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Analysis of Sciences Process Skills of Science Education Students in Microbiology Practice

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ABSTRACT

This study aims to assess the science process skills level of Science Education Study Program Teacher Training and Education Faculty Lambung Mangkurat University (FKIP ULM) students in the 2020/2021 academic year. This research employed a qualitative research. Data collection was conducted using validated scientific process skills observation sheets. Observations were made on 27 students of the Science Education Program FKIP ULM who conducted SPS-based practicum activities The data obtained was analyzed descriptively qualitatively using percentages on the eight items in the SPS section, namely skills, formulating problem formulation, identifying variables, defining operationally, developing hypotheses, making observations, designing experiments, analyzing data/information, and making conclusions. The results showed that student SPS is categorized very well on basic SPS and sufficient category on integrated SPS (defining variables operationally, designing experiments, and analyzing data/information). It directs learning to improve on integrated SPS so that in the end students can master the integrated SPS well.

Keywords: science process skills, students, microbiology practice

INTRODUCTION

The Microbiology course is a mandatory practical subject for undergraduate students of the Science Education Study Program, Faculty of Teaching and Education, University of Lambung Mangkurat. The scientific process is obtained through providing theory in lecture activities, while skills are obtained through practical activities to provide laboratory skills for prospective science teachers (Kenengsih, 2017). Practical activities in the microbiology course are carried out by carrying out practicum in the laboratory (Kenengsih, 2017).

Practicum activities are important because they can generate motivation to learn science and develop basic skills in carrying out experiments. besides that, it can be a vehicle for learning scientific approaches and supporting understanding of subject matter (Suryaningsih, 2017). The skills obtained from the practicum can be used as an example or practice for prospective science teachers before teaching at school. This is because today's teachers must be able to create learning that is not focused on rote exercises (Daniah, 2020). Teachers must be creative to adapt learning to the demands of the twenty-first century, one of which must be mastering science process skills.

Problem of Research

Students can improve a range of abilities through practicum. Students studying scientific education who intend to become teachers or instructors and need to develop a variety of teaching techniques might benefit from this. Today's teachers must be able to create learning that is not focused on memorizing exercises. Teachers need to be creative in order to adapt learning to the demands of the twenty-first century. Science process skills are one of the abilities that may be acquired to equip teachers for the twenty-first century (Lepiyanto, 2017). Although practicum activities continue to be carried out, the assessment of science process skills as an objective has not yet been carried out, especially in the microbiology course in the Undergraduate Science Education Program at Lambung Mangkurat University. Several studies on the analysis of science process skills were carried out in physics courses (Darmaji, et al., 2018; Hasyim, 2018).

Science learning including microbiology needs to hone students' science process skills (SPS). A number of benefits can be obtained if learning is directed to the formation of science process skills, including: (1) encouraging students to be active in learning; (2) involving students physically and mentally in learning; (3) enabling students to learn cooperatively; (4) training students to work like scientists who do not easily believe in something (Hasruddin et al., 2018). SPS is needed to learn and comprehend science as a whole, so that it can solve problems in everyday life (Hunaepi et al., 2020). Science process skills are very necessary for a student to prepare to face the challenges of an increasingly tough future. Students are required to have various skills to get a decent job (Arsyad & Sartika, 2021).

Students majoring in science and those enrolled in academic study programs based on scientific disciplines must possess science process skills (SPS). In order to build a knowledge of scientific concepts to support subsequent abilities, one has to be able to process actions as well as scientific reasoning (Darmaji et al., 2018). SPS is a fundamental skill necessary for mastering science and may assist students with finding solutions to issues encountered in daily life. SPS is therefore crucial for students (Syazali et al., 2021). Through the practicum, students are exposed to both naturally occurring situations and ones that have been artificially altered through research.

Practicum that is very supportive of the achievement of the scientific process that needs to be applied in learning to develop students' abilities in process skills such as observing, interpretion, asking questions, hypothesizing, planning experiments, applying concepts, and communicating. Science Process Skills (SPS) are thinking skills so that SPS is very crucial to develop good concepts for students. Lepiyanto (2017) explains that the science process skills (SPS) approach is a learning approach that is oriented to the Science/Biology process.

