

Received : 13 August 2020  
Revised : 25 June 2021  
Accepted : 25 July 2021  
Online : 30 July 2021  
Published: 30 July 2021

DOI: doi.org/10.21009/1.07108

# Comparison of Basic Science Process Skills for Students on Electrical Materials with the Rasch Model Analysis

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## Abstract

Prospective teacher students must have good science process skills to create learning that focuses on science process skills-based learning. This study aims to describe the comparison of the basic science process skills of prospective elementary school teachers in electric subjects. This research is descriptive. The sample of this study was 184 students consisting of 104 students in the 4th semester and 80 students in the 6th semester. The data collection technique was using a test that consists of 25 questions about basic science process skills. Data analysis using the Wright Person Map in Rasch Model. Based on the results, the researcher obtained information that most prospective elementary teachers' science process skills were classified as moderate. In addition, the results were obtained that the science process skills of 6th-semester students were better than the 4th semester. This research also found that the science process skill of female students was better than male students.

**Keywords:** basic science process skill, prospective teacher, electric, rasch model

## INTRODUCTION

A scientific process becomes the basis for the formation and development of science or what is commonly known as Natural Science. Students need to develop science within themselves as a form of providing meaningful experiences. This meaningful experience can be used to equip these students in the form of skills in an effort to develop themselves to the next stage. Learning science starts from asking about specific events, phenomena, or symptoms until answers to those questions. A person's skills honed through science are the skills of doing the scientific activities themselves. These skills are called science process skills.

Science process skills (SPS) are fundamental in meaningful learning because learning is carried out throughout life, and each individual must be able to find, interpret and make conclusions from existing evidence even though they are in different conditions (Karamustafaoğlu 2011; Rahayu & Anggraeni 2017; Hernawati et al. 2018). Science process skills can be an approach used as a reference for teachers to design and implement science learning processes. Learning with the Science process skills approach is more focused on building skills in gaining knowledge and then communicating that knowledge (Haryadi & Pujiastuti 2019). Science process skills can be a way for students to investigate and understand the surrounding environment and build scientific concepts correctly (Gultepe 2016). Learning with the Science process skills approach emphasizes the existence of treatment in teaching and learning activities that emphasize using thinking skills and creative abilities efficiently and effectively to achieve learning goals.

Science process skills are divided into two categories. Those are basic process skills and integrated process skills. Basic science process skills are the beginning of the integrated science process skills forming. According to Wyne Harlen (Rustaman et al. 2005), science process skills have several aspects and characteristics described in TABLE 1.

**TABLE 1.** The Science Process Skills and Its Characteristics

No	Science Process Skill	Tha Characteristics
1	Doing Observation (Observation)	Using the senses that are owned (sight, touch, taste, hearer, and smell); Use of relevant facts
2	Interpret observations (interpretation)	Record every observation result; Linking observations
3	Grouping (classification)	Find regular patterns from observations; Make conclusions
4	Predict	Look for differences; Contrasting traits; Looking for common ground; Comparing; Search for the basis for the classification or pattern found
5	Communicate	Proposes an estimate of an event that has a tendency
6	Hypothesize	Read charts, tables, or diagram
7	Planning an experiment or investigation	Describe a chart, table, or diagram of empirical results
8	Using tools and materials	Describe the results of the experiment
9	Apply a concept or principle	Create, compile, and be able to convey structured and clear reports
10	Asking question	Create and declare a relationship of several variables to the cause of an event
11	Carry out experiments / experimentation	Determine tools and materials; Determine a variable or variable; Determine the sample variables and independent variables; Determine what has been observed, measured, or written; Determine a procedure and work steps; Determine how to process data

Basic science process skills include (1) ability to observe, (2) ability to measure, (3) ability to classify, (4) ability to conclude, (5) ability to predict, and (6) ability to communicate (Hernawati et al. 2018). According to (Gultepe 2016), basic science process skills include the ability to observe, deduce and classify, measure, predict, use numbers, communicate, and use space-time relationships. Some mention aspects of fundamental science process skills, including observing, classifying, communicating, measuring, stating the relationship between space and time, using images, inferring, and predicting (Sayekti & Kinasih 2017). Integrated science process skills are a combination of basic science process skills with the addition of several aspects. These aspects include (1) determining and controlling variables, (2) making/formulating hypotheses, (3) collecting data, (4) making operational definitions (Gultepe 2016; Hernawati et al. 2018). Some detailed aspects of integrated science process skills including (1) the ability to identify variables, (2) the ability to make tables, (3) the ability to make graphics, (4) the ability to describe the relationship between variables, (5) the ability to obtain and process data, (6) ability to perform investigative analysis, (7) ability to formulate a hypothesis, (8) ability to make operational definitions of variables, (9) ability to make investigative designs, and (10) ability to conduct experiments (Rauf et al. 2013; Aydogdu 2015).

