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Research Paper

Identification of the Misconception Levels of Students in Several Public Senior High School in Jember on Straight Motion Material Through Graphical Representation Approach and CRI

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Abstract: Misconception is one of the problems faced by many students in learning physics. Misconception is a deviation from the actual concept and can be said to be an understanding of the wrong concept so that it is contrary to the concept set by the experts. Almost all materials in physics learning do misconception, one material that is considered necessary is straight motion. This research aims to identify the level of students' misconception in solving straight motion problems through a graphical representation approach and CRI (Certainty of Response Index). The method used is descriptive qualitative analysis. The research subjects were students of class X IPA in several SHS in Jember. Data collection is done by observation, test, and interviews. The results of data analysis showed that the average percentage of misconceptions of class X students of several SHS in Jember on straight motion materials through a graphical representation approach and CRI was 35.05%. This shows that the level of misconceptions is in the medium category. It is hoped that the teacher can analyze the initial conception to students so that misconceptions can be overcome immediately.

Keywords: Misconceptions; Straight Motion; Graphical Representation; Certainty of Response Index

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INTRODUCTION

Physics has an important role in life, as can be seen from the review of the subjects in it which are closely related to various phenomena in daily life (Sari et al., 2018). Physics is also a science that can provide a variety of knowledge to increase the power of reasoning and thinking so that one's reasoning ability can continue to develop (Anjani et al., 2018). However, in reality, there are still many students who think that physics is a complicated and boring subject. This makes students enthusiastic about understanding the material and not running optimally. Physics is not a material that can be understood by memorization but requires more reasoning and understanding of concepts (Ikbal et al., 2020).

The importance of students in mastering a concept is to be able to communicate and classify ideas and events that exist in daily life (Suranti et al., 2016). Mastery of concepts in physics learning is very important as a reference point for the success of students in receiving learning materials (Astuti, 2017). One of the subjects taught in high school class X is straight motion. Understanding the concept of straight motion

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material students is very important because it serves as a basis for studying later subjects such as work and energy, two-dimensional motion kinematics, modern physics, to quantum physics (Suyuti et al., 2016; Yusro et al., 2017). The concept of straight motion as one of the physics materials studied in the field of mechanics is important to learn because of its application in everyday life so that students can make decisions when facing a problem (Linawati et al., 2018; Yusro et al., 2017). Some experts revealed that there were several misconceptions about the material of straight motion, such as students often assuming that distance and displacement are the same things, quite some students think that if two objects are moving in the same time and acceleration then the distance traveled is the same, in the event acceleration due to gravity students assume that objects with a larger mass will fall faster than objects with lighter masses (Ma'rifa et al., 2016).

The main problems in learning physics include the amount of material that is abstract, the ineffective quality of the learning delivered, and the low question and answer activity when learning takes place. Ideally, students should be able to master the concept of straight motion material using a balanced multi-representation approach, both pictures, mathematics, graphics, and verbal. However, in reality, there are still many students who have problems mastering the material using a complete multi-representation approach. This can trigger students to experience misconceptions. Misconception has a definition as a condition in a person in which he has a different conception or misunderstanding in relating one concept to another from a concept that has been agreed upon by experts (Ibrahim, 2019: 27).

Based on the results of observations that have been made in three public high schools in Jember Regency, namely PSHS 1, PSHS 4, and PSHS Arjasa, learning is student-centered. However, at certain times there is teacher-centered learning. The misconceptions experienced by the three schools are based on different representations. Many of the students only learn formulas without understanding the physics concepts that have been conveyed by the teacher in learning. Students assume that physics problems only use mathematical representations so the use of representations that students have in solving problems is not balanced. Because of these problems, it is necessary to provide a multi-representation approach to reduce the level of student misconceptions. Multi-representation has a meaning as a form of concept that can be explained back into various combinations of representation formats such as graphics, verbal, mathematical, and images (Mahardika, 2012: 47). The multi-representation approach has a definition as an approach that is able to combine various kinds of representations such as representations of diagrams, graphs, mathematics, motion diagrams, and tables, each of which can present information about the conditions experienced by an object and can complete cognitive processes (Purwanti et al. al., 2017).