Research Focus

The SPS indicators used in this study proportionally cover eight aspects of skills which include formulating problem formulations, identifying variables, operationally defining, formulating hypotheses, making observations, designing experiments, analyzing data/information, and making inferences. This research is expected to be able to clearly reveal the level of SPS possessedd by students majoring in science education FKIP Lambung Mangkurat University so that it can then be used as a reference or consideration in developing learning tools as well as appropriate methods and approaches for students in understanding scientific attitudes and concepts of science, to later can be applied in everyday life and in the world of work as a teacher of science subjects.

Based on the background that has been described, this study is conducted to determine the level of SPS owned by students majoring in science education, FKIP University of Lambung

Mangkurat, in microbiology practicum activities. The assumption underlying this research is that the SPS level in the implementation of microbiology practicum provides opportunities for students to prove themselves the theories they have acquired in the classroom so that students can clearly understand the concept of science and develop their own knowledge. Based on these assumptions, the hypothesis in this study is that the use of a science process skills-based microbiology practicum guide is able to provide students with an understanding of scientific attitudes and scientific concepts in the implementation of Microbiology practicum.

METHODOLOGY OF RESEARCH

General Background of Research

This research employed a qualitative descriptive study about student SPS through Microbiology practicum activities. The research was conducted during the Microbiology Practicum course at the Science Laboratory, Faculty of Education and Teaching Science. Observation activities in this study took place in three meetings.

Subject of Research

The research sample was all 27 students majoring in science education, Faculty of Education and Teaching Science Lambung Mangkurat University who enrolled in Microbiology course in the academic year 2022/2023.

Instrument and Procedures

The SPS measured in this study includes formulating problems, identifying variables, operationally defining, developing hypotheses, making observations, designing experiments, analyzing data/information, and making inferences. Data on SPS were collected using a performance assessment sheet (PAS). The SPS instrument is listed in Table 1.

Table 1. SPS Instrument

SPS	Indicator
Formulate a problem statement	Make a problem statement
Identify variables	a. Determining variables b. Determine what to measure and observe
Operationally defined	Determine the operational definition in accordance with the variable that have been determined
Develop hypotheses	a. Knows more than one possible explanation b. Realize that one explanation need to be verified
Make observations	a. Use as many sense as possible b. Gather or use relevant facts
Designing experiments	a. Determine the tools and materials used b. Determine what will be implemented in the form of work steps
Analyze data	Using the concepts that have been studied based on the data obtained.
Make conclusion	Arranged conclusions based on practical results

Data Analysis

The data that was collected then analyzed descriptively using the following equation:

$$\text{NPKS} = \frac{\text{Score of each SPS}}{\text{Maximum scor e of SPS}} \text{ x } 100$$

Result of the analysis data are interpreted based on the Table 1:

Table 1. Criteria for Student Scientific Process Skills

Score	Category
≤ 20	Very poor
> 20-40	Poor
> 40-60	Fair
> 60-80	Good
> 80-100	Very good

RESULTS AND DISCUSSION

Based on data collecting in this research, data was analyzed by formula and was categorized by criteria in the table 1. Result of the analysis can be seen in the Table 2.

Table 2. SPS Category by SPS Score

SPS Components	SPS Score (%)	Category
Problem Statement	83.11	Very good
Identifying Variables	90.04	Very good
Variable Operational Definition	50.79	Fair
Making a Hypothesis	83.11	Very good
Making Observations	96.96	Very good
Designing Experiments	55.41	Fair
Analyzing data/information	55.41	Fair
Making Inferences	69.26	Good

Based on Table 2, the science process skills of students of the science education study program FKIP ULM according to 8 skill items showed the highest SPS score of 96.96 for skills in making observations and the lowest SPS score of 50.79 for skills in defining variables operationally. SPS as an inquiry is grouped into two, namely basic SPS and integrated SPS. The two SPSs are interrelated, this can be seen in the basic SPS with high categories, such as making observations, formulating problems, and making inferences (Harahap et al., 2019).