Teachers must possess science process skills before the teacher creates opportunities for students to grow their science process skills through learning (Aydogdu 2015). This applies to prospective elementary school teacher students. Science process skills of prospective elementary school teacher students must also be well prepared through learning. Science learning must be designed to create opportunities for students to develop their science process skills maximally. Science process skills are a primary and critical component of a science learning process under teacher supervision (Ango 2002). A teacher has an important role and a positive influence on students' science process skills through an appropriate learning process (Rauf et al. 2013; Aydogdu 2015). If the teacher cannot create good science learning, students' science process skills will not develop. Teachers who do not understand science process skills well can hinder science process skills in the learning process (Sayekti & Kinasih 2017). Learning that is created appropriately and specifically to improve students' science process skills can positively impact improving student learning outcomes. Research (Abungu et al. 2014) obtained results that students' science process skills had a good effect on improving student learning outcomes. Anisa et al. (2014) also state that student learning completeness can be achieved effectively by using learning that is approached by science process skills.

Assessment of science process skills is used to assess students' ability to master all science process skills. There are two ways to measure a person's science process skills: prospective teacher-student, observation, and tests. Observations can be made in every classroom, laboratory, or field using the science process skills observation sheet format. The written test can be done using objective tests and/or descriptions. One of the instruments for measuring the science process skills test is a multiple-choice reasoning test. Multiple-choice tests have proven to be effective in measuring science process skills (Ilmi et al. 2016; Zainab & Wilujeng 2016; Ratnasari et al. 2017; Haniah et al. 2018). The previously developed reasoning multiple-choice test was used to measure the science process skills of prospective elementary school teacher students. This study aims to describe and compare the basic process skills of future elementary school teacher students on Electrical Material between 4th and 6th-semester students based on gender using Rasch Model analysis.

## METHODS

This research is a descriptive study that aims to provide an overview of the results of the comparison of the basic science process abilities of prospective elementary school teacher students. The subjects of this study were students of Elementary School Teacher Education at a private university in Jakarta. A total of 184 Elementary School Teacher Education students were sampled in this study. It consisted of 104 students in the 4th semester and 80 students in the 6th semester. Samples were taken randomly. The data collection technique used in this study was the science process skills test developed previously. The developed science process skills test was a reasoned multiple choices test consisting of 25 valid questions. The reliability of the instrument was 0.66. The student science process skills test results were then analyzed the data. Student science process skills data were then analyzed using the Rasch Model. There are so many studies that use analysis with the Rasch model. The Rasch model analysis provides information to researchers whether the data obtained ideally illustrates that people who have high abilities give patterns on answers to items according to their level of difficulty (Geramipour, 2021). In this study we use analysis with the Rasch model with Winstep software. The data processing results with the Rasch Model using Wright Person Map are then presented in the form of a percentage explaining the effects of student science process skills comparisons.

## RESULTS AND DISCUSSION

Science process skills data in this study were analyzed using the Rasch Model. The Rasch model is an alternative to describe prospective elementary school teacher students' basic science process skills completely. Analyzing this data is different from the calculations carried out in previous studies (Shahali et al. 2017). In a study conducted by Shahali (2017), data was collected using the SPS instrument. The instrument used was an instrument called the Science Process Skills Questionnaire (SPSQ) and was tested using Cronbach's alpha.

Descriptions of primary science process skills result for future elementary school teaching students in both 4th semester and 6th semester are presented using the Wright Person Map. The basic science process skills for 4th-semester students can be seen in FIGURE 1 below.

