Gravity: Jurnal Ilmiah Penelitian dan Pembelajaran Fisika

http://jurnal.untirta.ac.id/index.php/Gravity

ISSN: 244-515x; e-ISSN: 2528-1976

Vol. 08, No. 02, September 2022, Page 127-131

Analysis of student understanding of free body diagrams

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(Received: 05 April 2022; Accepted: 18 September 2022; Published: 30 September 2022)

ABSTRACT

This study aims to determine: (1) The ability of free diagram representation student objects on Newton's Law material (2) Student difficulties in represents a free-body diagram on Newton's Law material. The type of research that carried out is a mix method research. The research was conducted through written test activities and Interview. Test activities are used to obtain data on the ability to represent diagrams object-free, namely in the form of a free-body diagram. Interview activities are used to obtaining data on student difficulties in describing object-free diagrams in the form of a description of the results of the interview. The research subjects were students in the Department of Physics Education UNTIRTA and students majoring in Physics Education UNSIQ. The results showed that the student's object-free diagram representation ability included in the category of Needs Improvement (needs improvement). The most difficulty Many students experience in making free-body diagrams is determining the length of the vector forces acting on objects.

Keywords: *Free-Body Diagrams, Newton's Law, The representation ability*

DOI: 10.30870/gravity.v8i1.15883

INTRODUCTION

According to Trianto (2012) the nature of physics is a science that studies symptoms through a series of processes that known for the scientific process that is built on the basis of scientific attitude and the results manifest as scientific product composed of three components the most important in the form of concepts, principles, and theories universally applicable. Destination physics learning contained in the 2013

curriculum framework is to master concepts and principles and have skills to develop knowledge and self-confidence as a provision for continue education at a higher level and develop knowledge and technology (Kemendikbud, 2014). Abdullah (2012) stated that already become a common understanding among educators that physics is a good subject considered difficult for most students, more harder than math. Therefore, most students don't like the lesson physics. All topics in physics lessons closely related to the diagram, there is problems that arise in schools in physics lessons, namely how to represent phenomena in diagrams. Several representations can be used to solve problems in physics lessons. Multi representation is a model that represents the concept the same in several different formats. Multi-representation method (representation double) should be the main strategy in physics learning (Carl Angell et al., 2007)

Rosengrant et al. (2007) stated that representation is something that can symbolized or symbol on an object or process. They added that in physics the representation can be in the form of words, drawings, diagrams, graphs, computer simulations, math equations and so on. Form student interpretation can be in the form of words or verbal, writing, pictures, tables, graphs, objects concrete, mathematical symbols and others (Sabirin, 2014). Representation ability is not just making an image, a diagram, table or graph of a problem but the type of representation chosen for describe a problem and relation to the components what is in the problem is very important (Nurhayani et al, 2015). Atjiang dan Darsikin (2015) states that students should have the ability to represent in order to help students in solving problems. Matter of force on Newton's laws is one of the physical materials that requires students to describe the styles who works on the object first so that students can complete given problem. Style that works on the object depicted on the diagram, namely object-free diagrams so that students can understand it. Students' ability in analyze and describe the styles of will help make it easier for students to understand the concepts being taught, because students tend to be easier to understand concept if represented visually (Utami, 2013). The free body diagram is one of the branches of mechanics that can represented in the form of a diagram, complete graphic form with variables style (Van Heuvelen, et al, 2009).

According to Rosengrant, et al (2009), when solve some students' problems using a free-body diagram not only to identify the problem but also to help construct the equation mathematical. Create object-free diagrams is the first step in the process solve the problem. that stage will then affect the process next done. In other words, if students can make object-free diagrams correctly, then the student's chance can solve bigger problems. Students' ability to describe, analyze, and describe the styles that work requires the right strategy. Method appropriate in delivering the subject matter, can make students learn more effectively resulting in better learning outcomes optimal. Ways of presentation that can be used is a free-body diagram representation. The free-body diagram representation is one way of presenting using multiple representation (Utami, 2013). Ability students can draw free body diagrams trained by providing learning about the steps to draw free detailed body diagrams (Rahmaniar, 2016). Through free diagrammatic representation objects, students are required to draw, describe and analyze the styles that work on something first so that students can arrange equations mathematics used to solve given problem. Ability free diagram

representation of objects owned students play an important role in helping problem solving. Savinainen, et al. (2013) stated that students who make free-body diagrams significantly more successful in quantitative problem solving For solve most of the problems on Newton's Law material requires representation free-body diagram first so that students better understand the problem given. Based on the description above then researchers are interested in doing research about "Analysis of student understanding of free body diagrams ".

