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ANALYSIS OF SCIENCE PROCESS SKILLS IN PHYSICS EDUCATION STUDENTS

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Abstract

This study aims to analyze students' science process skills on specific heat material by reviewing two aspects of basic science process skills indicators (observation and classification), and two indicators of integrated science process skills (identifying variables and making hypotheses). This research uses a descriptive quantitative method. In this study, the sample used was 35 students of physics education of batch 2018 who were randomly selected. The assessment instrument used was the science process skills observation sheet with the skill score used in the form of a Likert scale. The results of the study show that the students' mastery of basic science process skills on the observation indicator is 65% in the good category, 30% in the high category, and 10% in the category of not good to low, whereas, the classification indicators obtained are 54.3% and 37.1% of students have mastered classification skills in both good and high categories. The remaining 8.6% are classified in the not good category. For the mastery of integrated science process skills in the variable identification indicator, 60% of them are in the good category and 14.3% in the high category. The rest are in the category of not good and low. For the indicators of skills in making hypotheses, 65.7% and 14.3% are in the good and high categories. It proves that physics education students have mastery of science process skills that are in the good category.

Keywords: *education, science process skills, prospective teachers*

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Introduction

Education, as a conscious effort to realize fully Indonesian people, namely, people who believe and have faith in God the Almighty, are noble, healthy, knowledgeable, capable, creative, independent, responsible, and become citizens who are democratic, is a process of improving the lives of Indonesian people (Kurniawan, Astalini, & Anggraini, 2018, p. 125). Education is a conscious and planned effort to create an atmosphere of learning and learning process so that students actively develop their potential.

Education in Indonesia has been well-integrated and needs further development. Continuing education should be closely related to the curriculum used. The curriculum has two aspects, namely as a plan that must be used as a guideline for the implementation of the teaching and learning process, and as a tool to achieve educational goals (Astalini, Darmaji, Kurniawan, & Destianti, 2019, p. 3). As a process, education must be done in stages starting from basic education to higher education. Each level of education has different characteristics in the knowledge learned, in accordance with the development of students themselves, for instance, high school students will not be the same as elementary and junior high school students (Astalini, Kurniawan, & Sumaryanti, 2018, p. 59). The frequent change of curriculum in schools is due to the fact that it is not appropriate or the learning application is not according to the curriculum. The current curriculum used is the 2013 revised curriculum, so that students are expected to have a scientific attitude in learning (Astalini, Kurniawan, Melsayanti, & Destianti, 2018, p. 216).

In accordance with the 2013 curriculum, high school students have been set on future career choices. It is shown by the selection of majors, namely, Mathematics and Natural Sciences or Social Sciences. The selection of these majors is in accordance with the abilities seen from the interests and talents of the students. In the Mathematics and Natural Sciences major, they will receive lessons focusing on Physics, Biology, and Chemistry (Reza, Syukur, & Soeleman, 2017, p. 57). Usually, the selection of these majors also determines the selection of study programs in tertiary institutions.

Physics is usually always a difficult subject for students so that not many people are interested in taking courses related to physics. Many factors make physics difficult for students. The most frequently-occur factor is that the students must memorize the whole formula given by the teacher, which is a conventional way of learning (Astalini, Kurniawan, & Sumaryanti, 2018, p. 59). One third of students carry it over until they study in higher education (Astalini, Kurniawan, Perdana, & Kurniasari, 2018, p. 475). The method of memorizing learning is the lowest level of the learning sphere raised by Bloom, known as Bloom's Taxonomy. Memorizing is in the lowest realm of knowledge (Netriwati, 2018, p. 349). In fact, the curriculum of all countries is based on Bloom's taxonomy.

The domains discussed in this knowledge are six levels, namely C1 to C6, from the lowest, that is, knowing to create works, while the memorization part is only in the first cognitive domain or C1 (Prasetya, 2012, p. 108). Higher education certainly leads to how theory is obtained. Thus, the physics education study program is required in the field of natural sciences to carry out practical activities which refer to the Indonesian National Qualification Framework (Darmaji, Kurniawan, Parasdila, & Irdianti, 2018b, p. 346). One of the references to be achieved is skills that are specialized in process skills (Darmaji, Kurniawan, & Suryani, 2019, p. 2). Skills also include behavior, which is an important process of one's self. Process skills are the skills of students to carry out activities related to practice, where students are required to experience themselves and discover and connect the results of practicum with theory to write the formula mathematically (Lestari & Diana, 2018, p. 49). Direct student involvement will make it easier to understand the concepts of the theory being studied.