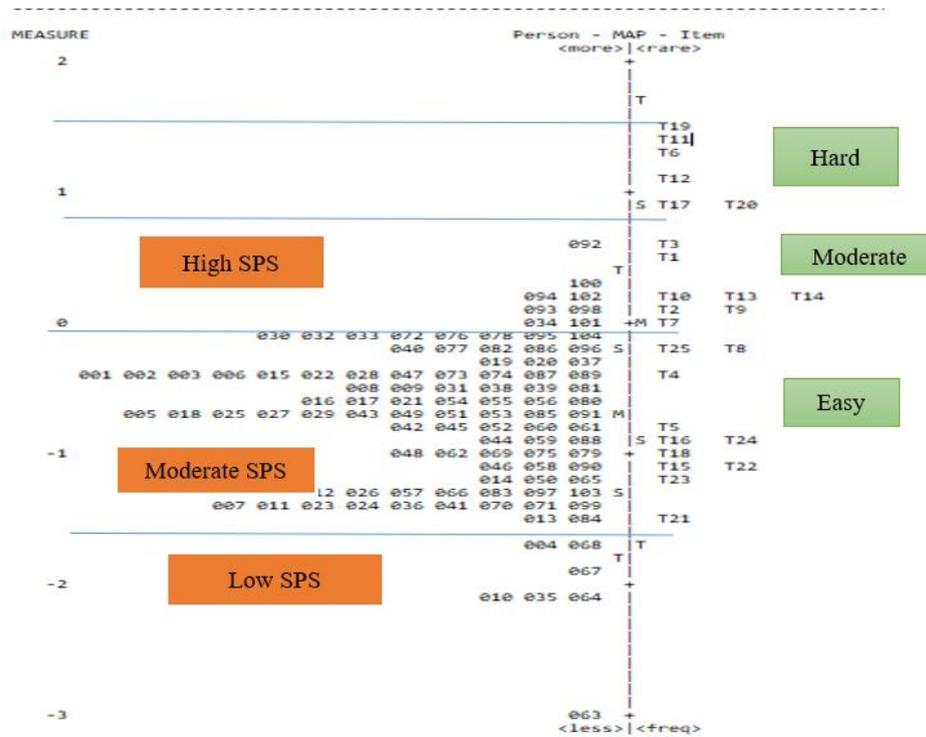


FIGURE 1. Wright Person Maps of SPS in 4th semester

The Wright person map shows the distribution of student science process skills and the level of difficulty of the items (questions). Based on FIGURE 1, it can be seen that the Science Process Skills of students are not higher than the difficulty level of the questions given. Student's Science Process Skills are said to be higher than the difficulty level of the questions if there are students whose position is higher than item T19 (item number 19 science process skills question). FIGURE 1 shows that the position of the student science process is entirely under this item, which means that the questions used can measure student science process skills well. 8 out of 104 students have high science process skills, namely students with codes 092, 100, 094, 102, 093, 098, 034, and 101. Students can have the high ability (high science process skills) because they are in a position above the average item 0.00. Seven students have low science process skills, namely students with codes 004, 010, 035, 063, 064, 067, and 068. As many as 89 out of 104 students were identified as having moderate science process skills. A complete summary of the 4th-semester science process skills analysis results can be seen in TABLE 2 below.

TABLE 2. The Analysis Result of SPS in 4th Semester

Science Process Skills Category	Low	Moderate	High
Number of Students	7	89	8
Percentage (%)	6.73	85.58	7.69
Numbers of Male Students	0	11	1
Percentage (%)	0	10.58	0.96
Numbers of Female Students (P)	7	78	7
Percentage (%)	6.73	74.42	6.73

Based on the data in TABLE 2, it can be seen that the majority of 4th-semester students have a moderate science process skills category with a percentage of 85.58%, where 74.42% are female students while male students who have science process skills in the medium category are 10.58%. 4th-semester students who have high science process skills are 7.69%, where 0.96% are male students, and 6.73% are female. This 4th semester, information was obtained that there were no male students who had low science process skills. As many as 6.73% of students who have low science process skills are female. For the 4th semester, both male and female students are in the moderate science process skills category. In general, male students' science process skills results were better than female students with two indicators, namely (1) For the high science process skills category, and male students were better than female students, and (2) male students who had low science process skills were not found.

The distribution of science process skills analysis results for prospective elementary school teaching students in the 6th semester can be seen through the Wright Person map as shown in Image 2. The distribution of science process skills results for 6th-semester students is also categorized as high, medium and low science process skills.