In line with the findings of Liunokas (2020) and Widdina, et al (2018) showing that SPS makes observations that have the highest value, followed by SPS to identify variables. It is understood that science begins with the process of observation, inference and making conclusions is the result of the process of observing. Lubis, et al (2022) add that inference is the process of drawing conclusions from the observed phenomena. According to Harahap, et al (2019) it is good that SPS relies on daily experiences (activities), and practicing these activities in the learning process.

Students get meaningful experiences through observation activities to collect data and find facts related to learning materials. Observing is a process that involves the five senses to collect data and find facts from the object to be studied, the data collected can be in the form of qualitative or

quantitative data (Abdullah, et al., 2015; Molefe et al., 2016). Before conducting the experiment, the identified variables were then defined operationally.

Variable identification skills require to determine the independent variable and the dependent variable. Student skills in identifying categorical variables are very good. These results can be stated that students understand the concept of causality, as stated by Schwichow, et al (2022), namely the relationship between concepts can be defined as the relationship between the observed variables and the concept of causality cannot be defined based on the causal concept itself.

Experiments depend on how the variables to be observed are defined operationally, one must operationally define the object to be observed, and on student SPS measurements, this aspect (defining variables operationally and designing experiments) has sufficient category. This result is reinforced by the findings of Liunokas (2020), namely that the integrated SPS which has sufficient categories, among others, defines operational variables, formulates hypotheses, and formulates models (modelling), as also found by Widdina, et al (2018), SPS designs the investigative process has a sufficient category.

SPS makes inferences have a good category, this shows that students can make good conclusions from the results of the experiments carried out. According to Utami, et al (2019) conclusions are made based on observations and relevant evidence obtained during the practicum process. A conclusion can be obtained through deductive reasoning and inductive reasoning. The activity of inferring from general premises to something more specific is a form of inductive reasoning. Deductive reasoning comes to a conclusion after considering observations and facts. The ability to construct inference is very important because it is used as the basis for making the final decision on the problem being investigated (Hunaepi, et al., 2020).

SPS operationally defines and experimental design is categorized as sufficient. This is influenced because students are rarely taught how to operationally define and design experiments. Therefore, it can be stated that microbiology practicum activities have not been able to train operationally defining skills to prospective science teacher students, or in other words, statements in the ongoing learning process. Not only in microbiology course, but also in other subjects operationally defining skills are rarely trained.

Student's SPS is categorized as sufficient, it also occurs in experimental design skills (experiments). This is influenced by the learning culture, namely that in the learning process students are not trained to arrange or design experiments independently, but the steps or work processes carried out by students in conducting practicum or conducting experiments in the laboratory are steps or procedures. which has been prepared by the lecturer as a teacher. In line with Sujarittham, et al (2019) in his study of investigating students' abilities in designing physics experiments, stated that the low ability of students to design physics experiments was still low. This is influenced by students not understanding the core concept that will be tested, or the concept for which the experimental design will be designed. Therefore, in this case it is understood that the low SPS of students in designing experiments is caused by students not understanding concepts well, both concepts in designing experiments, and concepts to be experimented with.

The sufficient category also occurs in the student integrated SPS in terms of analyzing data/information. Teaching analytical skills both as part of SPS and as part of critical thinking skills, aims to help students to have the skills or abilities to analyze, compare, evaluate, assess, and make decisions (Taleb & Chadwick, 2016). The process of facilitating the acquisition of analytical skills can be done through the application of SPS in the learning process. It is stated that the sufficient category in the SPS analyzes the data/information because the learning process that takes place in the lecture process is a learning process that emphasizes more on basic skills, or in other words the

statement that the learning process that is carried out emphasizes more (more dominantly) on skills. formulate problems, identify variables, formulate hypotheses, make observations, and make inferences.

CONCLUSIONS

This study aims to analyze student SPS and based on the results obtained that student SPS is categorized very well on basic SPS and sufficient category on integrated SPS (defining variables operationally, designing experiments, and analyzing data/information). Integrated SPS is a more difficult SPS than basic SPS since integrated SPS requires a higher cognitive level. Thus, based on these results, it directs the learning to improve on integrated SPS so that in the end students can master the integrated SPS well.

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