RESEARCH METHODS

The type of research used in This research is a mix method research. Research Subject are students majoring in Physics Education UNTIRTA and students majoring in Physics Education UNSIQ. retrieval technique The sample in this study used the technique of purposive sampling. The research was conducted through test activities and interviews. Test activities are used to obtain data representation ability free object diagram in the form of pictures object free diagram. Instruments used for the written test in the form of a description question consisting of on 10 questions, namely one question regarding the definition free body diagrams and various styles which acts on the object while the nine other questions regarding students' abilities in make a free-of-body diagram require students to make diagrams free things first solve the next problem. To find out students' abilities in drawing free-body diagrams done by describing directly based on the results of the description test that in the form of a free object diagram.

Diagram free of objects that have been described by students then classified with a certain scale so that it becomes something that can be meaningful to describe. The results of the students' answers in the form of a free object diagram classified based on the classification rubric which has been made by Rosengrant, et al (2009). Interview activities are used to obtain data on student difficulties in describe a free-body diagram that is in the form of a description of the results of the interview. Activity The interview was only attended by six students from all students who took part in the test. Selection of samples used in interview activities based on grouping the results of student test activities into upper, middle and lower groups. Two people are selected for each group be a sample in interview activities

RESULTS AND DISCUSSION

Research that has been carried out in the Department of Physics Education UNTIRTA and UNSIQ obtained the results that for the questions number 1, students have not been able to define free-body diagram. Whereas students' ability to name the various forces acting on objects good. In addition, for students' ability in make free-body diagrams and solve calculation problems. The results of student answers are grouped based on right and wrong answers. Answer correct is the answer that gets calculation score 3, while the wrong answer is the answer that gets a score calculation of 0, 1, and 2. Based on Table 3 it can be seen that The result of the student's answer

with the most is the results of student answers who get a score of 2 for free-body diagrams and a score of 3 for the calculation is equal to 343 answers. This matter shows that the free-body diagram made by students are included in the need category enhancement. According to Rosengrant, et al (2009), free diagram of objects included in the category needs improvement, it means that students have able to draw free-body diagrams and determine the forces acting on things correctly but can't determine the length of the force vector and naming the force acting on each object. Figure 2 is the result of the wrong answer one student in the upper group. From the figure, it is known that the free diagram created objects fall into the category need improvement. According to Rosengrant et al (2009), a free-body diagram that includes in the need for improvement category means students already able to draw free body diagrams and determine the forces that act on things correctly but can't yet determine the length and the origin of the vector style. Based on the picture, students have not able to describe the vector of gravity object A correctly. Gravity vector layout object A is not at the center of thing A

