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# Exploring Students' Procedural Knowledge in Determining the Quality of Liquids

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***Abstract*** *– The objective of this research is to describe students' procedural knowledge at SMAN 9 Makassar. This research is qualitative research with a descriptive approach. The subjects in this research were XI-grade students of SMAN 9 Makassar who were considered to have good physics mastery. The instruments used in this research are the researchers themselves, with additional instruments in the form of procedural tests and procedural assessment sheets for students. The data were collected from the provision of procedural test instruments with interviews and documentation. The data tested for validity is then analyzed. The results of this research show that the procedural knowledge of students at SMAN 9 Makassar in determining the quality of liquids (cooking oil) is still in the moderate category. There are 50% of respondents who are in the category. This is based on the analysis that has been carried out on the respondents' answers. Therefore, this study implies that teachers should find more strategies to improve students' procedural knowledge, particularly in determining liquid quality.*

***Keywords:*** *cooking oil; high school physics; liquid quality; procedural knowledge*



## I. INTRODUCTION

Physics is a branch of science that outlines the elements in nature as well as their phenomena empirically, logically, systematically, and rationally (Wati, 2019). The essence of learning physics is to discuss, study, and prove the existence of facts and assumptions about the symptoms of physics (Hamidah & Mubarak, 2020). Physics is also a quantitative science or science of systematic measurement, experimentation, and experimental results, where it emphasizes the importance of students' understanding rather than memorization (Hakim et al., 2020).

Learning physics cannot be separated from mastering the basic concepts of physics through understanding. Learning physics that needs to be developed is the ability to think analytically, inductively, and deductively in solving problems related to environmental events, both qualitatively and quantitatively, using mathematics, as well as developing

knowledge, skills, and self-confidence (Depdiknas, 2003). Physics Learning aims to improve students' mastery of knowledge, concepts, and principles of physics and develop students' skills (Rerung et al., 2017).

Physics learning is inseparable from the skills that must be possessed to support it. It is based on physics which is one of the branches of natural science that requires investigation or scientific work to obtain a concept, principle, theory, and law (Leli & Yosaphat, 2016). One of the processes of scientific inquiry can be carried out with practical activities, especially in the implementation of simple physics experiments (Darmaji et al., 2019). Knowledge related to the right steps or methods of experimentation is accompanied by an understanding of the corresponding concepts of physics. Students are expected to be able to know all the processes from the beginning to the end of the experiments correctly so that students will have skills in carrying out the activities. In physics learning, knowledge related to physics experiments is classified as technical knowledge or procedural knowledge (Mundilarto, 2010; Cashata et al., 2022).

Procedural knowledge is one of the four domains of knowledge that starts from factual knowledge, conceptual knowledge, procedural knowledge, and meta-cognition knowledge (Bautista, 2013). Procedural knowledge reflects the ability to utilize certain rules related to a concept i.e. perform procedures (Nahdi & Jatisunda, 2020; Sarwar & Trumpower, 2015). Procedural knowledge is knowledge related to steps or methods used in the process of physics experiments (Jihad & Haris, 2008; Ocal, 2017; Surif et al., 2012). Procedural knowledge is the knowledge of how people do things. Students' procedural knowledge can be seen when the students conduct an experiment in learning. Students who play an active role in learning have better procedural knowledge (Bautista, 2013; Saad et al., 2019; Munandar et al., 2022). Understanding more about students' procedural knowledge can also inform and improve classroom instruction (Serbin et al., 2020; Taramopoulos & Psillos, 2022).

Meanwhile, the implementation of learning, especially physics learning in schools, currently does not involve the active role of students. Based on the preliminary observations done at SMAN 9 Makassar, it was known that the learning ran quite well, and the students already know the steps for implementing the experiments. However, most students do not understand the process when carrying out experiments properly. This is because students only conduct the learning process through online platforms without conducting simple experiments. Physics learning carried out by teachers mostly uses conventional learning models using lecturing and discussion methods. Moreover, offline learning has only been carried out in the last two months and with very limited time in every meeting.

