

# Analysis of Science Process Skills on Science Learning in Primary School

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**Abstract :** Science process skills are very important to be developed in science learning because helps students develop their thoughts to make discoveries, therefore they can be assisted using scientific concepts. Science process skills become the provisions of students to develop and obtain new knowledge or knowledge they already have. Science process skills are divided into two namely basic process skills and integrated process skills. This study aims to describe the science process skills of fourth-grade primary school students which amounts to 29. This study only examines students' basic process skills which include observing, making hypotheses, planning experiments, conducting experiments and interpreting data. This type of research was qualitative research using data collection techniques, namely observations, interviews, and tests. Observations and interviews were conducted with teachers and fourth-grade students. The form of the test given is a multiple choice test to measure students' science process skills. Data analysis was performed using the analysis interactive model. The results of the study show that students achieve aspects observing 43%, aspects of making hypotheses by 62%, experimenting aspects by 34.5%, aspects of conducting experiments by 48%, and aspects of interpreting data by 19% are complete. Based on the results of the research shown in this process, fourth grade students are still relatively low.

**Keywords:** *analysis, science process skills, science learning*

## INTRODUCTION

The 21st century generation is better known as the millennial generation which demands the development of quality human resources to be able to compete in global competition. Quality education will create quality human resources too. In addition to being equipped with knowledge, students need to be equipped with thinking skills to be able to solve problems in daily life. One of the learning in schools that emphasizes the skills of students is through science. Parera (2014) states that science education is very important to be developed for developed countries and developing countries especially in the generation of 21<sup>st</sup> century.

Science learning is a vehicle for students to learn themselves and the natural surroundings, so that it can be applied in everyday life (Trianto, 2013). Science learning is very important to be mastered by students because it emphasizes providing direct experience to develop competencies and discover new knowledge scientifically. In addition to students being able to knowledge based on students' own experiences, science learning also trains students' skills in solving problems.

Science learning should be fun learning by doing a lot of experiments. The idea of Calis (2012) reveals that experiments can encourage student creativity to be able to improve skills in problem solving, hand skills, and communication skills so that the concept is understood more meaningfully. Learning carried out through experiments will assist students to understand the concepts conveyed by the teacher.

The facts in the field contradict the opinion of Calis, in fact experiments or experiments are rarely carried out by the teacher. This was evidenced by the results of an interview with a fourth-grade teacher at Diponegoro Islamic Elementary School on April 6, 2019 which revealed that experimenting was rarely done in the classroom, and had only done simple experiments. The results of the interview

are reinforced by the results of the Somantri's study (2018) which explains that around 92% of students are still under the KKM (Minimum Completeness Criteria) with an average score of around 53.78 due to lack of science learning such as conducting experiments / lab work.

The lack of experimental activities in the classroom for science learning has resulted in many misconceptions that have arisen in students so that science learning outcomes are also low. This phenomenon is evidenced by the results of the Program for International Student Assessment (PISA) study in 2016 which stated that Indonesia was ranked 62 out of 72 other countries in the field of science (IPA). Based on the results of the research, Indonesia is still far below Singapore, which at that time was ranked first and defeated the education system in Europe, North and South America (Berlianto, 2016).

The data are strengthened by the results of data obtained from the Surakarta City Education Office regarding the value of National Examination in science lessons in Surakarta which is still not far from expectations. The average UN grade for science lessons in Surakarta in the 2015/2016 school year was 62.88. In the academic year 2017/2018 academic year is the average score of the natural science lesson was 63.66. Based on the data of the last two years it can be concluded that the learning outcomes in science lessons are still low.

Efforts to overcome these problems are that students need to have science process skills, especially experimental skills. Science process skills possessed by students can improve understanding of concepts more meaningfully. Natural Science (IPA) is very closely related to daily life, so students need to master science process skills to be able to solve problems their daily life. Hancer, Sensoy and Yildirim (2003) state that science education is very important and effective in developing creativity and problem solving skills in children.

Akano (2016) explains that process skills are divided into basic and integrated skills. Basic skills include; measuring, classifying, concluding, communicating and predicting all that serves as the basis for integrated skills. Whereas integrated process skills include formulating hypotheses, controlling variables, and experimenting, formulating models, interpreting data and defining operationally. Both basic and integrated skills need to be developed by students.