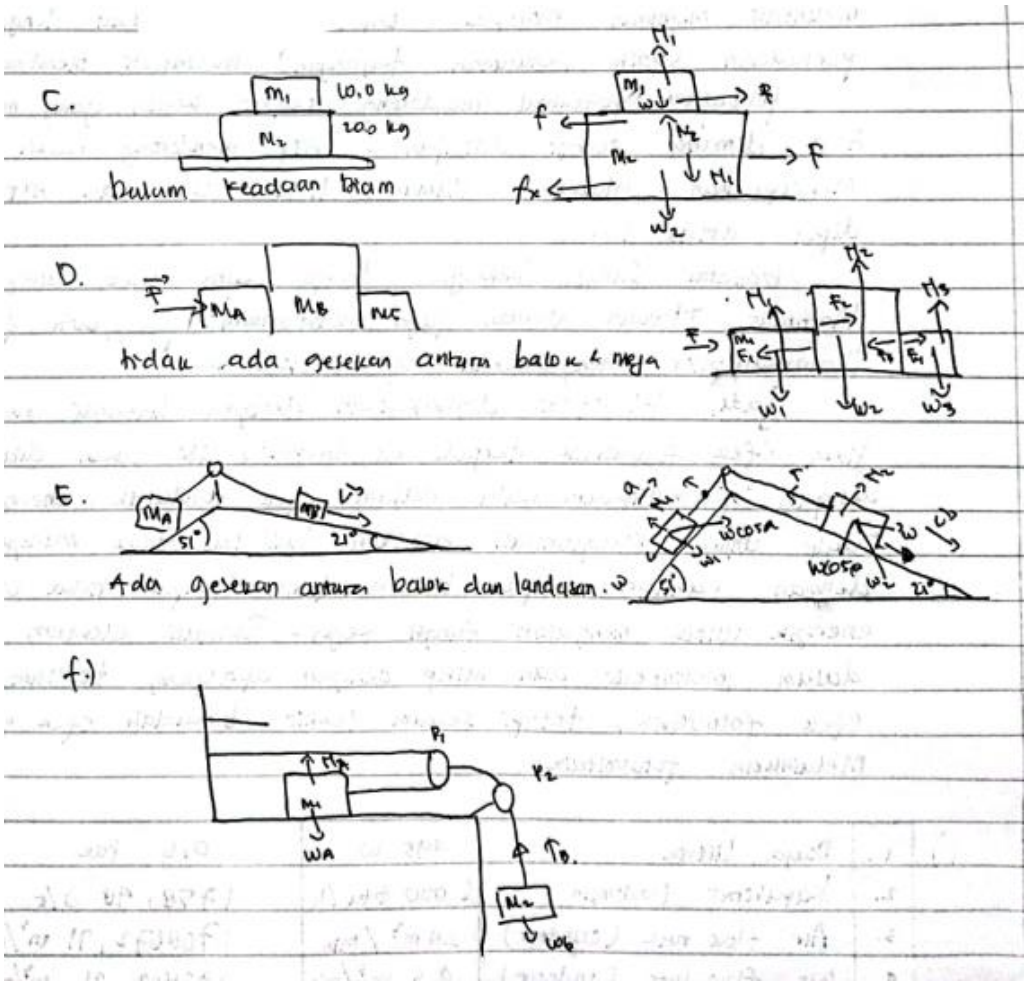

Figure 1. Sample answer from one of the students

From Figure 2 it is known that the results of student's calculation answer is correct. Student able to compose initial mathematical equations based on a free body diagram so that students can solve calculation problems correctly. Even though the diagram is

object free described are included in the category need improvement, but the style diagram already made students have shown the direction of the style work on objects so that students can formulate mathematical equations correctly. This is as expressed by Ayes, et al. (2010) that students who work on or draw free-body diagrams correctly can solve physics problems with appropriate.

CONCLUSIONS

Based on research that has carried out it can be concluded that Free object diagram representation capability UNTIRTA and UNSIQ Physics Education Students at Newton's Law material is included in the Needs Improvement category. The difficulties experienced by UNTIRTA and UNSIQ Physics Education Students in making the free-body diagram representation is determine the force acting on the object, determine the starting point of the force vector, determine the length of the force vector, and determine the projection of the force vector acting on an object on an inclined plane.

REFERENCES

Abdullah, Muhamad Yusuf. 2012. Strategi Efektif Pembelajaran Fisika: Ajarkan Konsep. Prosiding: Seminar Nasional Fisika. Palembang: Universitas Sriwijaya.

Angell, C., Guttersurd, O. and Henriksen, E.K. 2007. Multiple Representations as a Framework for a Modelling Approach to Physics Education. Department of Physics, University of Oslo, Norway, and Per Morten Kind, School of Education, Durham University, UK.

Atjiang, Nurhijrah N., dan Darsikin. 2015. Analisis Kemampuan Siswa Mengubah Representasi dalam Physics Problem Solving Pada Siswa SMA Kelas X. Jurnal Pendidikan Fisika Tadulako, 2(3).

Ayesh, N. Qamheih, N. Tit, and F. Abdelfattah. 2010. The Effect of Student Use of The Free-Body Diagram Representation on Their Performance. Educational Research 1(10);505-511.

Kemendikbud.2014. Materi Pelatihan Implementasi Kurikulum 2013 Tahun Ajaran 2014, Mata Pelajaran Fisika SMA/SMK. Jakarta:tidak diterbikan.

Masduki,dkk. 2016. Kesulitan Siswa dalam Memecahkan Masalah dalam Hukum Newton. Prosiding Seminar Nasional Pendidikan IPA Pascasarjana UM. Malang: Universitas Negeri Malang

Nurhayani, Jusman Mansyur dan Darsikin. 2015. Kualitas Diagram Benda Bebas Buatan Siswa Dalam Physics Problem Solving. Jurnal Sains dan Teknologi Tadulako, 4(3):28-35.

Rahmaniar, A., Rusnayati, H. and Sutiadi, A., 2016. Analisis Free Body Diagrams pada Siswa SMA dalam Menyelesaikan Tes Uraian Terstruktur. JPPPF, 2(2):1-6.

Rosengrant, D., E. Etkina and AV. Heuvelen. (2007). An Overview of Recent Research on Multiple Representations. Rutgers, The State University of New Jersey GSE, 10 Seminary Place, New Brunswick NJ, 08904.

Rosengrant, D., A. Van Heuvelen, & E. Etkina. 2009. Do Students Use and Understand Free-Body Diagrams?. Physical Review Special Topics Physics Education Research 5: 010108.

Sabirin, Muhammad. 2014. Representasi Dalam Pembelajaran Matematika. JPM IAIN Antasari, 1(2):33-34