One of the efforts used by the teachers in conducting simple experiments is to provide contextual examples for children around the school environment. This can be done by integrating dimensions of local wisdom in learning (Ilhami et al., 2019). Local wisdom is defined as a truth that has become a tradition (Hartini et al., 2018; Hartini et al., 2017; Suastra et al., 2017). Local wisdom is a way of life that is inherent in society and prevails in a certain region or region with its distinctive characteristics that develop from generation to generation.

One of the local wisdom that is widely found in the students' environment is oil. Oil is one of the local wisdom with various characteristics it has, starting from how to make, material selection, and processing process. This is very interesting to be studied further using physical science. The idea of the authors that can be studied with oil objects is the determination of oil quality by relating several physics topics in class XI at the high school level. For example, the quality of oil can be reviewed by knowing the density, hydrostatic pressure, refractive index, and others.

Therefore, in this study, the researchers wanted to see how students could determine the method (procedure) so that the right measurement results were obtained. The limitation of the researcher is only up to the procedural picture when students are given oil objects. Thus, the research question in this study is how is the description of students' procedural knowledge in determining the quality of liquids (cooking oil) in class XI at SMAN 9 Makassar?

## II. METHODS

This research is qualitative research with a descriptive approach. This study produced descriptive data in the form of written or spoken words from participant and observer behavior. This research was carried out for six months in 2021 at SMAN 9 Makassar, South Sulawesi, Indonesia. This study focuses on the students' physics procedural knowledge in determining the quality of liquid substances in class XI MIPA 5, which consists of 34 students. The procedural knowledge is the students' ability to determine the steps of cooking oil quality experiments reviewed with physical magnitudes, namely density, hydrostatic pressure, and refractive index.

The data were collected using the researchers as the main instrument and procedural test instruments. Data collection was carried out through the provision of tests and further interviews with the respondents. The test instruments have been validated by the experts. The feasibility of validation results were tested using the Gregory test with the condition that $R \geq 0.75$ (Widiartini, 2017). The results of the validity of the expert showed that the value of R was 1, so the researchers concluded that the instrument was suitable for use in the study.

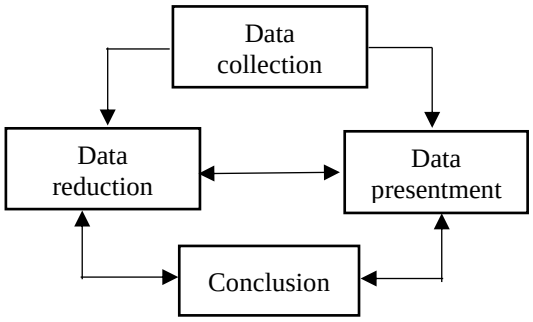


**Figure 1.** Research procedure

Furthermore, the percentage of procedural knowledge is based on categories according to Riduwan (2018) as follows:

**Table 1**. Score of categorization

| Score interval | Category |
|---|---|
| 0 – 20 | Very low |
| 21 – 40 | Low |
| 41 – 60 | Moderate |
| 61 – 80 | High |
| 81 – 100 | Very high |

## III. RESULTS AND DISCUSSION

The students' procedural knowledge was obtained by calculating the number of students who answered the questions correctly in each question item of each indicator of procedural knowledge. The questions given to respondents consisted of 15 questions, with each indicator shown in Table 2.

**Table 2**. Indicators of each question item

| No | Indicator | Questions number |
|---|---|---|
| 1 | Determine the concepts used | 1,6,11 |
| 2 | Write down tools and materials | 2,7,12 |
| 3 | Write down the data-collecting procedure | 3,8,13 |
| 4 | Write data analysis | 4,9,14 |
| 5 | Make a conclusion | 5,10,15 |

The data in Table 2 above became the basis for determining the students' procedural knowledge of class XI at SMAN 9 Makassar. Students were given tests based on validated questions. The test results of the respondents are shown in the following Figure 2.