When choosing majors related to natural science, especially physics, students must take part in practical activities. Practicum activities will help students understand the courses taken better. Basic physics is one of the compulsory subjects for physics education students (Septiyanto & Darman, 2018, p. 14). In practicum activities to provide process skills for observational indicators, it must be ensured that students already have information and knowledge about the material to be practiced (Supahar & Prasetyo, 2015, p. 98) through the practicum guides. The material in two basic physics courses includes metal heat. Metal heat cannot be taught only by giving the material in class. It also has to go through experimental activities in the laboratory (Nugroho & Suliyanah, 2018, p. 355). By conducting experiments in the laboratory, students' scientific processes can be improved.

Practicum activities that prioritize process skills are also indicated in 21st-century education, where the practicum will provide a place for students to analyze and evaluate with a critical mind of the results of the experiment (Pop, 2014, p. 1). The 2013 curriculum certainly has a striking difference compared to the curriculum that has been previously set (Setiadi, 2016, p. 167), where the core competencies are classified into four, namely social attitudes, spiritual attitudes, knowledge, and skills. 21st Century education is an education that guarantees students to be able to improve their soft skills (Andrian & Rusman, 2019, p. 15). The 2013 curriculum has been integrated with 21st-century education wherein the 2013 curriculum, there is a scientific approach (Bancong & Putra, 2015, p. 28). The scientific approach is the *5M* approach, namely: observing (*mengamati*), asking (*menanyakan*), gathering information or data (*mengumpulkan informasi atau data*), associating (*mengasosiasi*), and also communicating (*mengomunikasikan*) (Wahyuni, Indrawati, Sudarti, & Suana, 2017, p. 166). This scientific approach is a very natural approach in the learning process.

For these demands, students must have science process skills. Science process skills are a skill that provides a means in science learning, research, and active learning, building a sense of responsibility when learning and increasing knowledge (Darmaji, Kurniawan, & Irdianti, 2019). Science process skills include: asking questions, observing, predicting, and simulating (Lestari & Suliyanah, 2014, p. 61). Those elements will increase the professionalism of students as future teacher candidates.

As future teacher candidates, it is necessary to analyze how the science process skills possessed by physics education students (Siswono, 2017, p. 84). By direct observation in practicum activities undertaken, especially as a prospective physics teacher or natural science teacher, he/she must have scientific process skills.

In this process skills, two scopes can be known, namely basic process skills and integrated process skills (Khaerunnisa, 2017, p. 342). Based on research conducted by Darmaji, Kurniawan, Parasdila, and Irdianti (2018a, p. 497), the science process skills of students in University of Jambi are good enough for the 2017 class.

Based on the aforementioned explanation, the researchers tried to analyze the process skills in the 2018 physics education students of University of Jambi, especially in the practicum method. What will be seen are indicators of students' process skills for the basic skills of the indicators observed and classification and skills, while the integrated indicator is the identification of variables and creating hypotheses. Good science process skills can illustrate the students' knowledge (Srirahayu & Arty, 2018, p. 169). Through good science process skills, students certainly have a strong motivation to learn and have critical thinking skills seen from the classification indicators and making hypotheses.

Research Method

This research uses a descriptive quantitative research method. Quantitative methods are a numerical method of research. This type of research usually connects the attachment between variables (Creswell, 2014, p. 288). The purpose of this study is to know the mastery of science process skills, especially on basic process skills indicators (observation and classification) and integrity skills indicators (variable identification and hypothesis). This study involved 35 students of the Physics Education Study program of batch 2018 in Jambi, which was currently taking the Primary Physics Course 2.