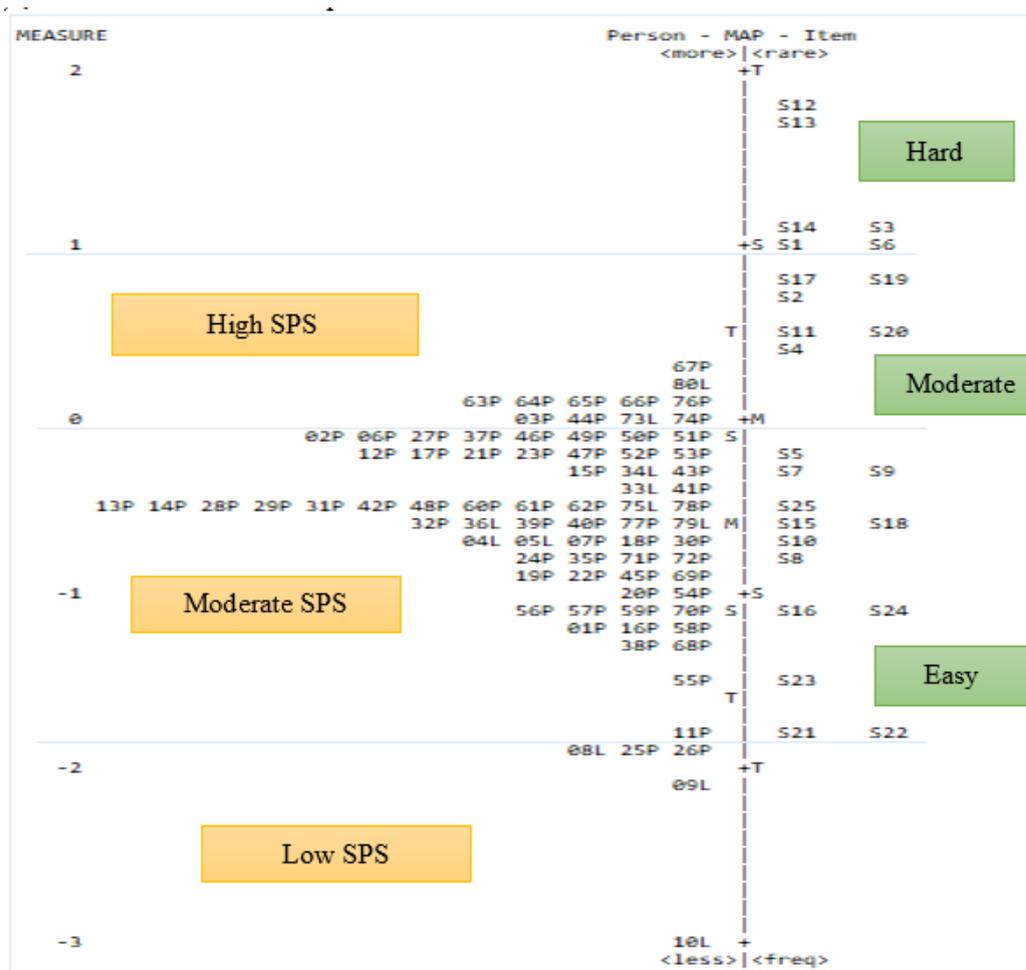


FIGURE 2. Wright Person Map of SPS in 6th semester

FIGURE 2 shows the overall distribution of person (left side) and item (right side) of 6th-semester students. It can be seen that the distribution of student science process skills abilities is from the highest to the lowest. There are 11 out of 80 participants who are classified as having high science process skills. As many as 5 out of 80 students have low science process skills. There are 64 of 80 students identified as having science process skills. The summary of the 6th-semester student science process skills results based on gender and the completion percentage is in TABLE 3.

**TABLE 3.** The Analysis Result of SPS in 6th Semester

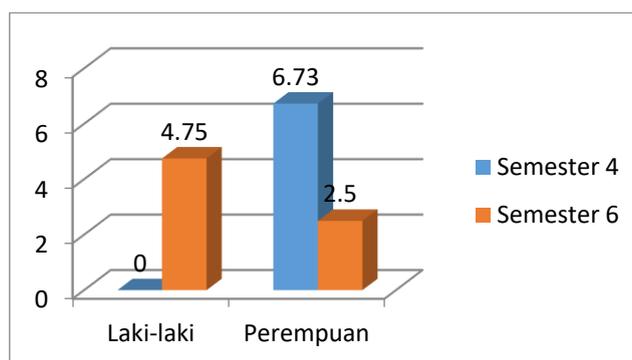
Science Process Skills Category	Low	Moderate	High
Numbers of Students	5	64	11
Percentage (%)	6.25	80.00	13.75
Numbers of Male Students	3	7	2
Percentage (%)	4.75	8.75	2.5
Numbers of Female Studnets	2	57	9
Percentage (%)	2.5	71.25	11.25

