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Analysis of Student's Misconceptions in Static and Dynamic Electricity Physics Using the Three Tier Test

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ABSTRACT

Physics is one of the subjects that is considered difficult, this assumption is reinforced by students who experience misconceptions, some even do not understand the concept. This study aims to find out students' misconceptions about static electricity and dynamic electricity. The research method is qualitative, with research subjects consisting of 20 students from class XII. The test instrument used consisted of 10 static and dynamic electricity questions self-made with content validation results of 0.96, empirical validity of 1.01, and reliability of 0.8 using the three tier test method. The data collection techniques used in the form of tests. The results of the study showed that 33.5% of students experienced misconceptions, the value was categorized as moderate. Meanwhile, 29.5% did not understand the concept and 35% understood the concept. Although the level of misconception is categorized as moderate, it still has to be an evaluation.

INTISARI

Fisika merupakan salah satu mata pelajaran yang dianggap sulit, anggapan tersebut diperkuat dengan siswa yang mengalami miskonsepsi, bahkan terdapat pula yang tidak memahami konsep. Penelitian ini bertujuan mengetahui miskonsepsi siswa pada materi listrik statis dan dinamis. Metode penelitian adalah kualitatif, dengan subyek penelitian terdiri dari siswa kelas XII berjumlah 20 siswa. Instrumen tes yang digunakan terdiri dari 10 soal listrik statis dan dinamis yang dibuat sendiri dengan hasil validasi isi 0,96, validitas empiris 1,01, dan reliabilitas 0,8 dengan metode *three tier test*. Adapun teknik pengumpulan data yang digunakan berupa tes. Hasil penelitian terdapat 33,5 % siswa mengalami miskonsepsi, nilai tersebut dikategorikan sedang. Sedangkan siswa yang tidak memahami konsep sebesar 29,5 % dan siswa yang memahami konsep 35 %. Meskipun tingkat miskonsepsi dikategorikan sedang, namun tetap harus menjadi evaluasi untuk pembelajaran.

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A. Introduction

The quality of education is related to quality because the central point in the teaching and learning process of students is the students. Students are expected to gain as much knowledge and insight as possible by learning. The low understanding of students in understanding a lesson is indicated by student achievement that is not in line with expectations. The incompatibility of learning

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outcomes with what is expected is a dilemma that will refer to the learning system [1].

Physics is a science that is closely related to natural phenomena. As a science, physics has various kinds of concepts. Many students have difficulty understanding physics concepts [2][3]. Physics is a subject that is regarded as challenging. Despite the fact that it is a crucial subject, some students lack interest for a variety of reasons. This may contribute to children developing misconceptions. Alamsyah and Sudrajat [4] define misconceptions as errors in linking one concept with others, between new concepts and concepts that already exist in students' thoughts, which leads to the formation of incorrect concepts that are at odds with expert conceptions.

Misconceptions often occur in physics subjects, especially static electricity in this study. While students' understanding of concepts is a goal in learning physics [5]. According to Malikha [6] defines misconception as a strong understanding of a concept, but not in accordance with the concept presented by the expert. The cause of misconceptions is not only from the students themselves, it can be other factors such as the teacher's delivery, the media, or the teaching materials used

Students' understanding of physics does not entirely prepare them to solve challenges in the actual world [7]. The results of the 2015 PISA (Program for International Student Assessment) review, in which Indonesian students' physics success score was rated 69th out of 76 nations, provide evidence of this. The PISA physics component measures students' capacity to recognize issues with comprehending natural facts, occurrences, and alterations in the environment.

According to Pujayanto [8] low student knowledge and misconceptions are to blame for Indonesian students' continued lack of physics proficiency. A three-tiered diagnostic test can be used to identify student misconceptions. The three-tier diagnostic test consists of questions with three alternative answers, including the degree of confidence in selecting an answer, the reason for selecting an answer, and the degree of confidence in the explanation. It is a three-level multiple-choice test. Misconceptions can cause new knowledge not to be properly integrated into students' cognitive structures [9]. If new concepts are transferred into students' cognitive structures and mixed with misconceptions, it will result in wrong understanding [10]. Didik and Aulia [11] define a three-tier diagnostic test as a three-level test with the first level (one tier) of ordinary multiple choice, the second level (two tier) of multiple choice reasons for choosing the first level, and the level when (three tier), namely the choice of students' beliefs based on the answers in the first and second levels.