One of the science process skills that must be mastered by students is the ability to interpret graphs. Interpreting graphs in physics is important because graphs are a tool used in presenting ideas. Graphics are a form of representation related to mathematical representations to visualize verbal representations that are quite complex so skills in making and reading graphs are needed in the physics learning process (Mahardika, 2012: 52). Understanding graphical representation is closely related to mathematical understanding (Hidayatulloh et al., 2021). Graphs can present pattern information from data relationships, phenomena, and relationships of physical variables that may not be visible when the data is presented in the form of numbers so the presence of graphs can make it easier to perform statistical data analysis to be able to explain quantitatively and qualitatively the characteristics of the data (Rufiana, 2019). On the subject of straight motion, graphics are used as a representation to explain the concept of motion. The concepts of linear motion include displacement, velocity, and acceleration which are related to functions of time. The forms of motion of particles (objects) can be known by examining a straight motion graph.

In this research, only graphical representations were used to identify students' misconceptions about the straight motion material. To identify misconceptions, a method known as CRI (Certainty of Response Index) is used. CRI (Certainty of Response Index) is an instrument to identify misconceptions by comparing whether or not the respondent is correct in answering the questions as well as a benchmark against the high and low certainty index of the answers given. Identification through CRI is carried out by providing a level of certainty in each answer to a question based on a scale of 0-5 which indicates the level of guessing the answer to confidence (Muna, 2015). In this study, CRI was able to identify students into several categories, namely understanding concepts, misconceptions, do not know the concept. If the student is correct in answering the test based on the multi-representation approach and the selected CRI scale is > 2.5, then the student is included in the category of understanding concepts. If the student is correct in answering the test based on the multi-representation approach and the selected CRI scale is <2.5 then the student is included in the guessing category. If the student is wrong in answering the test based on the multi-representation approach and the selected CRI scale is > 2.5, then the student is included in the

category of misconceptions. If the student is wrong in answering the test based on the multi-representation approach and the selected CRI scale is <2.5 then the student is included in the category of not knowing the concept.

A graphical representation-based test is only able to find out that the student has misconceptions or understands the concept, but if there is a CRI amplifier, it can be classified as students who understand the concept, have misconceptions, or do not understand the concept. Based on the description above, the main objective of this research is to identify the level of misconceptions of class X students of several senior high schools in Jember on the straight motion material through the graphical representation approach and CRI.

METHOD

This research uses a qualitative descriptive research type. Qualitative descriptive research is research that can explains or describes a situation based on the facts of a particular population. The research process takes place in the even semester of the 2021/2022 academic year in three public senior high schools in Jember. The school of this research are include PSHS 1 Jember, PSHS 4 Jember, and PSHS Arjasa Jember. The subjects of this study consisted of students of class X SMA majoring in science at each school who only took one class as the research sample. Data collection techniques in this study used observation, tests, and interviews. The test used in this research is in the form of an essay test which is given a graphical representation approach and CRI to identify the misconceptions experienced by students in the material of straight motion.

a. First, see the results of the students' answers from the test that had done in the form of an essay test that have been given a graphical representation approach and CRI. Researchers assess the answers of students who are right and wrong.

b. Second, determine the category based on the CRI scale as follows

Table 1. CRI scale as a category of student confidience level

Scale	Category	Criteria
0	Very guessing	Questions are answered with a 100% guess percentage
1	Almost guessing	Questions are answered with a 75% - 99% guess percentage
2	Not sure	Questions are answered with a 50% - 74% guess percentage
3	Confident	Questions are answered with a 25% - 49% guess percentage
4	Almost very sure	Questions are answered with a 1% - 24% guess percentage
5	Very sure	Questions are answered with a 0% guess percentage

Source: (Gumilar, 2016).

c. Determining the level of student understanding based on the CRI scale to classify understanding concepts, misconceptions, and do not understand concepts as follow

Table 2. CRI scale as a category of student's level of understanding

Answer	CRI value	Description	Code	Indicator
True	> 2.5	Mastering the concept well	TK	Can explain the concept of straight motion with correct answers and a high level of confidence
	< 2.5	Don't know the concept	TTK	Can explain the concept of straight motion with correct answers but low level of confidence
False	> 2.5	Misconception	M	Errors explain the concepts of straight motion but the level of confidence in the answer is high
	< 2.5	Don't know the concept	TTK	Errors explain the concepts of straight motion and the level of confidence in a low answer

Source: (Mahardika *et al*., 2020).

d. The data that has been categorized is then calculated by the equation

$$P = \frac{f}{N} x\ 100\ \% \qquad (1)$$

where
P = group percentage figure(%)
f = number of student in each group
N = number of individuals (total number of students who were subject to research)

e. The percentage results are then grouped by category of level of misconception

Table 3. Kategory of Misconcesption

Percentage	Category
0 – 30 %	Low
31 – 60 %	Medium
61 – 100 %	High

RESULT AND DISCUSSION

Based on research that has been carried out at three public senior high schools in Jember, it can be seen that the number of students who are the subject of research at PSHS 1 is 35 students, PSHS 4 is 35 students, and PSHS Arjasa is 33 students. The class was chosen to be the subject of the study based on the documentation obtained from the final results of the student's tests of each school before the conduct of this research and the agreement between the teacher and the researcher. The number of class X students in several public senior high schools in Jember who have misconceptions about the material of straight motion through the graphical representation approach and CRI are as follows.