Science process skills need to be developed in science learning because it helps students develop their minds to make discoveries, so they can understand scientific concepts (Triatno, 2013: 158). In line with Triatno's opinion, Kazeni (2005) reveals that the development of science skills enables students to acquire the skills needed to solve daily problems. Likewise the opinion of Zeitoun and Hajo (2015) states that science process skills are important indicators for students in solving problems. Therefore, students need to master science process skills.

Nonetheless, the facts existing in the field of science learning are still somewhat untouched in developing science process skills optimally. This is evidenced in the research of Dewi (2014) which explains that as many as 45.45% of the students' scores on science process skills are still far below the KKM, the average score is in the low category. Factor causing low student is due to less innovative learning in the classroom. These results are reinforced by Rini's research (2017) which found that the low level of science process skills especially in experimental skills was caused by several factors:

- 1) experimental activities are rarely applied in learning; 2) the application of innovative learning models to support experimental activities is still lacking; 3) the maximum use of learning media and teaching aids to support experimental activities has not been maximized; 4) there are still many students who are busy themselves in attending learning; and 5) the quality of learning and learning outcomes achieved by students is less than optimal. This is supported by data on students' experimental skills in pre-action with the acquisition of students' average score of 57 from the limit of completeness in the value of experimental skills, namely 75.

Based on the data stated above, it shows that there are several factors that cause low experimental skills, among them are rarely applying the experimental method during science learning and lack of optimization in using media and teaching aids. This is inversely proportional to what Piaget stated that

the character of class IV students is still in the concrete operational stage. Class IV students cannot be invited to think abstractly and still need concrete media or activities that are directly related to students' daily lives. Therefore, this study was conducted to describe the science process skills of fourth-grade students in science learning.

## **METHOD**

This research was a qualitative study with a case study method. Sukmadinata (2013) states that a case study is a study that is directed at collecting data, making meaning, and gaining an understanding of the case. The objects of this study were 29 fourth-grade students at Diponegoro Islamic Elementary School, Pasar Kliwon, Surakarta, Central Java, Indonesia. The selection of the object of this study used a purposive sampling technique. Purposive sampling is a sampling technique of research sources with certain considerations, for example the person is considered having the most expertise of the theory than we expect (Sugiyono, 2016). The reason the researchers conducted research at Diponegoro Islamic Elementary School, namely the Elementary School was very oriented towards student academic achievement. In addition, this school has science extracurricular activities. Likewise, principals and students are very cooperative to facilitate the research.

The research data were collected through observation, interviews, and tests. Observations were carried out when learning took place in the classroom. The interview was conducted with the teacher and several fourth-grade students. As the science process skills test used material in the fourth grade under the Theme 5 with KD 3.7, properties of light and its related stuffs were used. The test consisted of ten multiple-choice questions in which the aspects of science process skills are observing, making hypotheses, planning experiments, carrying out experiments, and interpreting data/drawing conclusions.

The data analysis technique used triangulation techniques of methods, sources, and theories. According to Moleong (2005), triangulation is a technique of checking the validity of data that utilizes various sources with various methods and various theories for the purposes of checking or comparing data. Furthermore, data analysis techniques used interactive models with the following processes: (1) data reduction; (2) data presentation; (3) draw conclusions. This process is interrelated and continuous until the data collection and processing process is complete.

## **RESULTS AND DISCUSSION**

This research described and revealed the real situation regarding science process skills in science learning. The subjects used were the fourth grade students of Diponegoro Islamic Elementary School totaling 29. The instruments used were observation sheets and tests of science process skills. Data analysis employed interactive model analysis.

The assessment rubrics for science process skills tests are as follows:

**Table 1.** Classification of completeness criteria for science process skills

<b>Percentage Score</b>	<b>Criteria Classification</b>
> 75% s/d 100%	Very good
> 50% s/d 75%	Good
> 25% s/d 50	Not good
0% s/d 25%	Very not good

Prilianti (2014) revealed that Natural Sciences is defined as knowledge obtained through data collection with experiments, observations, and deductions to produce an explanation of a symptom that can be trusted. The implementation of the scientific approach to learning involves process skills such as observing, classifying, measuring, predicting, explaining, and concluding. Science learning emphasizes the application of process skills.

