

Analysis of science process skills in student worksheet on microorganism topics for senior high school

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Abstract. The research aimed to analyze the potency of science process skills (SPS) which developed in the student worksheet. This research was content analysis. The population of this research was student worksheet in Yogyakarta based on curriculum 2013. Samples were taken with a purposive sampling technique. The instrument of the data collection was an observation sheet science process skills (SPS) adapted from Rezba. Data of the research were analyzed using qualitative analysis techniques. The results of the research that 1) the science process skills (SPS) developed in student worksheet is basic science process skills (BSPS) and integrated science process skills (ISPS); 2) the basic science process skills (BSPS) that developed in biology worksheet is observing, inferring, classifying and communicating, while the integrated science process skills (ISPS) that developed in the worksheet is tabulating and graphing data, analyzing investigations, and experimenting. The science process skills (SPS) developed in student worksheet are in line with the type of science process skills (SPS) required in the formulation of the curriculum 2013 basic competencies.

Keywords: *science process skill (SPS), student worksheet, microorganism*

1. Introduction

Science learning includes biology learning, not just teaching students about scientific knowledge. But, biology learning provides students to develop scientific knowledge, scientific processes, and scientific attitudes. Scientific processes are identical in the process of scientific activities that develop the science process skills (SPS) carried out by students through various activities, such as observing, analyzing, conducting experiments to find their own concepts as products of scientific science. Biology as part of natural sciences provides a variety of learning experiences and process skills to understand concepts related to life creating life [1]. Biology learning in schools should provide opportunities for students to develop process skills. This becomes a challenge for teachers to conduct learning that supports it. SPS may help students organize knowledge while they are learning. The SPS are related to the scientific research process in a way of searching for knowledge [2].

Process skills are a way or approach to teaching that can help students to understand concepts through inquiry [3]. Learning that allows students to use science process skills, students can practice skills: find problems and solve problems through investigation [4]. Scientists using SPS to solve problems and formulate results, so that knowledge is obtained [5]. Scientists use the scientific process, from asking questions then finding answers to questions. The SPS are the same as the skills we use to answer the questions we find in everyday life. If the teacher guides students to practice using SPS in biology lessons, the teacher means providing skills, which they can use in the future, to answer all



questions in daily life.

SPS can be divided into two levels, basic science process skills (BSPS) and integrated science process skills (ISPS) [6]. BSPS consist of observing, predicting, inferring, classifying, measuring, and communicating. ISPS consist of: constructing hypothesis, identifying variables, defining variables, tabulating and graphing data, analyzing investigations, designing investigations, experimenting [7]. One of the tools that can be used by teachers to support biology learning that can enable students to develop SPS is student worksheet. Some researchers have benefited from worksheet, which include increasing the SPS of middle and high school students [8]. The student worksheet based on the curriculum 2013 was designed to help students carry out learning activities to practice certain attitudes, knowledge, and skills. The student worksheet supports the steps of learning through the observation, asking questions, gathering information, associating and communicating.

BSPS and ISPS are very important to be mastered by students according to their level of education, because students who can master SPS well, can master more knowledge and connect between these knowledge [9]. The potential for SPS development through the use of student worksheet in learning needs to be utilized to the maximum extent possible by students in developing their SPS. One of the teaching materials that can be used by teachers in the learning process is student worksheet. Student worksheet can make learning active, effective and efficient. Through student worksheet, students can understand a concept, by carrying out activities according to instructions designed by the teacher. Learning activities that use student worksheet, students can do activities in groups [10]. Student worksheet can be used by students to help find information from concepts learned. In addition, student worksheet can also help students to achieve learning objectives on the topic being studied [11].

Many schools use student worksheet from publishers. However, student worksheet currently in circulation only contain practice questions that students must do. Student worksheet in schools tend to contain very short information and do not guide students to better understand the material thoroughly. So, student worksheet less the potential to develop science process skills. Student worksheet in senior high school of Yogyakarta, most of them made by teachers. But, the teacher does not pay attention to the potency of SPS in the student worksheet that have been made. To support the achievement of learning steps through the scientific process a variety of worksheet is needed. Now, there has never been researched on the analysis of SPS in student worksheet on microorganism topics for senior high school, so it is necessary to look for information about scientific process skills. ISPS are more appropriately developed in high school, it is hoped that student worksheet in high school have the potential to develop integrated science process skills

Yogyakarta is identical with the name of student city. The existence of this title certainly gives pride to the community. The city of Yogyakarta is referred to as a city student because many students and students continue to the next level of education in the city. This can be seen from the number of students both from the high school to the level of students from outside Yogyakarta, many migrate to Yogyakarta to study. Related to this, this research was conducted in the city of Yogyakarta. Biology learning is identical to observation and experiment activities. Therefore, the topic of microorganisms is also needed observational and experimental activities, to provide students' experiences to see learning objects directly. Although it requires a microscope and other supporters, it still requires student experience to see learning object directly. So, analysis of SPS in student worksheet on microorganism topics for senior high school is important to research because it can provide consideration in the preparation of worksheet in accordance with the curriculum 2013 and provide an overview of SPS in student worksheet for teachers. In addition, it can become a stock when plunging into the world of education and adding insight to researchers in developing student worksheet that can develop science process skills. The research aimed to analyze the potency of SPS which developed in the student worksheet of microorganism topics.