Eryilmaz and Surmeli have developed a three-tier diagnostic test instrument which is a combination of a two-tier test combined with the Certainty Response

Index (CRI) [12]. The three-tier test instrument has the advantage of being able to distinguish between misconceptions with a lack of understanding of the concept or not knowing the concept through the confidence level of the student's answers, so that it is accurate in detecting misconceptions. Three levels in the three-tier test, namely: (1) the first level asks descriptive questions, (2) the second level asks the reasons for the answers given and also inserts options in the form of blanks (free responses), to find out whether students experience new misconceptions or misconceptions which was not found in the previous literature, and (3) the third level asks students' confidence in answering questions [12].

Understanding the concept with correct answers (true or false), not understanding the concept with correct or wrong (true or false), or wrong (true or false) unsure answers, and misconceptions with right or wrong (true or false) sure answers are divided into three categories. Respondents in this study were 20 class XII high school students. Through the answers from the tests that have been answered by respondents to the misconception questions that have been distributed, the percentage of students' misconceptions about static and dynamic electricity can be obtained.

B. Method

This research is qualitative study. This study used a sample of 20 class XII high school students. The test carried out was a three-tier diagnostic test, and the research questionnaire consisted of 10 questions about static and dynamic electricity misconceptions. The static and dynamic electricity questions tested were self-made with content validation results of 0.96, empirical validity of 1.01, and reliability of 0.8 using the three tier test method. The data collection techniques used in the form of tests.

The type of research used in this research is descriptive research with a qualitative approach. The research design in this study was prepared according to the variables studied. This study aims to identify students' misconceptions about physics on the subject of static and dynamic electricity using a three-tier diagnostic test as the instrument. The use of a three-tier diagnostic test is expected to be able to detect students' Physics misconceptions well. Misconceptions can be identified by providing multiple choice test questions that are adapted to the subject matter of static and dynamic electricity in high school. In the use of a three-tier diagnostic test, multiple choice questions have three levels of answers. For the first level, namely in the form of multiple choice questions in general, the second level is in the form of students' reasons for choosing answers at the first level, and the third level is in the form of students' confidence in the answers of the two previous levels. This study uses a three-tier diagnostic test with open reasons, because it is expected that the reasons given by students are an understanding that is already owned and accepted during the learning process for each student. In addition, there

is confidence, namely to find out the stability of students towards their understanding. Identification of Physics misconceptions uses a three-tier diagnostic test to classify students who understand concepts, misconceptions, and do not understand concepts. Because the mistakes of students in giving answers are not all classified as misconceptions, this can happen because students do not understand the concept. To analyze the data that has been collected, the researcher takes the following steps: (1) Analyzes the students' answers between the multiple choice results, the reasons and the students' beliefs according to the categories of understanding levels in the three-tier diagnostic test. (2) Grouping the categories of students' answers into understanding, lack of understanding, and misconceptions. (3) Calculate the percentage of misconceptions experienced by students in each item. (4) Make conclusions from the data obtained in the form of a profile of misconceptions and the percentage of misconceptions.

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

Description:

P : Percentage of misconceptions

M : the number of students who have misconceptions

N : the total number of students

C. Result and Discussion

This research was conducted to determine the percentage of misconceptions that occur in static electricity material among high school students using a three-tier test consisting of 10 questions. The results of the answers obtained were grouped into three, namely understanding the concept (PK), not understanding the concept (TPK), and misconceptions (M), as can be seen in table 1.

