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Identification of science process skills of class XI students in the Torricelli theorem practicum using dynamic fluid learning media

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Abstract

This research aims to determine the level of science process skills of Class XI MA Al-Bairuny Jombang students at the Torricelli Theorem Practicum. This research emphasizes developing students' abilities to analyze the data that has been found. This research is a type of quantitative research with a research model, namely descriptive quantitative research with a one-shot case study design. The research population was students of class XI MA Al-Bairuny Jombang and the research sample used a purposive sampling technique and obtained a total of 20 students of class Data collection was obtained using observation sheets (practicum) and Science Process Skills assessment sheets during learning. The research results were analyzed descriptively quantitatively based on classroom observations. The research results showed that the percentage of students' Science Process Skills in the Torricelli Theorem Practicum with a result of 88.0% was in the very good category. It is proven from the SPSS version 22 statistical calculation test that the percentage of Science Process Skills in the Torricelli Theorem Practicum is 0.232 > 0.05 so it can be said that the data is distributed normally. Apart from that, it is also proven by the results of the significance value of 0.246 > 0.05 so it can be said that the data is distributed with homogeneous variance. This research makes it possible to improve the quality of learning, especially physics subjects, by integrating learning materials and media so that student's understanding of concepts and science process skills is increased.

Keywords: Science Process Skills Basic. Dynamic Fluid Learning Media. Torricelli's Theorem Practicum

INTRODUCTION (10%)

Physics learning is closely related to science process skills. Physics learning emphasizes observation activities and carrying out practicums in each material. Physics learning also encourages students to carry out scientific work and have a scientific attitude so as to make a good contribution to science. This shows that practical activities improve students' science process skills (Putri & Suratno, 2013; Utami et al., 2021a). In fact, current students' science process skills still tend to be low and there are still students' assumptions that science is a difficult subject, full of theory, and boring learning (Manurung & Panggabean, 2020). In laboratory learning, students do practice to prove the truth of the theory, but have not been directed to "find" (Dari & Nasih, 2020). Besides that, Science educators argue in the literature that the development of scientific process skills directly affects science achievement and

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science literacy (Dolapcioglu & Subası, 2022). Therefore, science process skills are very important in the 21st century (Ahmed et al., 2023; Darmaji et al., 2022; Temel Aslan & Ertaş Kılıç, 2022).

Science process skills are students' ability to apply scientific methods in understanding, developing science, and discovering knowledge systematically (Bulent et al., 2014; Bybee & DeBoer, 2001; Harlen, 1999). Science process skills are very important for every student as a provision to use scientific methods in developing science to obtain new knowledge or develop existing knowledge (Kurniawati, 2021; Rahmah et al., 2019; Sujarwanto & Putra, 2018). This is supported by the fact that science process skills are important for students because they are able to increase active student participation and develop a sense of responsibility in learning, as well as being able to develop the ability to think and behave like a scientist (Maison et al., 2019). Science process skills are not only considered a learning approach but also used to determine the outcome of learning (Ahmed et al., 2023). Science process skills are a form of fundamental skill both physical, intellectual, social, and mental which are related to the basic or scientific abilities that already exist within each student/learner (Putra & Sujarwanto, 2017).

Basically, science process skills are divided into two parts, namely basic science process skills and integrated science process skills. Science process skills are grouped into two, namely: basic and integrated skills which include observing, measuring, classifying, asking, formulating hypotheses, planning an experiment, identifying variables, determining work steps, experimenting, creating and interpreting information/graphics, applying concepts, concluding, and communication both verbal and nonverbal (Sheeba, 2013; Yildirim et al., 2011) (Figure 1). Science Process Skills (SPS) are very useful in designing and constructing scientific facts in natural sciences at the school level and in scientific activities which involve a variety of methods, including such activities as observing phenomena, questioning, scrutinizing, examining books, and also other sources of information to find out about the phenomenon (Baharom, 2020).

