The Relationship between Students' Misconception Levels Using Four Tier Diagnostic Tests with Concept Understanding

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ARTICLE INFO	ABSTRACT
Keywords: Misconceptions; Four Tier Diagnostic Test; Student Understanding *Article history:* Received 2022-02-17 Revised 2022-05-23 Accepted 2022-07-22	This study was conducted to know the relationship between the level of students' misconceptions and students' understanding. This study uses a quantitative descriptive method with a correlative research model. This research was conducted in MA. Miftahul Ulum Bettet Pamekasan in February 2022. The population in this study were all class X students with samples of class X Mathematics and Natural Sciences A, B, and C taken using the purposive sampling method. Data on the level of student misconceptions was obtained using a four-tier diagnostic test and analyzed with student understanding data using SPSS 25. The data obtained in the study, namely the correlation coefficient value was obtained at 0.088, which means that the level of relationship between students' understanding variables and students' level of misconceptions variables is very weak. *This is an open access article under the license.*

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1. INTRODUCTION

Physics is one of the disciplines in the world of education that plays an important role in the development of technology and science. Physics is a science that develops through scientific steps by focusing on the discovery of theories and concepts (Trianto, 2010). By studying physics, it is expected that students will be able to develop their reasoning power and ability to solve problems in everyday life, and can improve their process ability to understand physics concepts and grow scientific concepts and values. Physics also played an important role in the development of other disciplines (Titin et al., n.d.). The purpose of learning physics can be achieved if the learning process can take place effectively.

The learning process is an educational interaction that occurs to change one's actions and attitudes (Smith, 1994). Educational interaction is an active relationship between teachers and students with the medium in the form of science. Educational interaction is not possible if one of the elements is not active both in attitude, deed, and mental (Afrilianto, 2012). However, it is indicated that physics learning generally does not involve students optimally. This is to research conducted by several researchers,

namely during the learning process students are less active and less involved, causing students to have learning difficulties (Listia et al., 2017; Mardiah, 2021; Widodo & Widayanti, 2012).

Learning difficulties experienced by students cause students to make mistakes during the learning process. Sukirman revealed that error is a deviation from the right thing that is consistent, incidental, or systematic in certain areas. In addition, Rahmat Basuki stated that students' errors in solving problems were conceptual errors, carelessness errors, and operating errors, with the dominant error being conceptual errors. Meanwhile, according to Malau, when students make mistakes in working on questions, it can be seen from several things, namely lack of understanding of concepts in the subject matter and prerequisite material being taught, incorrectly applying and interpreting formulas, forgetting concepts, being less thorough, and miscalculations (Liliawati & Ramalis, n.d.). Based on the explanation above, the error can be said to be a deviation from the correct answer which is systematic and has an impact on students' understanding. In addition, many students believe that their misconception is correct. This is called a misconception.

The misconceptions experienced by students include all fields of science, one of which is physics (Suparno, 2015). Wandersee, Mintzes, and Novak in their research entitled Research on Alternative Conceptions in Science stated that misconceptions cover all fields of physics. From 700 misconception studies conducted, it is known that the highest misconception in physics is in the field of mechanics. Meanwhile, one of the topics that are considered the most frequent misconception is the topic of straight motion (Jumini et al., 2016). This happens because in straight motion material there are many concepts and formulas, while students generally only memorize formulas without knowing where the formulas were obtained (Puspitasari, 2018).

A misconception is one of the problems that play an important role in the world of education and the learning process. The misconceptions experienced by students will affect students understanding and learning outcomes (Hasanah et al., 2020; Kristin & Setyawan, 2021). In line with this, (Prasetyorini, 2013) revealed in his research that students who have a high level of understanding experience lower misconceptions compared to students who have a medium and low level of understanding. In addition, (Nurul, 2010) states that the misconceptions experienced by students are caused by answering by guessing correctly, lack of knowledge, mastering the concept correctly but misunderstanding it. Based on the description above, it can be said that the level of student understanding affects the level of misconceptions experienced by students.

The misconceptions experienced by students cannot be generalized so a diagnostic test is needed to determine the level of students' misconceptions (Leoni et al., 2020). In this study, the authors chose to use the four-tier diagnostic test which is the development of the three-tier diagnostic test. The format of the four-tier diagnostic test itself consists of four levels, namely: the first level is a question of knowledge in the form of multiple choice with 5 choice options, and the second level is the level of confidence in the answers chosen at the first level, level three is an empty choice filled in related to the reasons for the answers at the first level, and the fourth level, namely the level of confidence in the reasons written at the third level..