Table 1. Results of Respondents' Answers

Answer	Reason	Belief	Category	Code
True	True	Not Sure	understand the concept	UC
True	False	Not Sure	don't understand the concept	DUC
False	True	Not Sure	don't understand the concept	DUC
False	False	Not Sure	don't understand the concept	DUC
True	False	Sure	misconception	M
False	True	Sure	misconception	M
False	False	Sure	misconception	M

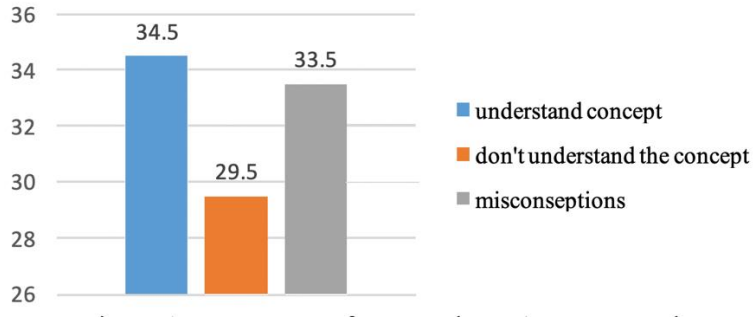

Figure 1. Percentage of Respondents Answer Results

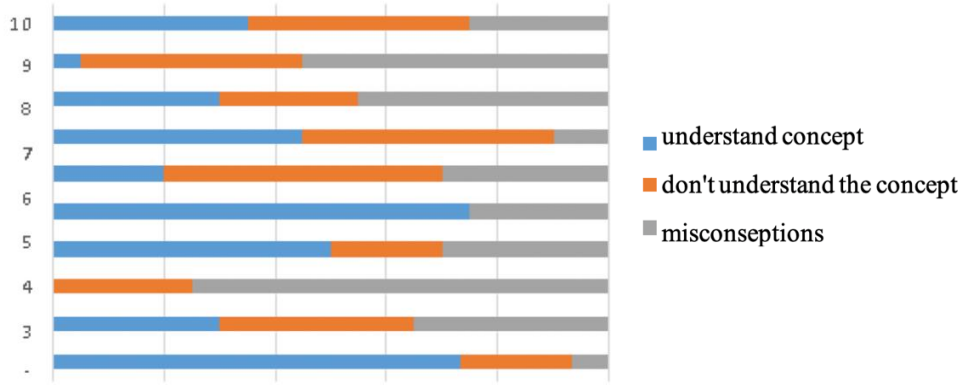

Figure 2. Results of Misconceptions for Each Question by Respondents

There are 2 student answer sheets in Figure 3, then the answers are processed according to the provisions in Table 1 so that the level of understanding is known.