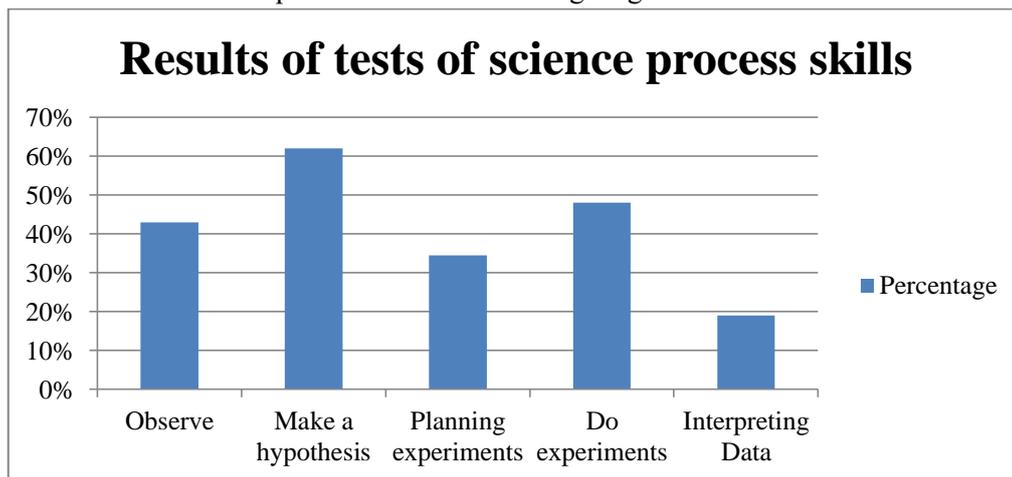
Temiz (2003) states that science process skills include observation, classification, quantification, number and related space, forecasting, recording data, using and modeling data, interpreting data and drawing conclusions, determining variables, changing and controlling variables, hypothesizing and testing and experimental skills. Indicators of critical thinking skills measured in this study are observing, making hypotheses, planning experiments, conducting experiments, and interpreting data.

The results of the science process skills test obtained in KD 3.7 Applying the properties of light and other sight-related things as follows:

**Table 2.** Results of tests of science process skills

No	Indicator	Percentage of indicator achievement	Criteria Classification
1	Observing	43%	Not good
2	Making a hypothesis	62%	good
3	Planning experiments	34,5%	Not good
4	Doing experiments	48%	Not good
5	Interpreting Data	19%	Very not good

Table 2 shows that of the 5 aspects observed in science process skills are classified as low because only 1 aspect is categorized as good which is making a hypothesis. Meanwhile, the 3 aspects of the indicator that have been observed, which are plan experiments and conduct experiments, can be categorized as not good, and interpret the data is classified as poor. To make it easier to understand the data, the table above will be presented in the following diagram:



**Figure 1.** Results of test of science process skills

Based on the diagram, it shows that the smallest percentage is equal to 19% or only as many as 6 children who complete that aspect on science process skills on the indicator of interpreting the data.

**Data Interpretation Question**

*When soapy water is blown in the sun, it forms a balloon with a sparkle of rainbow color. This event proves that light has properties ...*

- a. can refract
- b. can decipher
- c. straight propagate
- d. penetrate clear objects

To answer these questions, students must have critical thinking skills in analyzing the data provided and making conclusions. However, in reality the results of the test students still have

difficulty in interpreting the data consequently, many of them choose the wrong answer, for instance, they chose the option D. They think based on the data provided, the event of the appearance of rainbow colors in sunlight-exposed water is an example of the light penetrating objects clear, while the correct concept of the event is an example of the nature of light can be described.

The indicator of planning the experiment becomes one of the aspects that has the second lowest percentage indicating that it is classified as "not good" which is equal to 34.5% or only as many as 10 children who completed the aspect. According to Nur (2011) the design of experiments is to make an organized plan to test a hypothesis. In the process of designing will use many science process skills, namely: a) asking a question; b) develop a hypothesis; c) planning procedures; d) variable control; e) interpretation of data; d) draw conclusions.

***Planning Experiments Question***

*Tools and materials needed in conducting experiments to prove that light propagates straight are*

....

- a. wax, paper, thread*
- b. basin, mirror, carton*
- c. flashlight, plastic cup, carton*
- d. spoon, mirror, candle*

The question aims to determine students' skills in designing an experimental or experimental activity, for example preparing tools and materials to be used for experiments. The test results state that students in the indicator planning the experiment are still classified as not good or low. Students are still confused in determining the tools and materials for light experiments to propagate straight. It can be seen from the answers of students who choose the wrong answer rather than the correct answer, namely in the choice of answer C. The correct answer for the experiment is to use a flashlight, plastic cup, carton.