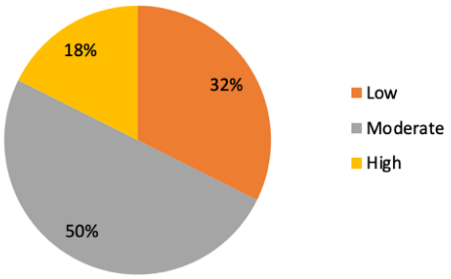


**Figure 2**. Percentage of students' procedural knowledge

Figure 2 shows the percentage of students' knowledge in answering physics procedural questions. The average procedural knowledge of students is in the moderate category (50%). Meanwhile, there were no students who were in the very low and very high categories.

Before the researcher gave a test to students in the form of a procedural knowledge test, the researcher first made preliminary observations to find out the students' procedural knowledge at SMAN 9 Makassar. The results of preliminary observations showed that the learning process at SMAN 9 Makassar ran quite well, and students already knew the steps for implementing the experiments. However, most students did not understand the process of carrying out experiments properly. This is because students only receive learning through online platforms or online without conducting simple

experiments. After making preliminary observations, the researchers were suggested to conduct research in class XI MIPA 5 at SMAN 9 Makassar, which had the highest physics subject scores.

Based on the data from a study conducted on 34 respondents, the researchers found that in one class, there were variations in respondents' procedural knowledge. There were 6 respondents in the high category (18%), 17 respondents in the medium category (50%), and 11 respondents in the low category (32%). Overall, the average procedural knowledge of respondents is in the moderate category.

The explanation above is in line with Suparti et al. (2017), who found that there are several factors that affect the low procedural knowledge of students. The low procedural knowledge of the students is caused by the conventional learning process in schools, do not involve experimental processes, so that students do not understand procedural matters. In addition, research that has been conducted by Minati (2017) also shows that the procedural knowledge of physics students taught using conventional learning models has a lower average score. Moreover, the respondents also admit that during the implementation of online learning, the experimental process has never been carried out directly, making them lack of procedural knowledge.

In this regard, the low procedural knowledge of students in Indonesia is caused by several factors. According to Laily (2019), students' procedural knowledge is also in line with their conceptual knowledge. If the student does not have good conceptual knowledge, then it will also be difficult to have good procedural knowledge. The respondents stated that they took additional learning courses outside of school to enhance their physics concepts, and as a result, they have good knowledge related to physics concepts and better procedural knowledge.

There were several respondents who answered the question well for the previous three indicators. This shows that, in general, respondents can already achieve indicators of writing experimental steps. But not for indicators 4 and 5, namely writing data analysis and drawing conclusions. In general, respondents have not been able to answer this indicator well. This is in line with the results of research conducted by Hamidah & Mubarak (2020), that students' ability to draw conclusions is still low because students' understanding of the material presented is also low.

Based on the results of the study, it is also known that of the five indicators assessed in the procedural knowledge test of students, only a few respondents were able to answer well up to the fifth indicator. This is in line with research conducted by Suparti et al. (2017), that conventional learning carried out in schools has not been able to provide procedural knowledge to students. Students are only given explanations related to the material with the project task. Based on the

results obtained, the students' ability to answer procedural questions is in the moderate category. The procedural knowledge of students only reaches indicator three, namely writing down the procedure for taking observational data appropriately but not systematically. In general, students in class XI MIPA 5 at SMAN 9 Makassar have not been able to write down data analysis and draw conclusions appropriately.

## IV. CONCLUSION AND SUGGESTION

Based on the results of the study, it can be concluded that students' procedural physics knowledge at SMAN 9 Makassar in determining the quality of liquids (cooking oil) is in the medium category. Students' procedural knowledge only reached the third indicator, namely writing the procedure for collecting observation data correctly but not systematically. In general, students of SMAN 9 Makassar have not been able to write down data analysis and draw conclusions appropriately.

This study has limitations, such as only using cooking oil to determine the quality of liquids. This research can certainly be developed for better research. Therefore, we suggest for future research to implement physics procedural knowledge in determining the quality of liquids by using other liquids, such as vehicle lubricating oil.

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