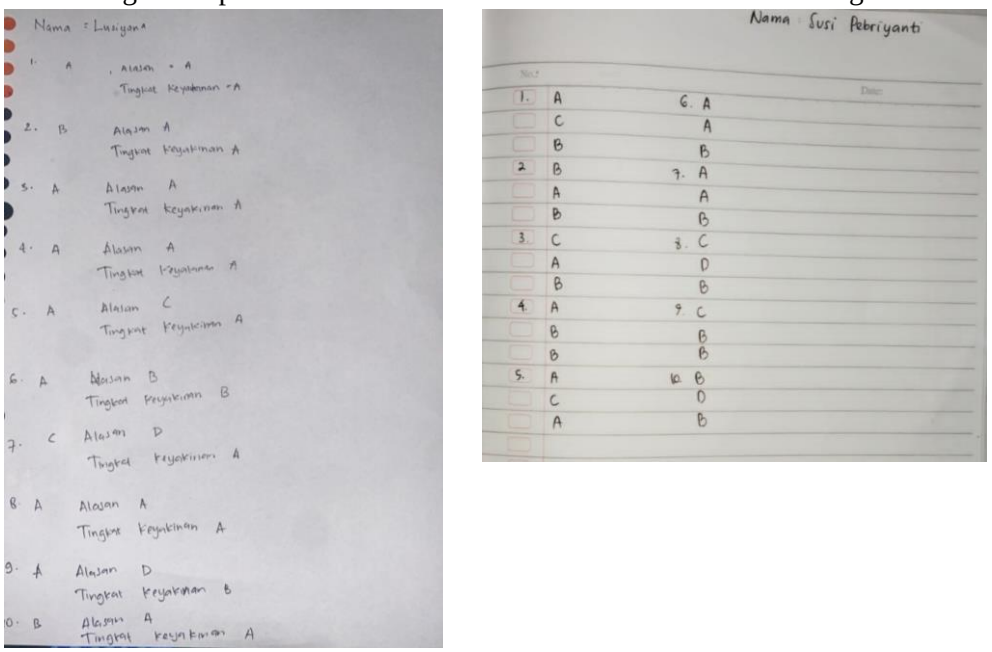

Figure 3. Student Answer Sheet

A total of 20 students participated in the observation of the concept of static and dynamic electricity. The results obtained for the students' understanding as a whole are written in Figure 3. The percentage of understanding the concept of 34.5% is included in the medium category; the presentation of not understanding the concept is 29.30%, which is categorized as low; and the percentage of misconceptions is 33.5%, which is included in the medium category. One of the factors causing misconceptions in students is the lack of variation in the methods used, which causes them to become bored. For example, when the teacher explains in front, students sit and pay attention. Over time, students will feel bored, until finally they become passive. Learning should be carried out as interestingly as possible, so that two-way communication is created and raises curiosity in students. Misconceptions among students, especially about static electricity material, also occur because this material is classified as abstract, especially in parallel electric circuits and electric charges that occur in the application of static electricity. Misunderstandings about concepts need to be straightened out so as not to hinder students in learning, although sometimes students who experience misconceptions find it more difficult to accept the correct concept. According to Suparno (2005) students who experience misconceptions will tend to defend their opinions, because these concepts are understood by students, students can also explain the concept. So the teacher needs to provide opportunities for students to convey concepts that they understand, so that they can find out whether they are in accordance with concepts or misconceptions.

Details of the level of understanding of the concept for each item can be seen in Figure 2, which shows in more detail the percentages of understanding the questions, not understanding the questions, and misconceptions on each question.

The first question contains the question of what happens if the positive and negative charges are brought closer together. All respondents managed to answer correctly. Even so, the level of student understanding only reached 55%; 15% did not understand the concept, and 5% of the misconceptions were categorized as low. This is evidenced by the percentage results obtained.

In the second question, students were asked to analyze the distance between the two loads, which was extended twice from the original distance. In this second question, the differences between understanding the concept, not understanding the concept, and misconceptions were almost even, with successive values of 30%, 35%, and 35%. The level of misconceptions in this question is categorized as moderate. This is evidenced by the percentage results, which are almost the same size.

The third question concerns the charges that occur on silk and glass after they are rubbed. The level of understanding of the concept of 0% is low; no students understand this concept. Conversely, as many as 75% of students

experienced misconceptions and answered that the electrons on silk cloth increased and the electrons on glass decreased; some students also answered that the electrons on glass and silk cloth increased. The remaining 25% do not understand the concept.

The fourth question is regarding the location of the strongest magnetic field. Misconceptions students answer the point between the two poles with a percentage of 30%. while understanding the concept of 50% and not understanding the concept of 20%.

The fifth question concerns the events that occur when a comb is rubbed against dry hair, then the comb is brought close to a piece of paper. The result is that 75% of students succeed in understanding this concept. While the misconception is 25% of the answer, there is a strong electric force, and after the two objects are rubbed together, they produce a magnetic field.

In the sixth problem, there was an event in which two blocks were rubbed, one of which experienced an excess of electrons; the question is the charge on one of the objects that had an excess of electrons before rubbing. Half of the students did not understand the concept here, 20% understood the concept, and the remaining 30% had misconceptions about the answer: that the object before rubbing had few electrons so that after rubbing it had excess electrons.

The seventh question is about a series of lights. The level of misconceptions on this question is in the low category, with a percentage of 10%. Students who understand and do not understand the concept of balance are separated by 45%.

The eighth problem is about the effect of two blocks rubbing against an electric charge. Students who have misconceptions respond that the proton charge moves and that if one object is overloaded, the excess will move; this misconception accounts for 45% of the total. Other students understand the concept to a lesser extent (30%) but not at all (25%).

A picture of an electric circuit with the switch closed is shown in the ninth question.The result is that 55% of students experience misconceptions, 40% do not understand the concept, and only 5% understand it. From this percentage, it can be concluded that the questions presented are in the difficult category.

You inquired about the quality of the lamp flame at various voltages in your previous question. Some students believed that the lamp would continue to glow brightly at different voltages. Miscoception is categorized as low with a percentage of 25%; it understands the concept of 35% but does not understand the concept of 40%.