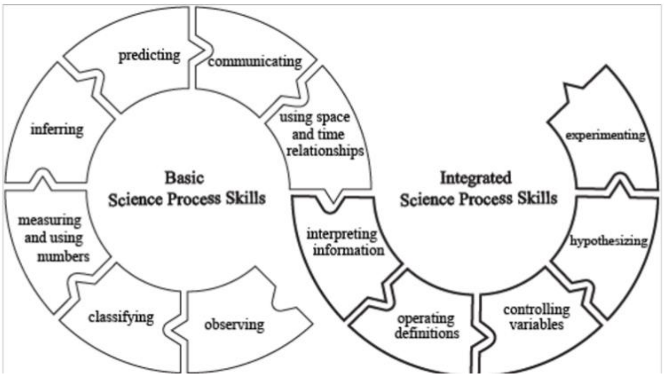

Figure 1. Basic and Integrated Science process skills (Baharom, 2020)

MA Al-Bairuny Jombang is an educational institution based on an Islamic boarding school environment in the Jombang region with diverse student backgrounds such as area of origin, school of origin, and academic, cultural, and socio-economic abilities. This difference is a factor that influences student learning outcomes. Therefore, researchers want to carry out further investigation and identification of the abilities and skills possessed by students using Fluid

Dynamics material (Torricelli's Theorem). The aim of this research is to determine the science process skills of students at MA Al-Bairuny Jombang.

METHOD

The method used in this research is descriptive quantitative. The design uses a One-Shot Case Study design where the research subjects will be given treatment and then observed in the classroom (Sugiyono, 2014). Researchers made observations using the Science Process Skills assessment sheet. This research was conducted on class XI IPA MA Al-Bairuny students. The population in this study were students of class XI IPA MA Al-Bairuny. The sample in this study was 20 XI IPA 1 MA Al-Bairuny students who were taken using a purposive sampling technique. The following is a One-Shot Case Study research design model.

X O

Information:
X : treatment given (independent variable)
O : observation (dependent variable)

Data collection was obtained through observation activities in learning during Torriceliì's Theorem Practicum activities. The instrument used in this research was a Science Process Skills assessment sheet during observation activities (Table 1).

Table 1. Indicators for assessing students' science process skills

No	Category	Indicator
1	Observing	Using practical media to identify Physics objects (Fluid Dynamics)
2	Grouping	Grouping data according to Physics concepts (Fluid Dynamics)
3	Measuring	Carrying out calculations to compare the results of practical calculations with the results of calculations according to Physics theory (Fluid Dynamics)
4	Communication	Presenting data from Physics practicum results (Fluid Dynamics) through tables graphs or diagrams
5	Predicting	Predicting physics concept phenomena (Fluid Dynamics) that exist in everyday life
6	Concluding	Conclude the concept of Physics (Fluid Dynamics) based on practicum results

Data analysis in this research is based on research data from the results of assessing students' Science Process Skills during pre-critic activities. The assessment sheet contains aspects of Science Process Skills which consist of 6 aspects and instructions for filling in the form of an assessment rubric when carrying out practical activities. The percentage value of students' Science Process Skills results through practicum activities can be calculated using the following percentage formula:

$$P = \frac{\sum skor}{40} \times 100\% \quad (1)$$

Data sheet or rubric for assessing students' Science Process Skills, the percentage data obtained is divided into five categories as listed in Table 2.

Table 2. Categories of Student Science Process Skills Assessment

Percentace	Categroy
≥85	Very Good
70-85	Good
55-70	Enough
40-55	Not Good
<40	Very Not Good

(Arikunto, 2010)

The research results were analyzed descriptively quantitatively based on classroom observations with SPSS version 22 statistical calculation test. For existing data, a normality test was carried out to determine whether the distribution of research data was normally distributed. This research also uses a homogeneity test to determine the level of homogeneity variance.

DISCUSSION

Based on the results of the research that has been carried out, data on the results of students' Science Process Skills (KPS) integrated TPACK in dynamic fluid material (Torricelli's Theorem) with an average of 88% in the very good category in Figure 2 which includes six categories: observing, grouping, measuring. , communicating, concluding, and predicting.