2. Research method

This research analyzed the science process skills (SPS) contained in the student worksheet.

2.1. Type of Research

This research was content analysis to analyze the potency SPS developed in the student worksheet. Each of the SPS that arises is analyzed based on statements in the research instrument. The analysis results are used to calculate the potency of SPS developed in student worksheet.

2.2. Subject of Research

The population in this research was student worksheet for high school students in Yogyakarta city who have implemented the curriculum 2013. The sample in this research is 26 student worksheet made by teachers in biology learning about microorganism topics. This sample is taken using purposive sampling techniques based on considerations determined by researchers. Student worksheet used for this study are student worksheet that teachers use for biology learning in class 10 semester 1. Microorganism topics consist of virus, bacteria, protist, and fungi topic.

2.3. Data, Instruments and Data Collection Techniques

The research instrument was an observation sheet for analyzing the contents of the student worksheet that was modified from the instrument model developed by Rezba. The research instrument to collect data on a variety of SPS developed in the basic competencies and student worksheet.

Data collection was carried out by 3 observers. All three observers have fulfilled the requirements. Data collected from this research are in the form of quantitative data.

2.4. Data Analysis Technique

Data obtained in this research were analyzed using qualitative analysis techniques. Data obtained from the three observers were tested for reliability using canonical tests according to Krippendorff. If the data compatibility coefficient has a value of more than 0.7 (> 0.7); then the data collected from the three observers can be said to be reliable [12].

3. Results and Discussion

Based on the match table (α) student worksheet of Krippendorff canonical test results, all student worksheet analysis data show that the match degree value (α) is more than 0.7 (> 0.7) so that the overall data is said to be reliable.

The student worksheet is a sheet containing assignments that must be done by students. The student worksheet is usually in the form of instructions to complete a task. A task that is ordered in the student worksheet must be clear the basic competencies that will be achieved. Student worksheet that are used by teachers in learning, are expected to facilitate students to learn independently and can develop critical analysis [13].

The research to collect data on a variety of SPS developed in the basic competencies and student worksheet. The basic competencies in the curriculum 2013 are the competencies of each subject for each class derived from core competencies. Basic competence is content or competence which consists of attitudes, knowledge, and skills that are sourced from the core competencies that students must master. The basic competence is developed by paying attention to the characteristics of students, initial abilities, and characteristics of a subject [14]. So, in this study, the potential of the SPS developed on student worksheet is compared to the demands on basic competencies in the curriculum 2013.

3.1. Variety of Science Process Skills (SPS) Developed in Curriculum 2013 Basic Competencies and Biology Student Worksheet

Observers analyzed a variety of SPS developed in basic competencies 3.4; 3.5; 3.6; 3.7; 4.4; 4.5; 4.6; and 4.7. Basic competencies 3.4 and 4.4 about virus, basic competencies 3.5 and 5.5 about bacteria, basic competencies 3.6 and 4.6 about protest, basic competencies 3.7 and 4.7 about fungi.

Based on research all of SPS are developed in basic competencies. A variety of SPS that have a frequency of 8 and a percentage of 100% are developed in all basic competencies. The SPS are observing, predicting, inferring, classifying, measuring, communicating, constructing hypothesis, identifying variables, defining variables, tabulating and graphing data, analyzing investigations, designing investigations, experimenting.

Observers identified a variety of SPS developed in student worksheet using research instruments. The worksheet used to research were 26 from 7 biology teachers in Yogyakarta city senior high school. The worksheet consists of 4 chapters compiled and used by the teacher to teach class X students.

