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Analysis of Students' Misconceptions Using the Certainty of Response Index (CRI) on the Concept of Work and Energy in SMA Negeri 1 Gorontalo Utara After Online Learning

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ABSTRACT

Research has been conducted on students' misconceptions on physics, especially on the concepts of effort and energy in high school. The targets of this study were students of class X Ipa 1 in SMA Negeri 1 Gorontalo Utara. The sampling technique is to choose a class that is very active in the school where the research is located. There were 26 students involved in this study. There are 4 concept indicators, namely the concept of work, the concept of energy, the concept of work and energy relations and the law of conservation of mechanical energy. This study aims to determine students' misconceptions on work and energy materials in SMA 1 Gorontalo Utara. The identification of students' misconceptions was carried out using the Certainty of Response Index (CRI) to easily see the level of misconceptions, questions made in the form of multiple choice tests or objective questions with a total of 20 items. From the results of the analysis that has been done shows that the indicator of the work concept of students experiencing a misconception of 45%, while the concept of energy of students experiencing a misconception of 60%, the concept of work relationships and energy of students experiencing a misconception of 30%, and the legal concept conservation of mechanical energy of students experiencing a misconception of 35%.

Keywords: Misconceptions, CRI, work and Energy

1. INTRODUCTION

Physics is the science that deals with natural phenomena as a whole. Physics learns about matter, energy, and natural phenomena, both macroscopic and microscopic, physics also deals with facts, concepts, principles and also the process of discovery. Physics is a subject that requires a lot of high intellectuality so that most students have difficulty in learning it, consequently it often causes

problems when the physics learning process is ongoing. [1]

1.1. Misconceptions

Misconceptions or misconceptions as misconceptions in connecting a concept with other concepts, between new concepts and old concepts that are already in the minds of students. Physics as a branch of science basically aims to study and

analyze quantitative understandings of phenomena or natural processes and their properties and applications. Physics concepts that are embedded in the minds of students are needed in the development of mindset to study physics in the future [2].

Misconceptions or often called incorrect concepts often occur and are found in every subject, especially in physics. [3] Misconceptions are a source of difficulties for students in learning science. Learning that does not consider the students' initial knowledge results in students' misconceptions becoming more complex and stable, misconceptions on students that emerge continuously can disrupt the formation of scientific conceptions. Learning that does not pay attention to misconceptions causes learning difficulties and will ultimately lead to low student achievement.

1.1.1. Causes of Misconception

Table 1. Causes of Misconception

Main cause	Cause of Case
Learners	Preconception, associative thinking, humanistic thinking, incomplete reasoning, wrong intuition, stages of student cognitive development, student ability, student interest in learning
Teacher	Do not master the material, not a graduate from the field of physics, do not let students express ideas / ideas, teacher-student relations are not good
Book	Erroneous explanations, especially writing errors in formulas, the level of writing books is too high for students, not knowing to read textbooks, fiction books and science cartoons are often misconceived because of the interesting reasons that are necessary,
Context	Student experiences, different everyday languages, wrong discussion partners, beliefs and religions, incorrect parent / other explanations, students' life contexts (tv, radio, wrong films, feeling of being unhappy, free or depressed.

How to teach	It only contains lectures and writes, straight into mathematical form, does not reveal misconceptions, does not correct homework, analogy models are used incorrectly, narrow demonstration models, etc.
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[4]

To identify misconceptions, and at the same time be able to distinguish them from ignorance of concepts, an identification method has been developed or known as the Certainty of Response Index (CRI) technique. Certainty of Response Index is a technique to assure someone's misconception by measuring the level of confidence or certainty of someone in answering the questions given [5].

There are several ways to determine whether a person experiences misconception, does not know the concept, or knows the concept including using a two-tier diagnostic test. CRI method and two-tier diagnostic test. There are diagnostic tests consisting of three levels, namely first in the form of one question that has two or three answer choices. The second level consists of several statements in the form of possible reasons for the answers chosen in the first level questions. Three-tier test is basically a two-tier test with three levels added which asks whether the respondent is sure of the answer given or not [6].

1.1.1.2. CRI (Certainty of Response Index)

Table 2. Criteria for understanding students with the Three tier test instrument

First level	Second level	Third level	Category
Right	Right	Sure	Understand the concept
Right	False	Sure	Misconception (false positive)
False	Right	Sure	Misconception (false negative)
False	False	Sure	Misconception
Right	Right	Not sure	Lucky guess, lack of confidence
Right	False	Not sure	Lack of understanding of concepts
False	Right	Not sure	Lack of understanding of concepts
False	False	Not sure	Lack of understanding of concepts

[7]

The concept of work and energy is a concept that is related to many formulas and calculations, this theory is in line with Suparno's findings which state that the biggest misconception is in the field of mechanics, one of which is work and energy materials. These eternal quantities not only provide a deeper understanding of the universe, but also provide another way to approach practical problems. The laws of conservation of energy and momentum are very useful in dealing with systems with many objects, where the details of the forces involved will be difficult [8].

