



Profiles of student representation types to solve problems in physics learning

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ABSTRACT

This study aimed to determine the profile of the type of representation of students to solve problems in learning physics. This type of research is descriptive quantitative. The sample used in this study was 170 high school and vocational high school students in the Merauke district, and the sampling technique used was purposive sampling. The instrument used in this study was a problem-solving ability test instrument using a multimode representation by the Rosengrant stage and a questionnaire instrument for student responses to various types of models in physics. The results showed that students could only use a single representation in text, image, and mathematical graphics. There are no students who can use the model of line diagrams, bar charts, and free-body diagrams. The students' questionnaire responses showed that students used different representations in understanding the concept, and the type of model most used was text representation.

Keywords: problem-solving skills, representation, rosengrant

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INTRODUCTION

The development of science and technology at this time has required students to master various skills. Education as a means of learning for students is expected to teach and practice these skills. Skills that need to be trained include communication, collaboration, critical, creative, innovative thinking skills, and problem-solving skills. The level of ability that students must have based on Bloom's Taxonomy which Krathwoll and Anderson have revised is HOTS (Higher Order Thinking Skills). Student competence cannot be limited to LOTS (Low Order Thinking Skills). The

primary ability expected to be achieved by students in HOTS is the ability to solve problems. This is supported by the issuance of Permendikbud Number 64 of 2013, which states that in the core competencies of the 2013 curriculum, the Graduate Competency Standards (SKL) in Physics subjects must have good problem-solving abilities so that they can be applied in everyday life (Permendikbud No 64, 2013). Based on this, students should be familiarized and trained to solve problems encountered using the concepts that have been learned.

To fulfill the competencies written in the Permendikbud, Physics as part of Natural Sci-

ences has been able to practice thinking skills to solve problems in everyday life using physical concepts (BSNP, 2006). In the learning process, general physics should familiarize students with seeing, observing, and conducting various experiments to understand natural phenomena around them. But the reality is that in schools, many students feel that learning physics is very monotonous because lessons are more focused on teaching formulas and teaching verbally without doing scientific experiments. Teaching carried out by the teacher emphasizes more on mathematical calculations using procedures only. In the end, students felt that memorizing formulas were more critical than understanding basic concepts. This, of course, results in the development of students' thinking and abilities.

Learning that is only focused on mathematical calculations also causes students to use one representation in understanding physics problems. If examined as a whole, learning physics cannot be understood if it only uses one type of representation, especially mathematical representations, because there are fundamental concepts that must be understood first so that visual and verbal representations are needed. Representation is a form of interpretation or presenting an idea in another condition that can be understood so that the concept being learned will be easier to understand. One type of representation in teaching students should not be done because students have different abilities in using representations.

There are many abstract concepts in studying physics, so students need to master various forms of representation such as text, conceptual, graphical, image, formula, and diagram representation representations (Mahardika, 2013). Izsak and Saherin stated that a form of teaching that involved multiple modes of expression was able to help students understand concepts better (Rosyid, 2013). Each student has a specific ability that stands out more than the others. There is a category of students representing images more prominently than their ability to illustrate the text. There are students whose spatial representation ability is more prominent than their mathematical representation ability. Therefore, various representations

in presenting and teaching physics concepts are essential when using multiple models. Suppose learning is only focused on one type of expression, for example, spatial name. In that case, students with spatial representation abilities will always be superior, while students with weak spatial representation abilities will feel disadvantaged because of difficulty understanding concepts (Suhandi, 2012). Another adverse effect is that students' representation skills will not experience development. For example, students accustomed to being taught only using text representations, then other representational abilities such as mathematical representations, diagrams, graphs, and others will not develop even though abstract physics concepts require various presentations in presenting their ideas to make it easier to understand them.

The problem-solving ability that you want to train in physics learning depends on the representation abilities of students. In his research, Brenner (Kartini, 2009) states that if students can represent problems well, such as constructing and using verbal, graphical, diagrams and mathematical representations to perform calculations, understand and solve student problems will be very good (Kartini, 2009). This is because multi modes representation trains three primary abilities as elements of problem-solving abilities, namely complementary information, limiting interpretation, and building understanding (Ainsworth, 1999).

In science learning, multi modes representation trains students to present the same scientific concepts and processes using different formats such as verbal, graphical, and numerical formats (Tytler, 2013). Multimode representation is a depiction of a natural system or method using several types of representations. Van Der Meij stated that multimode representation could describe different aspects of an actual situation or describe the same elements differently (Van Der Meij, 2007). According to Prain and Waldrip, multimode representation can be interpreted to re-represent the same concept in different formats, including text, images, graphics, and mathematics (Amar Amrullah', Desy Kumala Sart, 2017). Thus, in general, it can be stated that multimode repre-

sentation is a form of a configuration capable of describing something else in several ways (Kartini, 2009).

Someren divides the Multimodus Representation form into four categories: 1) Multimodus Representation in Human Reasoning. The formation of a person's understanding of information can be supported by a multimode of representation. Each person uses different views in understanding the information they receive so that it is easier to understand because everyone has their multi-intelligence. 2) Multimodus Representation in Learning (Someren, 1997). According to Dufresne (Astuti, 2013), There are three ways of representation that are used explicitly in learning physics, namely: (a) as a tool to describe the problems that students get when presenting a sketch of the physical situation and completing the information on the problem to be solved. (b) as the subject matter when students are explicitly asked to graph or find the value of a physical quantity using a graphic, (c) as a step or a formal procedure when students are asked to draw an accessible object diagram as one of the first steps solving a problem. 3) Multimodus Representation in Teaching. A teacher can explain and present abstract concepts in physics by turning them into visual representations so that they are easier to understand. To do this, teachers need to use a multimode of presentation. 4) Multimodus Representation in problem-solving. When a teacher has succeeded in directing students to understand a problem using various forms of representation to understand the questions, it will make it easier for students to solve the physics problems received.