The indicator of observing students only gets a percentage of 43% or as many as 12 children who complete. The problem with the indicator observes by presenting an image of an experimental example of the properties of light.

***Observing Question***

*Look at the following picture!*



*If the pencil is inserted into a glass containing water it looks broken. This shows the nature of light which is ...*

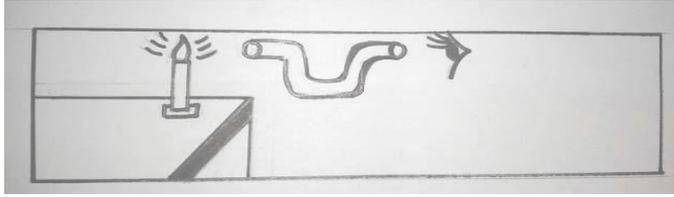
- a. can propagate straight*
- b. penetrate clear objects*
- c. can be reflected*
- d. can be refracted*

The question aims to measure students' ability to observe an image related to the experimental example of the properties of light. In fact, many students are still mistaken in distinguishing images of experimental examples of light properties. Many students assumed that the image in the question is an example of the experiment the properties of light penetrate the clear, while the correct answer is that light can be refracted.

Then the obtained percentage results were equal to 48% or as many as 14 children who were completed and classified as not good. The percentage is found in the indicator of conducting experiments.

***Experimenting Question***

*Look at the following picture!*



Based on the picture above, the most appropriate statement from the results of the experiment is ...

- a. the candle flame can be seen through observation using a straight parolon pipe
- b. the candle flame cannot be seen through observation using a straight parolon pipe
- c. the candle flame can be seen through observation using a curved parolon pipe
- d. the candle flame cannot be seen through observation using a curved parolon pipe.

The question aims to understand the students conceptual understanding of the light characteristics of students through experimenting. After the students carried out the experiment, on the question presented an image of the experimental activity then the students determined the results of the experiment on the image. The majority of students have been able to analyze the experimental results through the images presented. Students have been able to analyze that the candle flame cannot be observed using a curved parolon pipe.

The highest percentage is the indicator to make a hypothesis. As many as 62% or as many as 18 children completed the aspect, so that indicators of making hypotheses on science process skills can be categorized as good.

#### ***Making Hypotheses Question***

*Events that are the result of refraction of light are ...*

- a. formation of color in soap bubbles
- b. the riverbed whose water is clear seems more shallow than it really is
- c. the formation of a shadow by a mirror
- d. the arrival of sunlight on the surface of the earth

The question aims to determine the ability of students to make guess the correct answers based on the topics discussed in the question. The results indicated that students have been able to determine examples of the properties of light in daily life, especially in the event of refraction of light that is in the option B.

Based on the analysis of students' answers above, it can be concluded that the results of science process skills in science learning in the fourth grade are still relatively low. Many factors can cause low science process skills. When observing the learning process, it turns out that learning is teacher-centered in which students only listen to teacher's explanations. Teachers are the one dominating teaching and learning activities in the classroom.

Malikah et al. (2016) states that conventional learning or learning that does not activate the students have an impact on unsatisfactory results as well as students' disinterest in learning material. This opinion is in line with Turkmen's idea (2018) which reveals that changes in the learning environment will be obtained if student-centered learning. Student-centered learning will make the learning process more meaningful especially in science process skills.

Conventional learning does not develop students' ability to think and hypothesize critically to find their own knowledge. According to Yilmaz (2019), the higher the ability of students to hypothesize, the higher the science process skills. Teachers must be creative in choosing learning models in the classroom that can improve students' science process skills. Herrmann (2013) examined that cooperative learning models are able to make students more active in class and can foster mutual respect with their peers. Thus, cooperative learning models can be used as an alternative for teachers to conduct student-centered learning.

In addition, based on the results of observations, teachers use more textbooks in the process of learning science in the classroom without inviting students to explore their own information. The textbook used also does not contain much material that develops students' experimental skills. This causes students not to develop their skills, especially in experimenting. The teacher should need to invite students to think critically, for example by giving questions during learning. According to Tae Kang (2017) in his research, science teaching using pre-questions is meaningful method to improve

students' science process skills than traditional science lessons that use textbooks. Therefore, the teacher can give quizzes or questions to explore students' knowledge before starting to teach the material.