Energy is one of the most important concepts in science. To get a quantitative definition of kinetic energy, a moving object has the ability to do work and thus can be said to have energy. Motion energy is called kinetic energy. Then substitute into $F_{tot} = ma$ and determine the work done.

The principle of energy work tells if the total (positive) work of W carried out on an object, its

kinetic energy increases by a number of W , this principle also applies to the opposite situation if negative work W is carried out on an object, the kinetic energy of an object decreases by a number of W . To distinguish from kinetic energy rotation. The equation derived here for one-dimensional motion applies generally to translational motion in three dimensions and even if the force is irregular. So it is rewritten as.

2. EXPERIMENTAL METHOD

This type of research is a descriptive study that aims to describe and collect data related to the population. In this study, the research subject was the answer to the misconception test at a high school in the district. North Gorontalo Gorontalo Province. This research data collection technique using measurement in the form of objective questions in the form of a three tier test, meaning that this question has three steps, namely question, answer reasons, and is equipped with CRI or the level of confidence in the answers of students. The purpose of using the tier three test using CRI is to find out students who experience misconceptions. For more details, it can be written as in Table 3.

Table 3. Provisions to distinguish between understandings misconception and guessing [9]

Answer criteria	Low CRI (<2.5)	High CRI (> 2.5)
Correct answer	Correct answer but low CRI Means guessing answer (Lucky Gues)	Correct answer and high CRI means mastering the concept well
Wrong answer	Wrong answers and low CRI means guessing	Incorrect answer but high CRI means misconception

3. RESULT AND DISCUSSION

The initial stage of this research is the preparation of the problem lattice along with the matter of the misconception. In this study, only misconceptions were analyzed. The percentage misconception tables are as follows:

Table 4. Average Percentage of Work and Energy Concept

Num.	Material Indicator	Percentage of Average Misconceptions
1	Effort	45%
2	Energy	60%
3	Work and energy relationship	30%
4	The law of conservation of mechanical energy	35%

From the data above, the highest or largest percentage of misconceptions occurred in the work concept with a percentage of misconceptions of 45%, whereas in energy material students experienced a misconception of 60%, in the concept of work relationships and energy the students experienced a misconception of 30%, and in legal material conservation of mechanical energy of students experiencing a misconception of 35%.

The first question indicator about work concepts, many students experience misconceptions, one student experiences misconceptions on indicator number 5, where the problem is that a mother walks from point A around the park and back again to point A. Does the mother do work? Most students answer that the mother is doing work. As many as 50% of students choose option A to do work, with the reason because the mother has spent energy to walk. Even though we spend the energy to walk but if we return to the original place we do not do work because there is no movement.

The mistakes of these students equate the notion of work in physics with the understanding of work in daily life. In the seventeenth indicator there are 60% of students experiencing misconceptions, students do not understand the concept of energy. In the seventeenth indicator indicators there are 60% of students' misconceptions, where the concept of energy students do not understand well the concept of determining where the concept of kinetic energy and where the concept of potential energy. Problem indicator number 7 is the concept of the relationship between work and energy that has a misconception of 45%. Students who experience misconceptions

on these indicators, due to students experiencing errors in determining the relationship between effort and energy.

The results of the research conducted by researchers are in line with research conducted by previous researchers who said that the average misconceptions experienced by students from the highest percentage were: effort and potential energy (80%), the relationship between kinetic energy, potential energy, and energy mechanical (43%) and positive and negative effort (23%) [10]. What distinguishes this study from previous research is, using 4 concept indicators, namely effort and potential energy, the relationship between kinetic energy, potential energy, and mechanical energy and positive and negative effort, whereas research conducted by researchers uses 4 concept indicators namely effort, energy, work and energy relations and energy conservation laws. And the final results of research conducted by researchers who have the highest percentage of misconceptions on the energy concept that is equal to 60%.

4. CONCLUSION

Based on the results of research and data analysis, obtained from this study, it can be concluded that, after online learning in the work concept of students experiencing a misconception of 45%, while in the concept of energy students experience a misconception of 60%, in the concept of work and energy relations learners experience misconceptions as much as 30%, and the concept of the law of conservation of mechanical energy learners experience misconceptions as much as 35%. So it can be concluded that most students experience misconceptions on the concept of energy

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