D. Conclusion

The level of misconceptions about static and dynamic electricity is moderate, with a percentage of 33.5%. There is a high level of misconception about the charge state that occurs after a silk cloth is rubbed with glass. While the

category of misconceptions is found in the events that occur when positive and negative charges are brought closer, where the magnetic field is strongest, and in a series electric circuit, The rest are categorized as low misconceptions. Misconceptions occur because the learning methods used are not appropriate and students do not understand the material well.

Based on that misconception have found, a strategy learning needs to be designed for overcome these misconceptions students do not experience it anymore.

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References

[1] Suryawan, IPA., Santyasa IW., & Sudarma IK., "The Influence of the Discovery-Inquiry Learning Method on the Reduction of Misconceptions and Physics Learning Achievement *(Pengaruh Metode Pembelajaran Discovery-Inquiry terhadap Reduksi Miskonsepsi dan Prestasi Belajar Fisika)*". Jurnal Teknologi Pembelajaran Indonesia, vol.10(1), pp.25-34, 2020.

[2] Aritonang, K. T., "Interest and Motivation in Improving Student Learning Outcomes *(Minat dan Motivasi dalam Meningkatkan Hasil Belajar Siswa)*", Jurnal Pendidikan Penabur, no.10, June 2008.

[3] Wijayanti P.I. et.al., "Exploration of Student Learning Difficulties on the Subject of Light and Efforts to Increase Learning Outcomes Through Guided Inquiry Learning *(Eksplorasi Kesulitan Belajar Siswa Pada Pokok Bahasan Cahaya dan Upaya Peningkatan Hasil Belajar Melalui Pembelajaran Inkuiri Terbimbing)*", Jurnal Pendidikan Fisika Indonesia, vol. 6, pp.1–5, 2010.

[4] Alamsyah, S. & Sudrajat, Learning Learning in Elementary Schools *(Belajar Pembelajaran di Sekolah Dasar)*. Daerah Istimewa Yogyakarta: Deepublish, 2021.

[5] Suparno, P., Misconceptions and Concept Changes in Physics Education *(Miskonsepi dan Perubahan Konsep dalam Pendidikan Fisika)*. Jakarta: PT Grasindo, 2007.

[6] Malikha, Z. & Amir, M.F., "Misconception Analysis of Class V-B Students Min Buduran Sidoarjo on Fractions Material in View of Mathematical Ability *(Analisis Miskonsepsi Siswa Kelas V-B Min Buduran Sidoarjo pada Materi Pecahan Ditinjau dari Kemampuan Matematika)*", Jurnal Mathematics Education, vol. 2(1), pp.75-81, 2018.

[7] Wisudawati, A.W., The Science Learning Methodology is adapted to the 2013 Curriculum Learning *(Metodologi Pembelajaran IPA disesuaikan dengan Pembelajaran Kurikulum 2013)*. Jakarta: Bumi Aksara, 2017.

[8] Pujayanto, "Misconceptions of Science (Physics) in Elementary School Teachers. Journal of Materials and Learning Physics *(Miskonsepi IPA (Fisika)*

pada Guru SD)", Jurnal Materi dan Pembelajaran Fisika, vol.1(1), pp.22 – 24, 2011.
[9] Costu, B., Ayas, A. & Niaz, M., "Promoting Conceptual Change in First Year Student's Understanding of Evaporation", Chemistry Education Research and Practice, vol.11, pp.5-16, 2010.
[10] Mosik, P.M., "Efforts to Reduce the Occurrence of Physics Misconceptions through Learning with a Cognitive Conflict Approach *(Usaha Mengurangi Terjadinya Miskonsepsi Fisika melalui Pembelajaran dengan Pendekatan Konflik Kognitif)*", Jurnal Pendidikan Fisika Indonesia, vol. 6, pp.98-103, July 2010.
[11] Didik, L. A., & Aulia, F., "Analysis of the level of understanding and misconceptions on static electricity material for physics tadris students using the 3-tier multiple choices diagnostic method *(Analisa tingkat pemahaman dan miskonsepsi pada materi listrik statis mahasiswa tadris fisika menggunakan metode 3-tier muliple choices diagnostic)*". Jurnal Phenomenon, vol.9(1), pp.99-112, 2019.
[12] Pesman, Haki, Development of a three-tier test to asses ninth grade Student misconceptions about simple electric circuits. Master Thesis in Middle East Technical University, 2005.