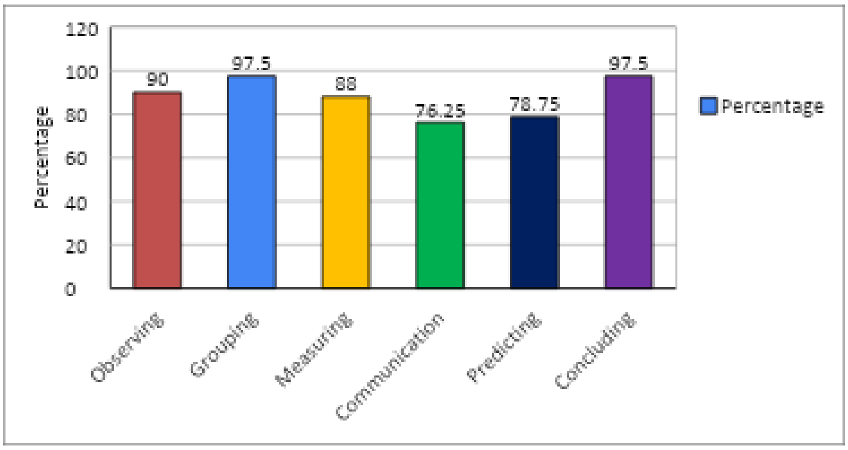

Figure 2. Average Value of Students' Science Process Skills in Torricelli's Theorem Practicum

Based on Figure 1, students' Science Process Skills will be explained based on the following six categories:

1. Observing

   In the observing aspect, it has a percentage of 90% with a very good category. This aspect emphasizes students carry out the observation process on practical media according to work instructions using their sensory tools. Students make observations on Torricelli's theorem material related to Fluid Dynamics. The observation process aims to collect data and information about Torricelli's theorem practical material. According to him, observation activities are a form of response to phenomena using the senses and are one of the basic skills in knowledge. In this category, students will find it easy to observe a phenomenon that is in accordance with research from (Angelia et al., 2022; Hardianti & Permatasari, 2023; Jannah et al., 2022; Lisa, 2019; Utami et al., 2021b; Widayanti, 2016).

2. Grouping

In the grouping category, the percentage was 97.5% in the very good category. This aspect emphasizes students' ability to classify several variables in the Torricelli Theorem Practical. Through student worksheets, it makes it easier for students to group measurement variables so that students can carry out practical work well, namely the water height variable (h), the water speed variable (v), and the water furthest distance variable (x). Students are really helped by these worksheets because they provide work instructions starting from the aim of the activity to the practical work steps. Students will be more critical and creative in analyzing a worksheet before starting the practicum because they need to know the initial basics of practicum activities. Students will be trained to analyze what measurement variables will be measured and calculated. In this category, students will find it easy to classify or group data according to research (Hardianti & Permatasari, 2023; Jannah et al., 2022; Utami et al., 2021b; Widayanti, 2016). However, research results from (Ariyansyah & Nurfathurrahmah, 2022) show that students' skills in the grouping category are not good because students are confused in determining the measurement variables and pay less attention to the statements on the worksheet (Lisa, 2019).

3. Measuring

In the measuring category, the percentage was 88% in the very good category. In the measuring category, students take measurements of variables related to Torricelli's Theorem as presented in the grouping category. Students carry out calculations by varying the height of the second bottle hole (h_2) where the first bottle hole (h) has been determined. Measurements were carried out in groups and shared tasks (Figure 3). In the Torricelli theorem practical activity, there were several students who experienced problems in measuring the distance the water traveled where there was a difference in time when removing the hole cover for both the first hole and the second hole, thus affecting the volume of water that came out of the bottle hole. This allows for differences in calculations between practical results and theoretical results. Therefore, group cohesion is needed in carrying out this practicum. In this category, students will find it easy to carry out measuring activities, which are supported by previous science process skills, namely observing and grouping (Hardianti & Permatasari, 2023; Lisa, 2019; Utami et al., 2021b).

Figure 3. Groups and shared tasks

4. Communication

In the communication category, the percentage was 76.25% in the good category. This category emphasizes students presenting practical data in the form of tables, pictures, diagrams, and/or graphs. Practical result data is entered into a table containing predetermined measurement variables. Apart from that, students also analyze the relationship between each measurement variable, namely the relationship between the height of the hole in the bottle and the relationship between the speed of the water and the distance traveled by the water in each hole. One group presented it in the form of graphs/diagrams from the data that had been processed and the other group only based on the narrative explanation of the practicum results data table. This shows that students' critical and creative abilities in conveying messages are not yet optimal and are still focused on the estimates or intuition of each student and are the same as research results (Ariyansyah & Nurfathurrahmah, 2022; Lisa, 2019; Widayanti, 2016). Apart from that, students in each group were also appointed to present the results of their practicum in front of the class. This will provide a stimulus for students to be more confident and can have an impact on students' ability to speak and also interact well with teachers and students. In this category, students will find it easy to present factual data, concepts, principles, and knowledge through audio, visuals, and audio-visuals (Angelia et al., 2022; Hardianti & Permatasari, 2023; Utami et al., 2021b).