Data retrieval was conducted with an electronic-based observation score sheet. This observation sheet refers to the value of the Linkert scale which employs the highest Strongswan 4 (Astalini, Darmaji, Kurniawan, Anwar, & Kurniawan, 2019, p. 25). The selection of scale four is intended to adjust the criteria desired by the researchers, namely: (1) low; (2) not good; (3) good; and (4) high. To find out the mastery of science process skills of students who have known the minimum score (X min) and the maximum score (X max), then the ideal average score can be found by using the formula Mi = 1/2 (X max + X min) and looking for ideal standard deviation using the formula SDi = 1/6 (X max – X min). Based on these references, the ideal mean is 2.5 and the standard deviation is 0.5. Thus, students' mastery of science process skills can be grouped into four categories as presented in Table 1.

The data of students' science process skills were analyzed using the statistic descriptive method so that the score of the mean, median, mode, minimum score, maximum score, deviation standard, and percentage, which is viewed from the assessment indicator, results in the sheet observation of the science process skills (Darmaji, Kurniawan, Astalini, Lumbantoruan, & Samosir, 2019, p. 11). Then the data were presented in the table of the distribution.

Findings and Discussion

After analyzing the assessment sheet, the results of mastery of basic science process skills and students' integrated science process skills were found. The results of the mastery analysis of the students' basic science processes on observation indicators and classification can be seen in Table 2.

Table 1. Level of the Score of Process Skills

Score Interval Formula	Score Interval	Categories
$X > M + 1.5\ SD$	$X > 3.25$	High
$M + 0.5\ SD < X \leq M + 1.5\ SD$	$2.75 < X \leq 3.25$	Not Good
$M - 1.5\ SD < X \leq M + 0.5\ SD$	$3.25 < X \leq 2.75$	Good
$X \leq M + 0.5\ SD$	$X \leq 2.75$	Low

(Widoyoko, 2011, p. 238)

Table 2. Analysis of the Students' Science Processe Skills on Observation and Classification Indicators

Indicator	Classification: Score Interval	Category	Total	Mean	Min	Max	Std. Deviation	%
Observation	$X > 3.25$	High	12	3.34	3.00	4.00	0.48	34.3
	$2.75 < X \leq 3.25$	Good	23					65.7
	$3.25 < X \leq 2.75$	Not Good	0					0
	$X \leq 2.75$	Low	0					0
	Total		35					100
Classification	$X > 3.25$	High	13	3.29	2.00	4.00	0.62	37.1
	$2.75 < X \leq 3.25$	Good	19					54.3
	$3.25 < X \leq 2.75$	Not Good	3					8.6
	$X \leq 2.75$	Low	0					0
	Total		35					100

Based on Table 2, it can be seen that from the mastery of science process skills of 35 students in the observation indicator, 23 students are in the good category (65.7%) and 12 students are in the high category (34.4%). Besides, a mean of 3.34, a minimum score of 3.00, a maximum score of 4.00, and a deviation standard of 0.48 are obtained. Meanwhile, in the classification skills indicator, 19 students are in the good category (54.3%), 13 students are in the high category (37.1%), and three students are in the not good category (8.6%). A mean of 3.29, a minimum score of 2.00, a maximum score of 4.00, and a deviation standard of 0.62 are obtained.

Based on the data, 23 students have a basic science process on the observation indicator that is already at a good level, while the other 12 people have skills of observation science process at an excellent level. Basically, observation is the first step of an activity, so it must be strengthened at the beginning (Darmaji, Kurniawan, Suryani, & Lestari, 2018, p. 242). The aforementioned results show that the level of the process skills observation skill for observation indicator is well-owned by the physics education students at the University of Jambi.

Furthermore, in the classification indicator, three physics education students are still in the category of not good (8.6%). Then, 19 students have science process skills for the good category (54.3%), while the rest 13 students have excellent science process skills (37.1%). Thus, physics education students at the University of Jambi have mastered the science process skills in the indicator of classification well. Classification is part of the basic science process skills, a second indicator that must be strengthened by the students of physics education of Jambi University after observation skill (Puspita, 2016, p. 31). Classification is also an important thing to do before experimenting. When students are able to classify according to the order or practical measures, it proves that the students are able to distinguish which ones to measure and which ones to weigh.

The information in Table 2 indicates that the physics education students of University of Jambi have a good mastery of basic science process skills. However, students are more proficient in the basic science process skills on the observation indicator with the largest percentage of 65.7%.