Table 1. Percentage (%) each science process skill developed in student worksheet

Science Process Skills	Chapter				Percentages (%)
	Virus	Bacteria	Protist	Fungi	
Observing	√	√	√	√	100
Predicting	-	-	-	-	0
Inferring	√	√	√	√	100
Classifying	√	√	√	√	100
Measuring	-	√	√	-	0
Communicating	√	√	√	√	100
Constructing hypothesis	-	-	-	-	0
Identifying variables	-	-	-	-	0
Defining variables	-	-	-	-	0
Tabulating and graphing data	-	√	√	√	75
Analyzing investigations	√	√	√	√	100
Designing investigations	-	-	-	-	0
Experimenting	√	√	√	√	100

A variety of basic SPS developed at student worksheet are observing, inferring, classifying and communicating. Basic SPS of predicting and measuring not yet developed on student worksheet. A variety of integrated SPS developed at student worksheet are tabulating and graphing data, analyzing investigations, experimenting. Integrated SPS of identifying variables, constructing hypothesis, defining variables, and designing investigations not yet developed on student worksheet. Based on table 1, SPS are not all developed in all chapters. The SPS that have a frequency of 4 and a percentage of 100% are developed in all chapters. The SPS include observing, inferring, classifying, communicating, analyzing investigations, and experimenting.

The SPS that have a frequency of 0 and a percentage of 0% are not developed in all chapters. The SPS include predicting, measuring, identifying variables, constructing hypothesis, defining variables, and designing investigations. This is because the 26 student worksheet analyzed included the closed model. Students who use the student worksheet with a closed model in carrying out activities, only follow the directions and work on assignments in accordance with the instructions set by the teacher without composing their own steps of the activity to be carried out. This causes only certain scientific process skills that can be developed while carrying out activities.

On the closed student worksheet, learning is so tightly packaged that students are not given broad opportunities to gain knowledge to answer questions and solve problems. On the closed student worksheet, students are forced to follow the instructions and do the assignment according to the instructions made by the teacher [15].

The worksheet used in this study were 26 closed worksheet. Students who use the student worksheet with a closed model in carrying out activities, only follow the directions and work on assignments in accordance with the instructions set by the teacher without composing their own steps of the activity to be carried out. However, the student worksheet with a closed model are suitable to be applied to class X students in semester 1, because the student worksheet with a closed model are aimed at students who are starting to learn. Starting learning is intended for students who are just beginning to study biology at the senior high school level.

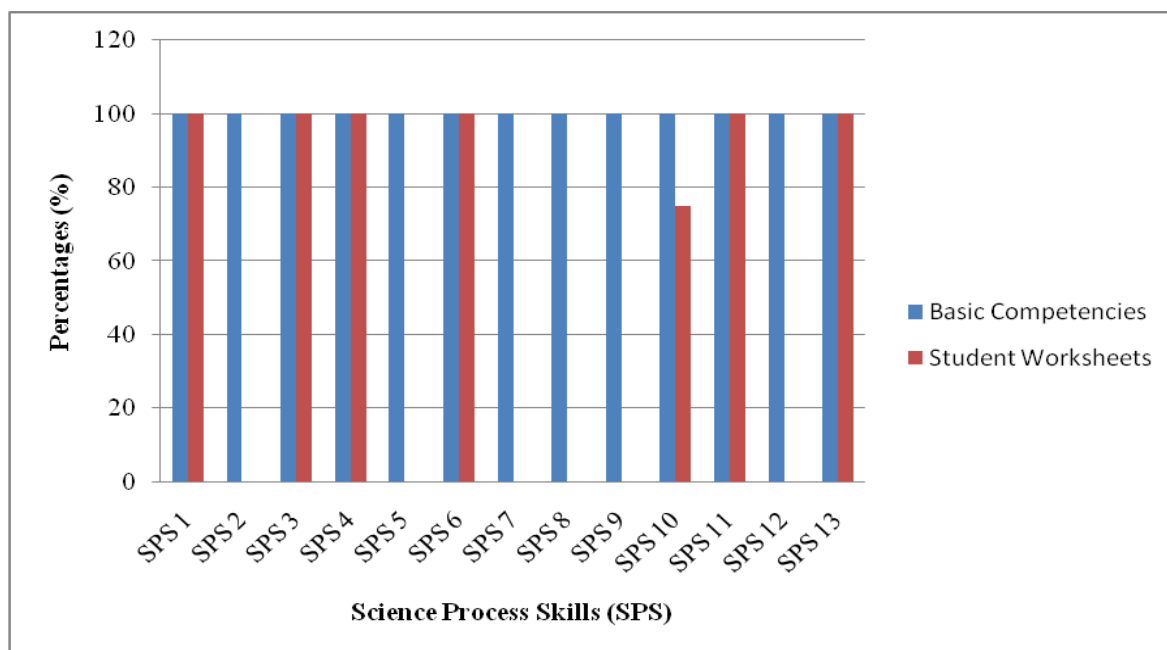


Figure 1. Percentage of SPS developed on basic competencies and student worksheet.

