PROCEEDINGS
Vol 2. ISSN.

The 4nd Education, Sciences and Technology International Conference 2024

Identification of Student Misconceptions Using a Four-Tier Diagnostic Test Based on Certainty of Response Index (CRI) in Dynamic Electricity Material at SMAN Unggul Pidie Jaya

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Abstrak

Miskonsepsi merupakan suatu konsep yang tidak sesuai dengan konsep ilmiah. Miskonsepsi pada peserta didik perlu diidentifikasi agar tidak menghambat pemahaman konsep materi selanjutnya. Tujuan penelitian ini adalah untuk mengetahui apakah terdapat miskonsepsi peserta didik pada materi listrik dinamis di SMAN Unggul Pidie Jaya; dan untuk mengetahui miskonsepsi peserta didik pada subpokok bahasan materi listrik dinamis di SMAN Unggul Pidie Jaya. Penelitian ini menggunakan pendekatan campuran (*mix methods*). Subyek dalam penelitian ini adalah 27 peserta didik kelas XII MIPA 1 SMAN Unggul Pidie Jaya. Instrumen yang digunakan berupa soal diagnostik berdesain *Four-Tier Multiple Choice Test* disertai *Certainty of Response Index* (CRI). Hasil analisis data menunjukkan persentase jumlah peserta didik yang Paham Konsep (PK) adalah 19,17%, Tidak Paham Konsep (TPK) sebanyak 35,73%, Miskonsepsi (M) sebanyak 33,77%, dan *Error* (E) sebanyak 11,33%. Persentase miskonsepsi pada masing-masing subpokok bahasan yaitu kuat arus listrik (37%), hambatan listrik (44,4%), Hukum Ohm (27,2%), susunan hambatan (36,1%), Hukum Kirchoff (31,5%), arus listrik searah (18,5%), arus listrik bolak-balik (14,8%), dan daya listrik (38,9%). Dari hasil analisis data diperoleh kesimpulan bahwa terdapat miskonsepsi peserta didik pada seluruh subpokok bahasan materi listrik dinamis di SMAN Unggul Pidie Jaya.

Abstract

Misconception is a concept that does not align with scientific concepts. Misconceptions among students need to be identified so that they do not hinder the understanding of subsequent material concepts. The purpose of this research is to determine whether there are misconceptions among students regarding dynamic electricity at SMAN Unggul Pidie Jaya; and to identify the misconceptions among students in the subtopics of dynamic electricity at SMAN Unggul Pidie Jaya. This study employs a mixed-methods approach. The subjects of this study are 27 students from class XII MIPA 1 at SMAN Unggul Pidie Jaya. The instrument used is a diagnostic test designed as a Four-Tier Multiple Choice Test accompanied by a Certainty of Response Index (CRI). The results of the data analysis show that the percentage of students who Understand the Concept (PK) is 19.17%, Do Not Understand the Concept (TPK) is 35.73%, Misconception (M) is 33.77%, and Error (E) is 11.33%. The percentage of

misconceptions for each subtopic is as follows: electric current strength (37%), electrical resistance (44.4%), Ohm's Law (27.2%), series resistance (36.1%), Kirchhoff's Law (31.5%), direct current (18.5%), alternating current (14.8%), and electric power (38.9%). From the data analysis, it can be concluded that there are misconceptions among students in all subtopics of dynamic electricity at SMAN Unggul Pidie Jaya.

INTRODUCTION

Misconception, or conceptual error in physics, refers to a misunderstanding that deviates from the definitions accepted by scientists (Paul Suparno, 2015). Conceptual errors can arise from within students, stemming from everyday experiences or interactions in their environment. The causes of misconceptions often relate to the initial concepts (preconceptions) that students already possess. Additionally, misconceptions can be influenced by teachers, teaching methods, learning resources, and the textbooks used by the students themselves (Tri Ade Mustaqim et al., 2014). Initial concepts held by students can be either correct or incorrect after acquiring knowledge in school; often, the concepts students develop diverge from scientific concepts. Consequently, many initial concepts are misunderstood by students, impacting their learning process as they progress to higher levels of education.

Efforts to identify misconceptions have been extensively undertaken; however, there are still difficulties in distinguishing between students who experience misconceptions and those who do not understand the concepts. Several tiered multiple-choice tests, including Two-Tier and Three-Tier tests, have been implemented, but distinguishing between students with misconceptions and those who lack understanding remains challenging. Without differentiating between the two, it becomes difficult to take subsequent steps, as correcting misconceptions is not the same as helping students who do not grasp the concept (Vanny Haris, 2013). Therefore, there is a need for a more complex tiered test instrument to identify misconceptions, specifically the development of a four-tier diagnostic test accompanied by a Certainty of Response Index (CRI). With the development of the four-tier diagnostic test along with CRI, students' misconceptions can be identified effectively.