Having basic skills is also necessary to know the mastery of the integrated science process skills, where integrated process skills are the enhancement skills of the basic skills in which the indicators are interconnected. There are two indicators that are examined in the science process skills of physical education students. The first integrity indicator is the variable identification and the second indicator is hypothesized experiment results. To know the mastery of the students' integrated science process skills on the indicators of variable identification and creating hypotheses, we can see Table 3.

Table 3. The Mastery Analysis of Student Science Process Skills on Variable Identification and Creating Hypotheses Indicators

Classification				Mean	Min	Max	Std. Dviation	%
Indicator	**Score Interval**	**Category**	**Total**					
Variable Identification	$X > 3.25$	High	3	2.80	1.00	4.00	0.80	14.3
	$2.75 < X \leq 3.25$	Good	6					60.0
	$3.25 < X \leq 2.75$	Not Good	21					17.1
	$X \leq 2.75$	Low	5					8.6
Total			35					100
Creating Hypotheses	$X > 3.25$	High	5	2.91	1.00	4.00	0.66	14.3
	$2.75 < X \leq 3.25$	Good	23					65.7
	$3.25 < X \leq 2.75$	Not Good	6					17.1
	$X \leq 2.75$	Low	1					2.9
Total			35					100

Table 3 provides an overview of the science process skills of 35 physical education students for a metal-type test of a variable identification indicator. It is apparent that there is a variable identification skill level. At the lowest level, 8.6% or three students have a high category of variable identification skills. In the next level, 17.1% or six students have not a good category in variable identification skills, and 60% or 21 students have a well-categorized variable identification. Meanwhile, the remaining 14.3% or five students have skills of variable identification in the science process in the category of very well. Further, a mean score of 2.80, a minimum score of 1.00, a maximum score of 4.00, and a standard deviation of 0.80 are obtained.

Table 3 also provides information related to the hypothesized indicator of a metal-type Calor experiment. From Table 3, it is known that there are one or 2.9% of students who have the skills to make the category hypothesis very unwell. Then, 17.1% or six students have the skills of creating hypotheses in a not good category. A total of 23 students or 65.7% have a science process skill to create hypotheses, or it is categorized into a good category. The remaining 14.3% or five students have the skills to create hypotheses that belong to the category of very well. Further, a mean score of 2.91, a minimum score of 1.00, a maximum score of 4.00, and a standard deviation of 0.66 are obtained.

Based on the information in Table 3, it can be concluded that the physics education students of University of Jambi have a good mastery of integrated science process skills. It is indicated by the percentage in each indicator which is in a good category. However, the students master the integrated science process skills on the indicator of creating hypotheses more, shown by the largest percentage of 65.7%.

After the variable identification, of course, in the practicum, a temporary hypothesis would be made for the results of experiments conducted from the theory studied. After the theory was studied, then, it is attempted to prove the theory. This indicator is very important in a process skill. Creating hypotheses will make students think about the influence of each existing variable in the experiment practice of metal type heat. This process is part of the results of collecting information. When students create hypotheses, it means that the learning has been in progress with a scientific approach, where learners are able to make a temporary suspicion after observing the variables in the metal-type Calor experiments. Based on those data, the physics education students of University of Jambi have mastered the science process skills well.

Conclusion

The remoteness of the science process greatly helps students conduct scientific activities, one of which is a physics education students who are obliged to perform a practicum on a basic physics course. One of the basic physical materials is temperature and heat. Temperature and heat are material that is mandatory for the experiment. In the experiments, the skills of the process especially the science process are certainly needed. Based on the research conducted, there are two kinds of science process skills: basic science process skills and integrated science process skills. This research has focused on the observation and classification indicators for basic science process skills, while variable identification and creating hypotheses indicators are for the integrated science process skills.

The result of this study concludes that in the basic science process skills of physics education students, few students still have ungood observation skills and it proves that the observation skills of physics education students are already in the good category. For the classification indicator, there are still very few students who have high classification skills and very few of them do not have good classification skills. Likewise, in the integrated science process skills, for the variable identification and creating hypotheses, the average physics education students have the skills of identifying variables and creating hypotheses. Therefore, the physics education students of University of Jambi in batch 2018 have mastered science process skills in the good category.

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