Table 4. Percentage of Misconceptions on Straight Motion Material Through Graphic Representation at PSHS 1

Number Problem	Indicator Problem	Number of students misconception	Percentage of graphical misconception student (%)
1	Graphing the relationship between distance and time on constant straight movement acceleration (GLB)	2	5.71
2	Graphing the relationship between distance and time on inconstant straight movement acceleration (GLBB)	15	42.86
3	Graphing the relationship between velocity and time on inconstant straight movement acceleration (GLBB)	24	68.57
4	Graphing the relationship between velocity and time on constant straight movement acceleration (GLB) and inconstant straight movement acceleration (GLBB)	5	14.29
5		13	37.14
Average percentage			33,71
Misconception level			Medium

Based on Table 4, it can be seen that the students of class X IPA at PSHS 1 Jember experienced a lot of misconceptions about the indicators of graphing the relationship between velocity and time in GLBB events with a percentage of misconceptions of 68.57%. The average misconception on the material of straight motion through the graphical representation approach is 33.71% which is included in the medium category.

The cause of students' misconceptions in solving problems based on graphic representations, namely the ability to receive lessons through a complete multi-representation approach is still lacking. Students admit that graphical representations are quite foreign because in their daily life students rarely include graphs in solving physics problems. It is still rare for students to understand that graphs can help summarize the concepts that have been taught so that it is easier for students. The form of students' misconceptions on graphical representation-based questions is that there are questions that have two event cases so that there should be two graphs depicted, but students only describe one graph. Some students do not write quantities and units on the graph. The level of confidence chosen in solving the problem can also cause misconceptions.

Table 5. Percentage of Misconceptions on Straight Motion Material Through Graphic Representation at PSHS 4

Number Problem	Indicator Problem	Number of students misconception	Percentage of graphical misconception student (%)
1	Graphing the relationship between distance and time on constant straight movement acceleration (GLB)	2	5.71
2	Graphing the relationship between distance and time on inconstant straight movement acceleration (GLBB)	16	45.71
3	Graphing the relationship between velocity and time on inconstant straight movement acceleration (GLBB)	13	37.14
4	Graphing the relationship between velocity and time on constant straight movement acceleration (GLB) and inconstant straight movement acceleration (GLBB)	4	11.43
5		14	40.00
Average percentage			27.80
Misconception level			Low

Based on Table 5, it can be seen that students of class X IPA at PSHS 4 Jember experience many misconceptions about the indicators of graphing the distance to time relationship in GLBB events with a percentage of misconceptions of 45.71%. The average misconception on the material of straight motion through a graphical representation approach is 27.80% which is included in the low category.

The cause of students' misconceptions in solving problems based on graphic representations, namely the ability to receive lessons through a complete multi-representation approach is still lacking. Students' errors in working on graph-based questions, most students do not understand the concept of physics so it is difficult to diagram graphs so that students experience misconceptions. Students admitted that they were rarely given the provision to interpret graphs in physics learning, but were only taught to know the general description of physics graphs. The form of student misconceptions on graphical representation-based questions is that they are often confused in placing variables that should be placed on the x-axis but are placed on the y-axis and vice versa. Most students only draw graphs with straight lines many do not even write down the quantities and units on the graph. The level of confidence chosen in solving the problem can also cause misconceptions.

Table 6. Percentage of Misconceptions on Straight Motion Material Through Graphic Representation at PSHS Arjasa

Number Problem	Indicator Problem	Number of students misconception	Percentage of graphical misconception student (%)
1	Graphing the relationship between distance and time on constant straight movement acceleration (GLB)	4	12.12
2	Graphing the relationship between distance and time on inconstant straight movement acceleration (GLBB)	21	63.64
3	Graphing the relationship between velocity and time on inconstant straight movement acceleration (GLBB)	22	66.66
4	Graphing the relationship between velocity and time on constant straight movement acceleration (GLB) and inconstant straight movement acceleration (GLBB)	17	51.52
5		8	24.24
Average percentage			43.64
Misconception level			Medium

Based on Table 6, it can be seen that the students of class X IPA at PSHS Arjasa Jember have many misconceptions about the indicators of graphing the relationship between speed and time in GLBB events with a percentage of misconceptions of 66.66%. The average misconception on the material of straight motion through a graphical representation approach is 43.64% which is included in the medium category.