Description: SPS 1 (observing), SPS 2 (predicting), SPS 3 (inferring), SPS 4 (classifying), SPS 5 (measuring), SPS 6 (communicating.), SPS 7 (constructing hypothesis), SPS 8 (identifying variables), SPS 9 (defining variables), SPS 10 (tabulating and graphing data), SPS 11 (analyzing investigations), SPS 12 (designing investigations), SPS 13 (experimenting).

Based on figure 1, basic competencies are required to develop various scientific process skills. However, on student worksheet, it has not facilitated students to be able to develop all science process skills, according to the demands of the curriculum 2013. This can be seen in the graph, SPS of predicting, identifying variables, constructing hypothesis, defining variables, and designing investigations have not yet been developed on student worksheet.

3.2. The Basic Science Process Skills (BSPS) and Integrated Science Process Skills (ISPS) Developed in Basic Competencies of Curriculum 2013 and Student Worksheet

The category of SPS in each basic competency is counting by the number of BSPS or ISPS from each of the basic competencies of curriculum 2013 divided by the total number of science process skills, then multiplied by 100%. The category of SPS for basic competency can be seen by adding up the total percentage of all basic competencies, then divided by the total number of basic competencies.

Table 2. The Science Process Skills (SPS) category developed in basic competencies

Basic Competencies	Potency	Basic Science Process Skills/BSPS (%)	Integrated Science Process Skills/ISPS (%)
3.4	13	46.2	53.8
3.5	13	46.2	53.8
3.6	13	46.2	53.8
3.7	13	46.2	53.8
4.4	13	46.2	53.8
4.5	13	46.2	53.8
4.6	13	46.2	53.8
4.7	12	46.2	53.8
Average (%)		46.2	53.8
Sum (%)		100	

Table 2 shows that the average of BSPS in basic competencies was 46.2%, while the average of ISPS was 53.8%. This means that the category of SPS in the basic competencies of curriculum 2013 more develops ISPS compared to BSPS. The category of SPS developed in the student worksheet is counting by the number of basic or ISPS from each chapter in the student worksheet divided by the total number of science process skills, then multiplied by 100%. The category of SPS developed in the student worksheet can be seen by adding up the total percentage of all chapters in the student worksheet, then divided by the number of chapters in the worksheet.

Table 3. The Science Process Skills (SPS) category developed in student worksheet

Chapter	Potency	Basic Science Process Skills/BSPS (%)	Integrated Science Process Skills/ISPS (%)
Virus	6	30.8	15.4
Bacteria	8	38.5	23.1
Protist	8	38.5	23.1
Fungi	7	30.8	23.1
Average (%)		34.6	21.2
Sum (%)		55.8	

Table 3 shows that the worksheet in bacteria and protist chapter developed the most SPS compared to the other chapters. This can be seen from the number of SPS developed by 8 SPS out of a total of 13 science process skills. Whereas the student worksheet in the virus chapter develop the least SPS compared to the other chapters. This can be seen from the number of SPS developed by 6 SPS from a total of 13 science process skills. Table 3 shows that the average of BSPS in student worksheet is 34.6%, while the average of ISPS is 21%. This means that the category of SPS in student worksheet more develops BSPS compared to ISPS.

BSPS is important to be applied in learning biology and concept formation at the elementary and junior high school levels, while ISPS is more suitable to be applied at the high school and university levels [16]. Biology teachers have compiled and used student worksheet that developed SPS with a percentage of 55.8%. This percentage is obtained by summing the average SPS in student worksheet. This means that the teacher has not reached the maximum percentage of 100% in compiling and using student worksheet. The percentage of 100% was obtained by adding up the average of SPS to the basic competencies of curriculum 2013.

The category of SPS in student worksheet tends to develop BSPS because BSPS have an important role compared to ISPS because BSPS are a prerequisite in mastering integrated science process skills.

ISPS are SPS that shape skills in solving various problems [17]. If students are able to understand basic science process skills, then to learn ISPS will be easier. The SPS developed in student worksheet are in line with the type of SPS required in the formulation of the 2013 curriculum's basic competencies. But, based on this research, improvement in the worksheet is needed that can provide facilities for students to more develop science process skills.

4. Conclusion

The results of the research that 1) the science process skills (SPS) developed in student worksheet is basic science process skills (BSPS) and integrated science process skills (ISPS); 2) the basic science process skills (BSPS) that developed in biology worksheet is observing, inferring, classifying and communicating, while the integrated science process skills (ISPS) that developed in the worksheet is tabulating and graphing data, analyzing investigations, and experimenting. The science process skills (SPS) developed in student worksheet are in line with the type of science process skills (SPS) required in the formulation of the 2013 curriculum's basic competencies.

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