2. METHODS

The approach taken in this research is a quantitative approach. Where quantitative research according to Creswell is the method used to test the theory by examining the relationship between variables (Kadir, 2015). While the type of research used in this research is correlational research. According to Nana Sudjana, the correlation research method is a correlation study used to study the relationship between variables.

This research was conducted in MA. Miftahul Ulum Bettet Pamekasan in the even semester of the 2021/2022 academic year. The population in this study were all students of class X MA. Miftahul Ulum Bettet with samples of class X MIPA A, B, and C determined using the purposive sampling technique.

Data collection methods used are tests and documents. The test method is used to measure the level of student misconceptions by using the four-tier diagnostic test developed by (Nurulwati &

Rahmadani, 2019). The instrument consists of 10 questions. This test method is carried out in several stages, namely the stages of giving questions and administering tests to students of class X IPA A, B, and C, then the stages of processing data from the test results that have been obtained. Then the data is analyzed and conclusions are drawn.

While the document method is carried out to obtain data on student understanding through the grades of report cards for physics subjects in the odd semester of the 2021/2022 academic year for each student obtained from the school curriculum section. The variables in this study consisted of the independent variable (X) namely students' understanding and the dependent variable (Y) namely students' misconceptions of the research design as shown in Figure 1. below.

Figure 1. Desain Penelitian

Information:

X: Student understanding

Y: Students' misconceptions

r: The correlation between students' understanding and students' misconceptions

After doing research and obtaining further data, analyzing the data is by grouping the test results first into several categories in Table 1.

Table 1. Answer Combination Category

Category	Answer	Confidence Rating Answer	Reason	Confidence Rating Reason
Understand Concept	Correct	Convinced	Correct	Convinced
	Correct	Convinced	Correct	Not sure
	Correct	Not sure	Correct	Convinced
	Correct	Not sure	Correct	Not sure
Don't understand the concept	Correct	Not sure	Wrong	Not sure
	Correct	Convinced	Wrong	Not sure
	Wrong	Convinced	Wrong	Not sure
	Wrong	Convinced	Correct	Not sure
	Wrong	Not sure	Correct	Not sure
	Wrong	Not sure	Wrong	Not sure
Misconception	Wrong	Convinced	Wrong	Convinced
	Wrong	Not sure	Wrong	Convinced
	Correct	Not sure	Wrong	Convinced
	Correct	Convinced	Wrong	Convinced
Eror	Wrong	Not sure	Correct	Convinced
	Wrong	Convinced	Correct	Convinced

(Ismail et al., 2015)

Then, calculate the percentage of students who understand the concept, misconception, and don't understand the concept with the equation proposed by Sudijono (2010) as follows:

$$P = \frac{f}{n} \times 100\% .... (1)$$

Where :

P = percentage value of student answers,

F = frequency of students' answers,

n = number of students

After that, the percentage value obtained from the calculation results is described in tabular form. Next, identify the misconceptions experienced by students in each question and then group them according to the percentage as shown in Table 2.

Table 2. Category Percentage Level of Misconception

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

(Istighfarin, 2015)

After identifying the misconceptions experienced by each student, then conducting a correlation test using the Spearman Rank correlation test because the data obtained did not meet the parametric statistical test. After finding the results of the statistical test, then the correlation categorization is carried out as in table 3.

Table 3. Correlation Criteria

Sample Correlation Value (r)	Interpretation
0	No correlation
0,01-0,25	Very weak correlation
0,26-0,50	enough correlation
0,51-0,75	Strong correlation
0,76-0,99	Very strong correlation
1	Perfect correlation

(Jonathan Sarwono)

3. FINDINGS AND DISCUSSION

3.1 Student's Misconceptions

The data obtained are the results of four-tier diagnostic tests that have been carried out by students of class X MIPA A, B, and C. There were 66 students who took the test. Then, the answers are analyzed using predetermined steps. Next, group students into the categories of misconceptions, do not understand and understand as in Table 4 below.

Table 4. The number of students who understand, do not understand, and misconceptions

No	Understand		Don't Understand		Misconception		Error
1	3	4.54%	28	42.42%	35	53.03%	-
2	5	7.57%	35	53.03%	26	39.39%	-
3	38	57.57%	24	36.36%	4	6.06%	-
4	-	-	32	48.48%	34	51.51%	-
5	-	-	33	50%	33	50%	-
6	24	36.36%	35	53.03%	7	10.60%	-
7	-	-	30	45.45%	36	54.54%	-
8	-	-	43	65.15%	23	34.84%	-
9	-	-	33	50%	33	50%	-

No	Understand		Don't Understand		Misconception		Error
10	7	10.60%	42	63.63%	17	25.75%	-
∑	77	11.67%	335	50.75%	248	35.75%	-