The cause of students' misconceptions in solving problems based on graphic representations, namely the ability to receive lessons through a complete multi-representation approach is still lacking. Students admitted that they are not used to working on problems based on graphical representations because they generally work on problems based on mathematical representations. Graphic representation is often

underestimated by students so students do not study the graphs contained in physics material seriously. Most students only paint the graph with origin without knowing the meaning of the graph that has been described so the relationship between variables is not clear. Most students only draw graphs with straight lines, many even do not write down the quantities and units on the graph.

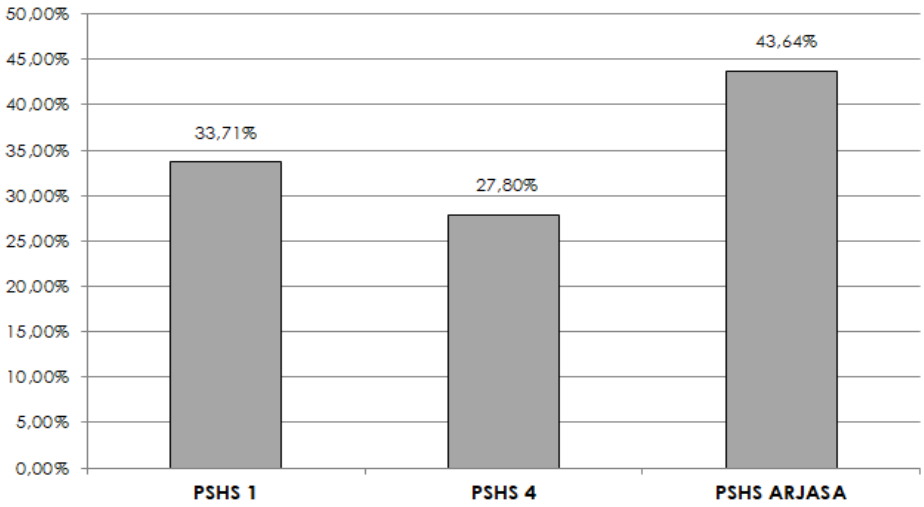

Figure 1. Graph of Percentage of Student Misconceptions on Straight Motion Material through graphical representation approach and CRI in Class X PSHS Jember district.

Based on the graph of the average percentage of misconceptions, the third shows the level of misconceptions in straight motion material through a graphical representation approach and CRI in PSHS 1 Jember students have a medium category with a percentage of 33.71 percent, PSHS 4 Jember students have a low category with a percentage of 27.80 percent, and PSHS Arjasa Jember students have a medium category with a percentage of 43.64 percent. The average percentage of misconceptions of class X students in several high schools in Jember on the material of straight motion through graphic representation and CRI is 35.05 percent in the medium category.

In this study, the average percentage of misconceptions on graphic representations is 35.05 percent, which is smaller than the research of Maulidyah and Zainuddin (2022) with a percentage of 56.00 percent. The level of misconception in the medium category can also be caused by the low ability of graphic representation by students. Selamet, Mahardika, and Supriadi (2018) state that their graphic representation abilities are still included in the very poor category with a percentage of 83.87 percent so many students do not understand and are less able to solve the problems presented.

The cause of misconceptions in graphical representation is that students are rarely provided with the provision to interpret graphs in solving problems but are only taught to know the general description of the graph. The lack of understanding of graphic concepts in previous learning is one of the factors for the low ability of students' graphic representation (Hasbullah, 2018). The difficulty of students in understanding graphs is influenced by the difficulty of students when connecting graphs with physical concepts so many of them are not used to being faced with various types of graphs that depict similar events (Toding et al, 2021). Therefore, teachers must also play an active role in designing learning in such a way that students' understanding of the ability to complete graphical representation-based tests can continue to be honed (Doyan et al, 2018).

CONCLUSION

Based on the results of data analysis and discussion of this study, the conclusions obtained regarding the identification of the level of misconceptions through the representation approach and CRI for class X students of several senior high schools in Jember are included in the medium category with an average percentage of misconceptions of 35.05%. Based on research conducted in three PSHS in Jember Regency, it is known that a large percentage of misconceptions occur in students. With this result, the researcher hopes that there will be other researchers who can apply multi representative learning to reduce the occurrence of misconceptions in students in learning physics, especially in the concept of straight motion.

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