5. Predicting

In the prediction category, the percentage was 78.75% in the good category. The predicting category emphasizes students in analyzing the physics phenomena presented in accordance with the results of the Torricelli Theorem practicum. Each group has analyzed the phenomenon of leaking tanks at different heights. Group 1 stated that a tank that has more than one leak will have a difference in the distance the water comes out, which will be farther because the height of the leaking area is lower and the water speed is the same. Group 3 stated that the distance the water comes out is influenced by the height of the hole in the tank, where the higher the hole, the closer the water travels to the tank. This is influenced by one of the hydrostatic pressures in the tank. From these two answers, it can be concluded that in group 1, predicting phenomena that occur only depends on their intuition, and in group 3, the ability to predict these phenomena is based on practical results and theory about Dynamic Fluids (Torricelli's Theorem). In this category, students have quite difficulty in predicting a phenomenon, which is according to research from (Utami et al., 2021b; Widayanti, 2016), but the results of research (Angelia et al., 2022; Hardianti & Permatasari, 2023) show that students' skills tend to be high.

6. Concluding

In the concluding aspect, it has a percentage of 97.5% in the very good category. This concluding category emphasizes students in concluding a concept from the results of the Torricelli Theorem practicum. Each group has conveyed its conclusions based on the results of their respective practicums, especially from the summary in the communication category and prediction category: a) the speed of the fluid coming out of each hole is the same as the speed of the fluid falling according to the height of the hole, b) there is a relationship between the speed of the water in the hole. comes out with the depth of the hole in the tank, and c) the distance the water travels out of the hole is influenced by the depth of the tank and gravity. In this category, students will find it easy to conclude the results of practical activities that are in accordance with research from (Jannah et al., 2022; Utami et al., 2021b).

The research data was analyzed using normality and homogeneity tests shown in Figure 4 and Figure 5. In Figure 4 it can be seen that the statistical test value for the student's KPS percentage is 0.232 > 0.05 so it can be said that the data is distributed normally.

One-Sample Kolmogorov-Smirnov Test

		KPS
N		20
Normal Parameters[a,b]	Mean	88.0000
	Std. Deviation	5.93828
Most Extreme Differences	Absolute	.232
	Positive	.218
	Negative	-.232
Kolmogorov-Smirnov Z		1.037
Asymp. Sig. (2-tailed)		.232

a. Test distribution is Normal.

b. Calculated from data.

Figure 4. Results of the normality test for science process skills data

Test of Homogeneity of Variances

SPS

Levene Statistic	df1	df2	Sig.
1.440	1	18	.246

Figure 5. Results of homogeneity test of science process skills data

In Figure 5, the SPSS version 22 calculation results show a significance value of 0.246 > 0.05, so it can be said that the data is distributed with homogeneous variance. Based on the identification of students' science process skills through the Torricelli Theorem Practicum above, in general the students' science process skills are very good, but there needs to be evaluation for improvement in several categories, namely communication and predicting.

CONCLUSION

The research results showed that the percentage of students' Science Process Skills in the Torricelli Theorem Practicum with a result of 88.0% was in the very good category. It is proven from the SPSS version 22 statistical calculation test that the percentage of Science Process Skills in the Torricelli Theorem Practicum is 0.232 > 0.05 so it can be said that the data is distributed normally. Apart from that, it is also proven by the results of the significance value of 0.246 > 0.05 so it can be said that the data is distributed with homogeneous variance. This research makes it possible to improve the quality of learning, especially physics subjects, by integrating learning materials and media so that student's understanding of concepts and science process skills is increased. Apart from that, it is necessary to implement learning with several innovative learning models in the classroom and follow up with integrated science process skills. This shows that there is support for improving students' science process skills and integrating them with students' critical thinking abilities and creative thinking abilities and according to research by (Astalini et al., 2023; Rini & Aldila, 2023).

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