Based on previous research conducted by Nugraeni, it was concluded that the average level of Uncertainty about Concepts (TTK) was 16%, Understanding the Concept (PK)

was 42%, and Misconceptions (M) were also 42%. Similarly, research by Reni Dias Agustin concluded that the average misconception rate among students was 40.3%. The misconceptions related to alternating current circuits were categorized as very low, which aligns with findings by Tia Ariani, whose data analysis showed an average Lucky Guess (LG) rate of 8.60%, Knowledge of Concept (TK) at 31.40%, Uncertainty about Concepts (TTK) at 24.20%, and Misconceptions (M) at 37.80%.

Based on discussions with teachers at SMAN Unggul Pidie Jaya, it was indicated that concepts likely to lead to misconceptions in dynamic electricity were identified. It was noted that students' physics learning outcomes are below the Minimum Completion Criteria (KKM). Most students have yet to grasp the concepts in physics learning according to scientific standards, and there is also a lack of interest in physics subjects, leading to ineffective learning and poor academic achievement in physics.

Given the background presented, the researcher is interested in conducting a study related to misconceptions. In this research, the investigator differentiates from previous studies by utilizing a Four-Tier Diagnostic Test accompanied by a Certainty of Response Index (CRI) at the senior high school level, titled "Identification of Student Misconceptions Using a Four-Tier Diagnostic Test Based on Certainty of Response Index (CRI) in Dynamic Electricity Material at SMAN Unggul Pidie Jaya."

RESEARCH METHOD

The approach in this research uses a mixed-methods methodology, incorporating both qualitative and quantitative methods. The study was conducted at SMAN Unggul Pidie Jaya, involving students from class XII MIPA 1, totaling 27 participants.

The data collection technique used in this research was the administration of a four-tier diagnostic test based on the Certainty of Response Index (CRI), consisting of 17 questions distributed to students to identify their understanding levels and misconceptions regarding the subtopic of dynamic electricity.

After the test, the data obtained from the four-tier diagnostic multiple-choice test based on CRI for dynamic electricity will be analyzed by categorizing the students' answer patterns according to their understanding levels. The categories for the students' answer patterns based on understanding levels are as follows:

Kategori	Tipe Jawaban			
	Jawaban	CRI	Alasan	CRI
(1)	(2)	(3)	(4)	(5)
Paham	Benar	> 2,5	Benar	> 2,5
Tidak Paham Konsep	Benar	> 2,5	Benar	≤ 2,5
	Benar	> 2,5	Salah	≤ 2,5
	Benar	≤ 2,5	Benar	> 2,5
	Benar	≤ 2,5	Benar	≤ 2,5
	Benar	≤ 2,5	Salah	≤ 2,5
	Salah	> 2,5	Benar	≤ 2,5
	Salah	> 2,5	Salah	≤ 2,5
	Salah	≤ 2,5	Benar	≤ 2,5
	Salah	≤ 2,5	Salah	≤ 2,5

Miskonsepsi	Benar	> 2,5	Salah	> 2,5
	Benar	≤ 2,5	Salah	> 2,5
	Salah	> 2,5	Salah	> 2,5
	Salah	≤ 2,5	Salah	> 2,5
Error	Salah	> 2,5	Benar	> 2,5
	Salah	≤ 2,5	Benar	> 2,5

Table 1. Categories of Students' Conceptions Based on Answers in the Four-Tier Diagnostic Test

(Sumber. Kaltacki dkk., 2015)

Then, in the next stage, the researcher will obtain results from the data using the percentage formula. The answers obtained from the respondents will be processed using the percentage formula, which is as follows:

$$P = \frac{F}{N} \, x \, 100\%$$

P = Percentage of students with misconceptions

F = Number of students with misconceptions

N = Total number of students

To categorize the characteristics of the answers from students experiencing misconceptions, the following classifications will be used:

Table 2. Categories of Percentage Levels of Misconceptions

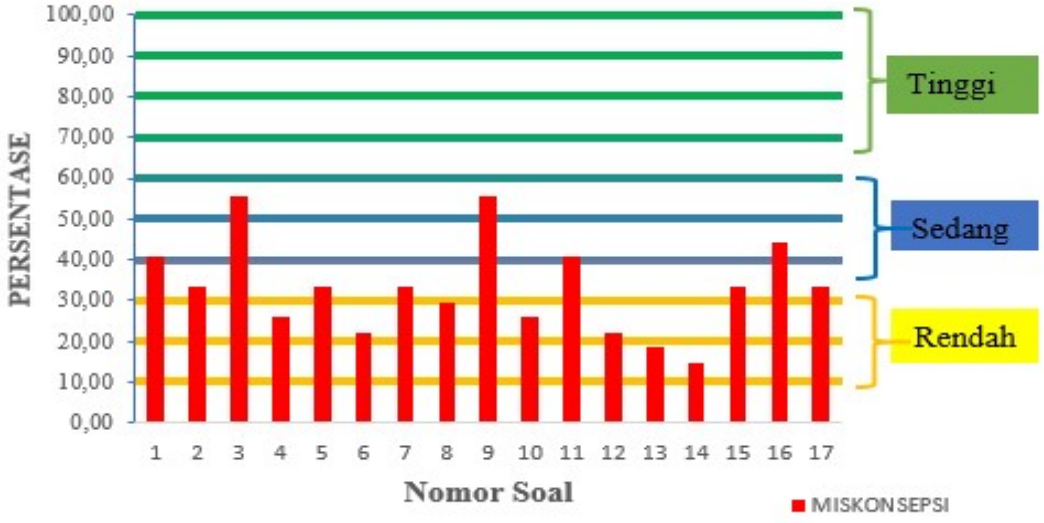
Persentase	**Kategori**
0 - 30%	Rendah

31% - 60%	Sedang
61% - 100%	Tinggi

(Sumber. Istighfarin dkk., 2015)

RESULTS AND DISCUSSION

Berdasarkan hasil penelitian dapat diperoleh dari grafik sebagai berikut:



Gambar 1. Persentase miskonsepsi peserta didik setiap butir soal

SUB POKOK BAHASAN	PERSENTASE				Kategori Miskonsepsi
	P	TPK	M	E	
Kuat Arus Listrik	14,8%	25,9%	37,0%	22,2%	Sedang
Hambatan Listrik	14,8%	35,2%	44,4%	5,6%	Sedang
Hukum Ohm	34,6%	29,6%	27,2%	8,6%	Rendah

Susunan Hambatan	25%	32,4%	36,1%	6,5%	Sedang
Hukum Kirchoff	3,7%	50%	31,5%	14,8%	Sedang
Arus Listrik Searah (DC)	3,7%	51,9%	18,5%	25,9%	Rendah
Arus Listrik Bolak-Balik (AC)	14,8%	51,9%	14,8%	18,5%	Rendah
Daya Listrik	20,4%	31,5%	38,9%	9,3%	Sedang
$\bar{x}$	16,5%	38,5%	30,7%	13,9%	Sedang

Tabel 3. Persentase Identifikasi Miskonsepsi per sub konsep

Based on Table 3, it can be observed that the average percentage of students' misconceptions is 30.7%, with an average understanding score (P) of 16.5%, an average score of Not Understanding the Concept (TPK) at 38.5%, and an average Error score (E) of 13.9%.

From Table 3, it can be seen that there is a percentage of misconceptions across all subtopics of dynamic electricity. The highest misconception occurs in the subtopic of electrical resistance, at 44.4%. In the subtopic of electric power, the number of students experiencing misconceptions is similarly high, at 38.9%. These results indicate that students in class XII MIPA 1 experience a significant level of misconceptions across all subtopics of dynamic electricity. Meanwhile, the highest average percentage of not understanding concepts is found in the subtopics of direct current (DC) and alternating current (AC), at 51.9%. The average percentage of not understanding concepts is also

relatively high in Kirchhoff's Law, electrical resistance, and series resistance, at 50%, 35.2%, and 32.4%, respectively.

This study found that the overall percentage of students who do not understand the concept (TPK) is quite high, at 35.73%, due to a lack of interest and motivation among students in learning. This aligns with research conducted by Nofitasari, which indicated that students struggle to understand dynamic electricity material due to low interest and motivation (internal factors) as well as insufficient implementation of teaching methods and media variations (external factors).

The high percentage of not understanding concepts (TPK) experienced by students across all subtopics is also attributed to their inadequate understanding of the material, stemming from low awareness in learning physics, a prevalence of misconceptions or misunderstandings, and a lack of comprehension of the concepts taught by educators at school. This is consistent with Fitriasari's research, which stated that students' achievement scores are still lacking due to insufficient awareness and motivation to learn, resulting in poor understanding of the material.

CONCLUSION

The overall percentage of students experiencing misconceptions is 33.77%, categorized as moderate, which is significantly higher than the percentage of students who understand the concept, at 19.17%, categorized as low. The highest misconceptions occur in the subtopic of electrical resistance at 44.4%, electric power at 38.9%, series resistance at 36.1%, electric current strength at 37%, and Kirchhoff's Law at 31.5%, all of which fall into the moderate category. Meanwhile, the lowest misconceptions are found in the subtopics of alternating current (AC) at 14.8%, direct current (DC) at 18.5%, and Ohm's Law at 27.2%, each categorized as low.

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