TABLE 3 provides information that the percentage of male students (4.75%) is higher than female students (2.5%) in the low science process skills category. In the moderate science process skills category, information was obtained that 8.75% of male students and 71.25% of female students were in the medium science process skills category. These findings provide information that female primary school teacher candidates are more dominant in moderate science process skills. In the high science process skills category, female students also dominate with 11.25% compared to male students with a percentage of 2.5%. In general, it can be seen that female students dominate at the medium and high science process skills levels, while male students are dominant at low science process skills levels. It can be stated that female prospective elementary school teacher students have better science process skills than male students. Comparison of Student science process skills for 4th Semester and 6th Semester in terms of gender differences can be seen in TABLE 4.

**TABLE 4.** The Comparison of SPS between 4th dan 6th semester

Science Process skills category	Entirety	4 <sup>th</sup> Semester		Entirety	6 <sup>th</sup> Semester	
		Male	Female		Male	Female
Low (%)	6.73	0.00	6.73	6.25	4.75	2.5
Moderate (%)	85.58	10.58	74.42	80.00	8.75	71.25
High (%)	7.69	0.96	6.73	13.75	2.5	11.25

Comparing the student science process skills analysis results in the 4th and 6th semesters shown in TABLE 4 can provide information that student science process skills for both the 4th semester and 6th semester are more dominant in the moderate category. The ability of 6th-semester students is more significant than 4th-semester students in the high science process skills category. Students in the 4th semester have a higher rate for the low science process skills category than the 6th semester, which means that more students in the 4th semester have low science process skills. Comparing the percentage of student science process skills for the low science process skills category based on gender is shown in FIGURE 3.



**FIGURE 3.** The Comparison of low SPS Based on Gender

Based on FIGURE 3, it appears that the students' science process skills ability in the 4th semester is better than the 6th semester for the low science process skills category. There are no male prospective elementary school teaching students with low science process skills (0% of male students in the 4th semester are classified as low science process skills). In contrast to male students, it was found that 6.73% of female students had low science process skills in the 4th semester, while for 6th semester, they had less percentage processing for students who had low science process skills. The complete comparison of the percentage of science process skills for the medium category is in FIGURE 4.

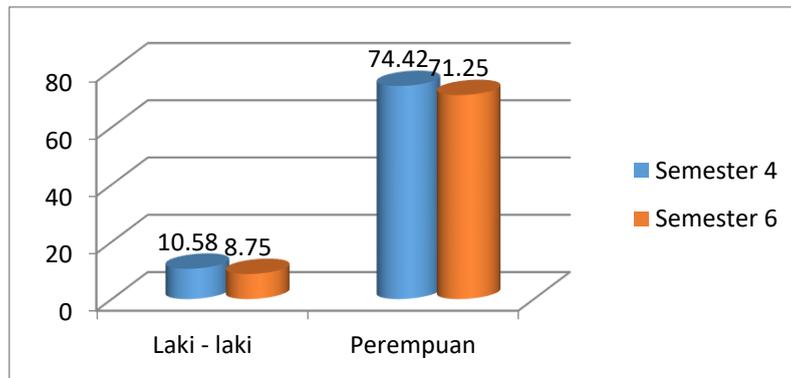


FIGURE 4. The Comparison of Moderate SPS Based on Gender

Comparing the percentage of science process skills in the medium category (FIGURE 4) shows that it is balanced between 4th semester and 6th-semester students. This finding informs that there is no significant difference between the 4th semester and 6th semester for science process skills, but it can be seen that the students' science process skills abilities in the 4th semester are better than those of 6th-semester students for the moderate category. Comparing the percentage of student science process skills for the high category is seen from the gender difference, more clearly in FIGURE 5.