The following is a presentation of the number of students who have misconceptions, do not understand, and have misconceptions in the form of a bar chart.
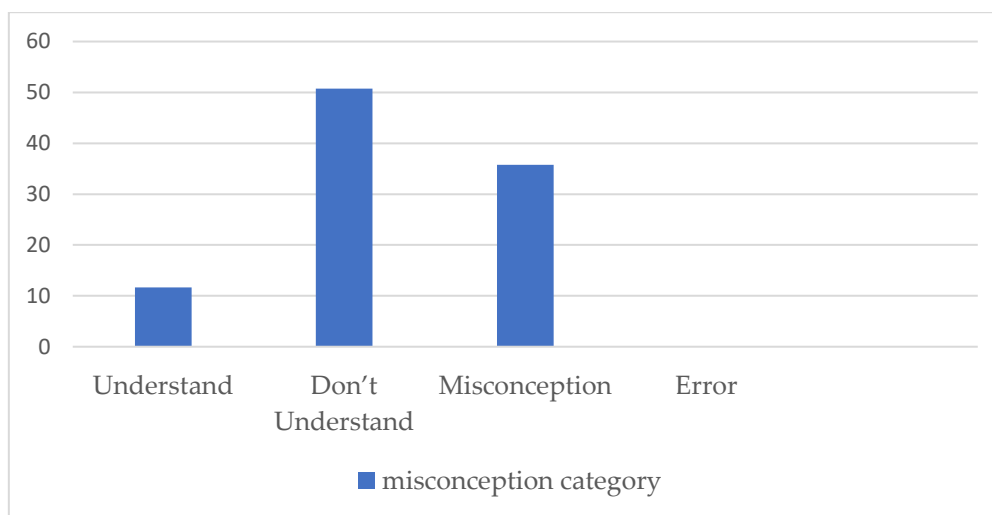

Figure 2. Student misconception category bar chart

Based on Table 4 above, the overall misconception experienced by students in the material of straight motion is 35.75% (medium category).

3.2 Overview of Student Understanding

Students' understanding in this study can be seen in the value of the results that have been achieved by students in physics subjects which are expressed in the form of numbers in the cognitive domain, namely report cards. The results of student understanding can be seen in Table 5.

Table 5. Distribution and Category of Students Understanding of Class X MIPA A, B, and C MA Miftahul Ulum Bettet Pamekasan.

Interval	Criteria	Frequency	Percentage
84-100	Very High	2	3.03%
68-84	High	64	96.96%
52-68	Medium	0	0%
36-52	Low	0	0%
20-36	Very Low	0	0%
	Total	66	100%

Based on Table 4 above, it shows that most of the students, namely 64 students (96.96%) have a high understanding of physics and 2 students (3.03%) have a very high understanding of physics. There are no students who experience low, medium, and very low understanding of physics.

3.3 Relationship between students' level of misconceptions with students' understanding

The results of the Spearman Rank analysis can be seen in Table 6. below.

Table 6. Spearman Rank Test Results

			Student Understanding	Misconception
		Correlations		
Spearman's rho	Student Understanding	Correlation Coefficient	1.000	-.088
		Sig. (2-tailed)	.	.483
		N	66	66
	Misconception	Correlation Coefficient	-.088	1.000
		Sig. (2-tailed)	.483	.
		N	66	66

Based on table 6, it is known that the significance value of students' understanding of misconceptions is >0.05, which is 0.483. So it can be stated that the understanding of MA students. Miftahul Ulum does not have a significant relationship to the level of misconception experienced by students. This can also be seen in the report cards of some students who are in the high category and all students have an average level of a misconception of 35.75% (in the medium category).

Based on interviews with several physics teachers at MA. Mifthul Ulum found that the reason for the high report card scores of some students was because the report card score was a combination of daily scores and student activity for one semester. In addition, the teacher gives additional assignments to students whose scores have not reached the KKM. This is one of the reasons students have high report cards even though they have misconceptions. School exams that tend to use multiple choice are also a contributing factor. Because multiple choice ignores the reasons students choose answers, students who do not understand or experience misconceptions can guess the questions correctly (Qodriyawati, 2010).

In table 6. it is known that the direction of the correlation is negative. Where this means that the lower the variable X, the higher the variable Y, and vice versa. The correlation coefficient value is obtained at 0.088, which means that the level of the relationship between students' understanding variables and students' level of misconceptions is very weak.

4. CONCLUSION

Based on the research conducted, it can be concluded that there is no significant relationship between students' understanding and the level of misconceptions experienced by students. This is shown in the significant value of the relationship between students' understanding and misconceptions of 0.483 (> 0.05).

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