Judyanto Sirait has conducted several previous studies regarding multimode representation in solving physics problems (Judyanto Sirait, 2010) and Rizky et al. (Rizky, Tomo, 2014). In his research, Judyanto concluded that 97% of students use mathematical representations, and students who can use image and graphic words will also be able to use mathematical models correctly. Rizky's research results show that students use more verbal and image models. This study presents a profile of students' ability in Merauke District to use

multimode representation in solving physics problems.

RESEARCH METHODS

This study aims to determine the profile of the type of student representation in solving physics problems. This type of research is descriptive quantitative. The research was conducted in SMA and SMK Merauke District. The sample in this study amounted to 170 people. The sampling used was purposive sampling because some Merauke District schools were still learning online during the Covid-19 pandemic. Retrieval of data using test instruments and questionnaires. The test instrument contains five essay questions with four stages of problem-solving using a multimode representation according to the Rosengrant framework. The four steps are: translating the problem in question, simplifying the issue, describing its physical form, and describing its mathematical structure. The research was conducted by providing test instruments and questionnaires for students to do. The test result data is processed by delivering an assessment score of the students' answers and then calculating the percentage of each representation that can be used by students in solving problem-solving problems. The questionnaire instrument used a Likert scale with a range of 1-5 about student responses to each data representation used to support the results of this study.

RESULTS AND DISCUSSION

The data on the types of representations used by students in solving physics problem-solving skills are presented in Table 1.

Table 1. Data from the use of student representations

No	Representation types	%
1	Text Representations	40
2	Image Representation	20
3	Line Chart Representation	0
4	Bar Chart Representation	0
5	Free Diagram Representation	0
6	Mathematical Calculation Representations	20

The results showed that students could only use representations of text, images, and mathematical calculations. For the use of text representations in stage 2 of the Rosengrant framework problem solving, there are 40% or 68 students who can use it appropriately. The use of this text representation is not only correct from the structure of the language but must be precise in terms of physics. This is what becomes a difficulty for students because many write representations of the text, but it is not by the concept of physics in the problem being worked on.

With the use of image representations in stage 1 of the problem solving of the Rosengrant framework, there were 20% or only 34 students who were able to present the issues in the questions appropriately in the form of images. The lack of ability to use image representations is in line with the lack of understanding of students' physics concepts in stage 2 of problem-solving. Students with low concept comprehension skills will have difficulty using symbolic representations and images (Legi, 2008).

For the use of line diagrams, bar charts, and free diagrams in stage 3, the result is 0%, which means that no student can use this representation in solving physics problems. With mathematical models in stage 4 of the Rosengrant framework problem solving, there are 20% or only 34 students who can present a mathematical solution to a given problem correctly.

Most students are only able to use a single representation, namely text representation or image representation. The model used is still not exactly what it should be, especially in the image representation, because there are still many image presentations that are not by the problem in question. From this data, it can be stated that students have difficulty using representations to solve problems in physics even though many physics concepts must use free diagrams such as Newton's Law, Work and Energy, and other materials so that students should be able to understand and use various types of representations. and integrated (Simbolon & Sinaga, 2015)

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Based on the results of the questionnaire given to students, it was obtained data that students could only understand if the concept was explained using text and image representations only. This is not by Physics which must present abstract concepts with various appropriate illustrations. This is one of the causes of student difficulty in solving Rosengrant's problem-solving abilities based on multimode representation questions.

From the results of the research data, it can be stated that students have difficulty using representations. In physics at high school to university, students have difficulty coordinating their understanding of scientific phenomena and representing these phenomena (Ainsworth, 1999). For example, students who are learning about ideal gas students rarely know how to translate macroscopic concepts (for example, pressure, temperature) with mathematical equations (for example, perfect gas law). Moreover, students have difficulty explaining how diagrams and illustrations of molecular interactions can explain the relationship of observed macroscopic phenomena with mathematical equations. Problems in student reasoning like this need special attention because it is one component of scientific competence, namely the ability to coordinate between different descriptions and representations of certain phenomena.

Learning Physics aims to train and familiarize students using the appropriate variety to understand and communicate macroscopic and microscopic natural phenomena. (Kozma, R. & Russell, 2005). Compared with other subjects, the difficulty of using various representations of scientific concepts occurs more in physics lessons. This is because multiple models can present a submicroscopic idea and several mathematical and symbolic representations to give a visible image. This fact is, of course, a

challenge for students. The challenges associated with selecting and interpreting expressions have been identified as an essential problem in physics learning in general and a significant barrier to studying physics. Therefore, students need to be familiarized and trained in various representations in each lesson.

CONCLUSION

The research data that has been conducted shows that most students can only use a single representation. The types of models that students can use are just text, image, and mathematical expressions. The achievement in the use of this representation is inadequate because of the students' weak understanding of physics concepts. For the benefit of line graph representations, bar charts, and free-body-diagrams, no student can use them appropriately. From these results, it can be stated that students still need to be accustomed to and trained in various types of representations because physics learning cannot only use a single model in explaining a concept that is abstract. Students will find it very difficult to understand the concepts presented in the physics textbook if they can only understand one type of representation.

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