The frequent use of textbooks without the development of creativity from teachers can also lead to the emergence of students' misconceptions. King's research (2010) states that out of 500 misconceptions are identified through surveys in which fifteen of them are misconceptions caused by a sentence presented by a textbook. Sometimes there are many discussions about material that are not understood by students, especially those in the fourth grade which can lead to misconceptions.

Another factor is that the teacher does not use learning media that attract students. The teacher does not use KIT teaching aids in schools and real learning media that can be found in the surrounding environment. This is supported by the results of interviews with fourth-grade students of Diponegoro Islamic Elementary School who stated, "Teachers rarely use learning media, usually they only explain material and give assignments from textbook".

Characteristics of fourth-grade students are still in the concrete operational stage, which means students cannot be invited to think abstractly and yet need concrete objects to observe. The use of teaching aids or innovative learning media can attract students' attention in the learning process. Amran and Muslimin's research (2017) reveals that an increase in student learning outcomes with the use of KIT IPA during learning can make students more active and directly apply the concepts they have acquired.

During this time, the learning process is more often done in class and students are rarely invited to observe directly outside the classroom. This is supported by the results of interviews with the fourth grade students of Diponegoro Islamic Elementary School who stated that so far science learning is only in the classroom and rarely does observations outside the classroom. This causes students to be less able to develop their abilities in scientific observation. Fourth graders really need to be invited out of the classroom to observe the surrounding environment as a learning resource.

Learning outside the classroom is an alternative to find a new atmosphere so that students do not feel bored during the learning process. Students can use the environment as a learning resource. Lin Ting (2014) revealed that the ability to observe can be increased by expanding the process of instructional learning outside the classroom; hence it can provide opportunities to see, touch, feel, smell and hear that requires the use of all senses. This opinion was supported by the results of a study from Sugiyono (2017) which stated that science learning with the outdoor learning method proved effective in improving the quality of learning.

Science learning has rarely carried out experimental activities. The results of the interview with the fourth-grade teacher stated, "So far, I have only done simple experimental activities because the time is not enough". This causes students' low science process skills, whereas experiments provide opportunities for students to directly discover new knowledge. Students can be more active and creative to make the learning becomes more meaningful. Yadav and Mishra (2013) revealed that the laboratory approach through conducting experimental activities is very beneficial for students in developing science process skills. The statement is supported by the results of research by Rati and Dewi (2017), which also prove that the use of experimental methods can improve science learning achievement of the fourth-grade students. Based on these statements, improving science process skills students in science learning can be done through experiments.

## **CONCLUSION**

Based on the data obtained from the observations above, it shows that science process skills of fourth-grade students are still categorized as low in the aspect of observing, designing experiments and interpreting data. It is due to experimental activities in science learning that are rarely done. Science learning should make students able to think critically in the presence of experiments related to daily life.

The results of interviews conducted with classroom teachers and fourth-grade students obtained information that: 1) experimental activities were rarely conducted in class; 2) learning is carried out in accordance with the guidelines in the 2013 curriculum and teacher-student manual without the development of a creative learning process from the teacher; 3) teaching aids and IPA KIT are not used properly during the learning process; 4) students only listen to the material explanation from the teacher, without conducting experimental activities. The results of the interview showed that the science process skills are low because they rarely conduct experiments

This is confirmed by the results of observations of the fourth-grade class at Diponegoro Islamic Elementary School in which the learning is still teacher-centered. The teacher only used books for teaching. Students are not actively involved in the learning process such as using the 5M scientific approach. Learning carried out so far makes students given less opportunity to discover and build their own knowledge. In science learning, students should be invited to find their own knowledge.

Based on the data obtained, namely through observation, interviews, and giving tests of science process skills in science learning, the light material of fourth grade students at Diponegoro Islamic Elementary School can be categorized as low due to several factors. As for the causal factors such as experimental activities are rarely carried out, the media and teaching aids of the IPA KIT are not utilized, and teacher-centered learning so students cannot find their knowledge to develop. In accordance with the conclusions above, it is suggested that: 1) the next researcher conducts broader, in-depth and specific research regarding science process skills in science learning and 2) the next researcher develops learning models or media that can help teachers improve science process skills in students primary school.

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