by inviting students to do practicum using Student Worksheets [25]. It is also supported by research, which states that students who learn by discovery will increase the level of science process skills in overcoming or solving problems compared to students who carry out the learning process by not doing the discovery process [26].

The lowest improved indicator of science process skills was communicating by obtaining a percentage increase of only 36%. Communicating is an activity in view orally, expressing concepts, or writing clearly [27]. The low increase in communication indicators is due to students lacking the confidence to communicate or write down their opinions [28]. The facts in the field stated that the results of observations in the learning process showed that students were not used to explaining the material through pictures, graphs, and tables [26].

The improvement of students' science process skills is also a review of the responses given by students obtained from student response questionnaires after conducting learning using Problem-Based Learning-based Student Worksheets on environmental pollution materials. The average result of the percentage of student responses is 93%, meaning that almost all students agree with the questions in the student response questionnaire. In other words, problem-based learning student worksheets on environmental pollution materials are very effectively used.

The description above shows that learning using Problem-Based Learning-based Student Worksheets on environmental pollution material can improve students' science process skills. A Problem-Based Learning-based student worksheet can also increase students' science process skills. Improving students' science process skills is also supported by the learning process by using student

worksheets with a problem-based learning model that is well-implemented.

CONCLUSION

The results showed that students experienced an improvement in students Science Process Skills through learning by using Student Worksheets on environmental pollution material. Students' science process skills increased in average scores from 31 to 92, obtaining an average N-Gain score of 0.88, which falls into the high category. The activity of students' science process skills is experiencing a high increase in the indicators of formulating problems. Improving students' science process skills is also supported by implementing learning that is carried out very well. The percentage of student responses to learning using problem-based learning-based student worksheets obtained a very effective category with an average percentage of 93%.

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