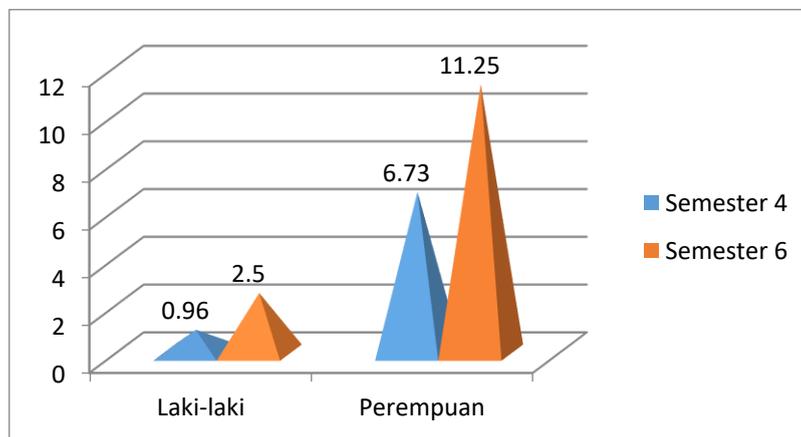


FIGURE 5. The Comparison of High SPS Based on Gender

FIGURE 5 provides information that the students in the high category of science process skills in the 6th semester are more numerous than students in the 4th semester. These findings indicate that more students in the 6th semester have high science process skills abilities than students in the 4th semester for both male and female students.

In general, this study obtained information that the majority of prospective elementary school teacher students' science process skills abilities were classified as moderate science process skills for both the 4th semester and 6th semester. The science process skills ability of 6th-semester students was better than 4th semester because of several indicators, namely (1) the percentage of 6th-semester students who had Low science process skills is less than in 4th semester and (2) the percentage of 6th-semester students who have high science process skills is more than 4th-semester students. The results of this study support research (Widayanti 2015), which states that someone who is at a higher level of

science process skills is usually better than to a lesser extent. This study indicates a need for improvement and follow-up efforts to improve the students' science process skills ability in the 4th semester so that there will be more student science process skills abilities in the high category. The indicator of the need for improvement is because the percentage for science process in the low sort is more and for science process skills in the high category is found to be less than in 6th semester even though there are more student science process skills than in 6th semester. In addition, information can also be obtained that the science process skills ability of female prospective elementary school teacher students better than male future elementary school teacher students. This is based on the indicator that the percentage of high science process skills and moderate science process skills of female students is higher than male students. This finding is in line with research (Aydogdu 2015) that, in general, female teachers' science process skills ability is higher than male teachers. Compared to the findings of (Rahayu & Anggraeni 2017), these findings are contradictory because these findings state that there is no science process skills influence between men and women.

The ability of science process skills of prospective elementary school teaching students in the 6th semester is better than in the 4th semester, indicating that there is a process of improving science process skills in the learning process, especially science learning. Prospective elementary school teaching students in the 6th semester have already taken most of the science learning that is planned in lectures. It is an essential note that these findings indicate that the science process skills of prospective elementary school teacher students are still dominant in the moderate category, so that efforts need to be made to improve and increase the learning process for future elementary school teaching students who are at lower levels. (Gultepe 2016) states that it is essential for a teacher to have and understand science process skills well to make it easier for students to investigate the surrounding environment in developing scientific concepts properly. This needs to be done because a teacher's science process skills, including prospective teachers, especially elementary schools, are important because it can affect the ability to design Science Process Skills-based learning. Science Process Skills-based learning is essential to implement because it has several positive impacts for students, including improving student learning outcomes (Abungu et al. 2014; Sari et al. 2017), students' mastery of concepts is getting better (Subagyo et al. 2009; Gultepe 2016), and practical to improve student learning completeness (Anisa et al. 2014).

## CONCLUSION

In general, the science process skills ability of prospective elementary school teacher students on electricity is classified as moderate science process skills, and 6th-semester students' science process skills are better than the 4th semester. Based on gender, it is found that female student science process skills are better than male students. It needs improvement in the learning process, especially in electricity, to increase the science process skills of prospective elementary school teacher students into a high category. The results of the fourth-semester student science process skills analysis showed that 6.73% of students who had science process skills were in a low sort, as many as 85.58% of students who had science process skills were in the medium category, and as many as 7.69% of students who had science process skills were in the high class. The results of the science process skills analysis for the 6th semester students were obtained as much as 6.25% of students who had science process skills in the low category, 80.00% of students who had science process skills in the medium category, as many as 13.75% of students who had the science process skills in the high class.

## ACKNOWLEDGMENT

Thanks to the Research and Development Institute of Universitas Muhammadiyah Prof. DR. HAMKA (UHAMKA), who allowed holding this research. Thanks to Elementary School Teacher Education, Faculty of Teacher Training and Education (PGSD FKIP) UHAMKA, who supported the implementation of this research.

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