

# Comparison of students science process skills after using learning an experimental and virtual laboratory on Archimedes Laws

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**Abstract.** In learning science, students can use the laboratory experiments and virtual laboratories (PhET) provided directly. This study aims to look at the comparison of students' science process skills to the experimental and virtual laboratories in the aspects of formulating questions, measuring, conducting experiments, interpreting data, concluding and communicating. The instrument is in the form of an observation. The study was conducted on students who numbered two classes. In the first class, data collection was carried out using practicum methods with a total of 35 students from 40 students. While the second class collected data using a PhET simulation with a total of 36 students from 40 students. The research method used is experimental research using quantitative methods. At measuring aspect  $\text{sig} = 0.031$ , conclusion aspect  $\text{sig} = 0.010$ , and communicating aspect  $\text{sig} = 0.010$  meaning statistically this difference is significant. Whereas in formulating the question aspect  $\text{sig} = 0.628$ , observing aspect of  $\text{sig} = 0.130$ , and collecting data aspect of  $\text{sig} = 0.218$  means that this difference is not statistically significant. The results are the use of virtual laboratories has a better percentage value in student learning compared to the use of experimental laboratories on Archimedes Law.

**Keywords:** *science process skills, PhET, Archimedes Law*

## 1. Introduction

Science education involves students in scientific inquiry. Scientific investigations include ways of thinking, attitudes, and steps of scientific activities to obtain scientific products and knowledge [1]. In learning science, scientific activities are needed that can be used to facilitate students in the learning process. Scientific activities that can be used in the learning process of students can be in the using of experimental laboratories or computer simulations (virtual laboratories).

Computer simulation in the form of PhET is a series of substantially growing and quality for teaching and learning science [2]. PhET simulation in class is generally effective in learning both teachers and students. The use of computers is important in learning science when applied in an experimental laboratory for difficult concept materials as aids in the laboratory [3]. One material that can be used PhET is Archimedes' Law. Several studies investigating the use of PhET in education. Learning by using a PhET simulation can make students excited do practical work so students can solve problems in learning activities [4].

Previous studies have shown that many students have misconceptions in Archimedes's legal phenomenon [5]. Archimedes Law is hydrostatic material from the behavior of sinking and floating



objects from the concept of buoyancy [6]. So we need a good learning method for students to understand the Archimedes Law.

Science process skills are one of the processes of learning science. Mastery of students' experimental skills is an important part of scientific education [7]. The aspects of science process skills that are formulating questions, measuring, conducting experiments, interpreting data, concluding and communicating [8]. Measurement of students' scientific skills in this study uses observations carried out in the laboratory or in the class separately.

## 2. Research method

The study was conducted on students who numbered two classes. In the first class, data collection was carried out using practicum methods with a total of 35 students from 40 students. While the second class collected data using a PhET simulation with a total of 36 students from 40 students. Classes that use experimental laboratories are called experimental groups 1, while classes that use PhET simulations are called experimental groups 2.

The research method used is experimental research using quantitative methods. In this study there were experimental groups 1 and experiment 2. In the experimental group 1, students were given treatment in the form of an experimental laboratory and teaching for some time while in experimental group 2, students were given a treatment in the form of a PhET simulation. Data collection techniques used in this study were using a observations. The collected data analysis using Independent Sample T-Test.

The instrument used in this study was an observation sheet used to measure students' science process skills. Observation sheet uses a Likert scale calculation 4. According to Sugiono (2012: 95), to analyze the observational data, researchers use the following formula [9]:

**Table 1.** Result category of value percentage.

Value of Criteria	Percentage	Category
4	76 % - 100 %	Very Good
3	51 % - 75 %	Good
2	26 % - 50 %	Low
1	0 % - 25 %	Very Low

So we get the result set value and interpretation can be made as follows:

$$Percentage = \frac{F}{N} \times 100\%$$

Noted:

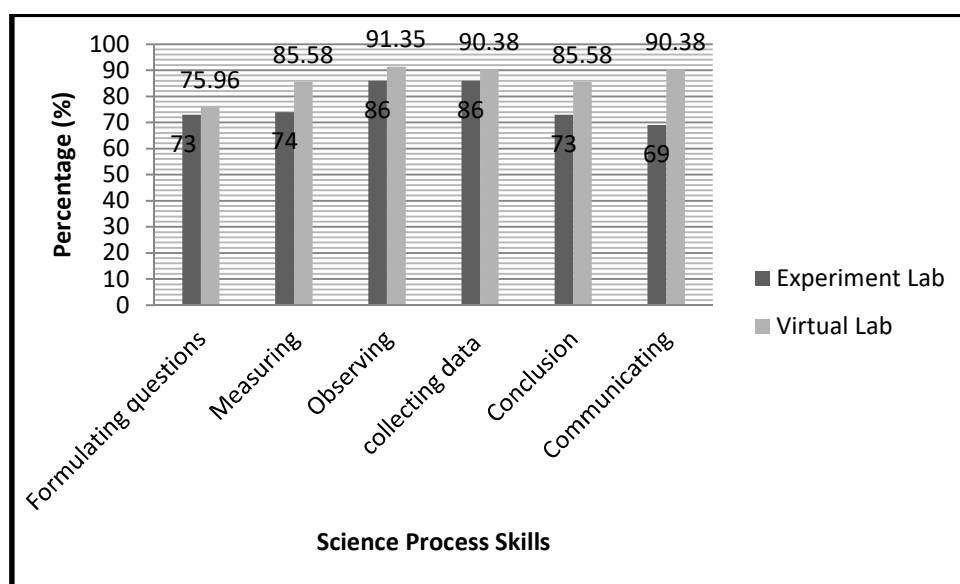
F : Frequency of answers from respondents

N: Number of respondents

## 3. Results and Discussion

The results of a comparative study of the use of an experimental laboratory with a PhET virtual lab on Archimedes Laws material on science process skills is to use a Likert scale observation sheet. Observation sheet is given to the observer when treatment. When the treatment (treatment) in using practical tools, students explained Archimedes Law material and methods of using these tools. Observation sheets in the form of statements in measuring science process skills such as aspects of formulating questions, measuring, conducting experiments, interpreting data, concluding, communicating.

In this study two class groups were used as research subjects, namely experimental group 1 and experiment 2. The experimental group 1 students consisted of 35 students and the experimental group 2 students consisted of 36 students. Here are the results of a comparison chart of the use of an experimental laboratory with a PhET virtual lab on science process skills.



**Figure 1.** Graphic Differences in Student Science Process Skills.

On the results of the measurement of science process skills from aspects of formulating questions, measuring, conducting experiments, interpreting data, concluding and communicating it can be seen that there is a difference in the use of experimental methods with PhET simulations on Archimedes' Law material. In the aspect of formulating the question has a percentage value of 73% for experimental laboratories and 75.96% for virtual laboratories that have better virtual laboratory results than experimental laboratories, the measuring aspect has a percentage value of 74% for experimental laboratories and 85.58% for virtual laboratories the results of which are very good virtual laboratories, aspects of conducting experiments have a percentage value of 86% for experimental laboratories and 91.35% for virtual laboratories that are better than virtual experiments, the interpretation of data aspects has a percentage value of 86% for experimental laboratories and 90.38% for virtual laboratories whose virtual laboratory results are better than experimental laboratories, the concluding aspect has a percentage value of 73% for experimental laboratories and 85.58% for virtual laboratories whose virtual laboratory results are very good, and the aspects of communication has a percentage value of 69% for experimental laboratories and 90.38% for virtual laboratories which results in excellent virtual laboratories.

The results of data analysis using the Independent Sample T-test are explained in Table 2.

**Table 2.** Results of data analysis using the Independent Sample T-test.

Science Process Skills	Sig (2-tailed)	Result
Formulating questions	0.628	Not significant different
Measuring	0.031	Significant different
Observing	0.130	Not significant different
Collecting data	0.218	Not significant different
Conclusion	0.010	Significant different
Communicating	0.010	Significant different

Table 2 explains the results of data analysis using the Independent Sample T-test. Where in the Independent Sample T-test, if  $\text{sig} < \alpha$  means significant and if  $\text{sig} > \alpha$  means not significant where the level of significance ( $\alpha$ ) = 0.05. At measuring aspect  $\text{sig} = 0.031$ , conclusion aspect  $\text{sig} = 0.010$ , and communicating aspect  $\text{sig} = 0.010$  meaning statistically this difference is significant. Whereas in formulating the question  $\text{sig} = 0.628$ , observing aspect of  $\text{sig} = 0.130$ , and collecting the data of  $\text{sig} =$

0.218 means that this difference is not statistically significant. The science process skills of students with inquiry training models using PhET are better than conventional learning [10]. The use of virtual laboratories with PhET simulations produced in animations is easy to use and easily understood by students so that the PhET simulation media reaches the learning targets desired by students [11]. From the results of this study it is expected that students can use both laboratories simultaneously both experimental and virtual laboratories so that students better understand the concepts of learning science better in class.

#### 4. Conclusion

In the science process skills from aspects of formulating questions, measuring, conducting experiments, interpreting data, concluding and communicating there is a difference in the use of experimental methods with the simulation of PhET on Archimedes Laws material. The use of PhET simulations has a better percentage value in student learning compared to the use of experimental laboratories. With the technology-based approach, PhET can be used to deepen understanding and increase students' interest in physics.

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