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Analysis of Student Misconception Using Three-Tier Multiple-Choice Diagnostic Test on Reaction Rate Material

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***Abstract*:** *Misconception or conceptual errors in learning are errors in understanding a meaning. This descriptive research aims to analyze the level of students' misconceptions on the reaction rate material and analyzing misconceptions on each concept in the reaction rate material. The reseach method used is descriptive research with a quantitative approach. The sample in this research are 30 students of Grade XI students of SMAN 2 Percut Sei Tuan. The instrument used in this research is three-tier multiple-choice diagnostic test, with total 20 questions.. The results showed that the average of students' misconception of SMAN 2 Percut Sei Tuan who experience misconception is 61,6%. Students' misconception occurs in each concepts of reaction rate material. Percentages of students' misconceptions on reaction rate and reaction rate expressions have percentage 54.25%, in concept reaction order have percentage 62.87%, in concept factors affecting reaction rate have percentage 60.58%, in concept collision theory have percentage 73.70%, and in concept reaction rate equation have percentage 52.58%.*

***Keywords*:** *misconception; three-tier multiple-choice diagnostic test; reaction rate*

INTRODUCTION

The progress of a nation is greatly influenced by education (Silaban & Panggabean, 2023). The quality of learning in the classroom is evidence of the quality of education (Saragih & Sugiharti, 2024). The ability of logic of Indonesian student is still relatively low, according to the results of the PISA (International Student Assessment Program) survey, the scientific literacy rankings in Indonesia in 2003, 2006, 2009, 2012, 2015 put Indonesia ranked 61 out of 70 nations (El Islami et al., 2019). PISA survey in 2018 set Indonesia at the 72nd rank out of 77 nations (Yusmar & Fadilah, 2023).

The different abilities that students have in receiving and processing the material presented can result in the emergence of different knowledge. It is not uncommon for students to relate their knowledge to other concepts that they happen to have. As a result, knowledge arises that is not in accordance with the actual concept. Conditions like this often give students misconception (Mellyzar et al., 2022). Misconceptions are student understandings of scientific concepts that differ from scientific concepts that are

analyzed in a scientific manner (Kirbulut & Geban, 2014).

The study of object, its properties, structure, compocition, and change is known as chemistry in philosophy (Situmorang et al., 2023). One chemical concept that is considered difficult and important to understand is the reaction rate material (Ginting et al., 2022). Reaction rate material is a material that has many abstract concepts , for example factors that influence reaction rates and collision rates (Irawati, 2019). Regarding reaction rates, there are also mathematical calculations and many factors that cause the reaction rate to incerease (Marpaung & Sutiani, 2020). The existence of this abstract concept makes it troublesome for students to get the concept of reaction rate and as a result gives rise to misconceptions (Sugiharti & Hasibuan, 2017).

One way to diagnose student misconceptions is to use diagnostic instruments (Rumapea & Silaban, 2022). Therefore, one technique that may be applied is a three-tier multiple-choice diagnostic test in order to dispel the student's misconception. The three-tier multiple choice diagnostic test consists of three levels of questions. Level one is a multiple-choice question, level two is the reason for the answer in level one, level three is the student's level of confidence in answering the question in level one, and level two is an answer between sure and not sure (Lestari et al., 2021). Using a three-tier multiple choice diagnostic test is expected used to identify students' concept understanding on chemical reaction rate material (Rizki & Setyarsih, 2022).

Redrieved from the comes about of interviews with chemistry instructor at SMA Negeri 2 Percut Sei Tuan students experienced difficulties in learning reaction rate, that is proven by fact that students' achievement of the KKM is still low, especially in determining reaction orders, reaction rate equations, and chemical calculation. Teachers usually carry out exercises/evaluations in the form of multiple-choice and essays. Teachers have never carried out an assessment to discover out the level of students' conceptual understanding by giving a three-tier multiple-choice diagnostic test.

Based on the clarification over, researchers realize the importance of knowing the level of misconception of grade XI students of SMA Negeri 2 Percut Sei Tuan with diagnostic tests.

LITERATURE REVIEW

Conceptions that are not in accordance with scientists' conceptions are generally called misconceptions (Adi & Oktaviani, 2019). Students' weakness in interpreting chemical concepts has become a problem that has occurred a lot lately, this causes students to have difficulty understanding lessons and chemical concepts, resulting in students misinterpreting concepts so that students ultimately experience misconceptions. This misconception needs to be addressed immediately because it results in the creation of an unbroken chain of misconceptions (Kurniasih, 2017). Some causes of the misconceptions about students include students themselves, teachers, textbooks and teaching methods (Aswita et al., 2017). One way to diagnose misconceptions is use the three-tier multiple-choice instrument test.

The excellence of three-tier multiple-choice diagnostic test that are to diagnose students' understanding of concepts and even misconceptions in depth, determine the material that need more emphasis when lesson take places, and can be used as a consideration in planning better learning to improve students' conceptual understanding (Hasniyah & Muchtar, 2021). Teachers can distinguish among students who comprehend the topic, they misunderstand the concept and do not understand the concept by using a three-tier multiple-choice diagnostic test to analyze student misunderstand, so that they can correct the misconceptions they have by changing the wrong concept towards the correct concept (Ni'mah et al., 2020).

METHODS

The research was carried out at SMA Negeri 2 Percut Sei Tuan which is located at Jalan Pendidikan, Bandar Klippa, Percut Sei Tuan District, Deli Serdang Regency, North Sumatra. The population for this study was all 11th grade students at SMA Negeri 2 Percut Sei Tuan for the 2023/2024 academic year, which consists of 4 classes. The sample with random sampling technique was used, so the sample is one class of XI, there are 30 students.

This study is descriptive with a quantitative approach. This descriptive research aims to identify and analyze the misconceptions experienced by students regarding reaction rate material at SMA Negeri 2 Percut Sei Tuan.

Calculating Misconception Percentages

Use this formula:

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

(Firmasari & Nopriana, 2020)

RESULT AND DISCUSSION

Students' Misconception on Reaction Rate Material

The degree of students' misunderstanding was determined by the outcomes of three-tier diagnostic test on reaction rate content is presented in Table 1.

Table can be presented as follow:

Table 1. Percentage of students conceptions for each question item

Nmber of Question	Misconception(%)
1	37.1
2	71.4
3	77.1
4	65.7
5	74.3
6	77.1
7	88.6
8	20
9	91.4
10	20
11	82.9
12	74.3
13	8.6
14	14.3
15	71.4
16	48.6
17	68.6
18	77.1
19	82.9
20	80
Total	61.6

According to the findings of three-tier multiple-choice diagnostic test that was administered to students, a significant portion of the pupils had misconceptions in comparison to the basic categories of understanding the topic, lack of knowledge, and guessing, which is an average of 61.6%. The misconceptions percentage is included in the high category.

Analysis of Student Misconception on Each Reaction Rate Concept

The reaction rate material consists of five concepts, namely understanding of reaction rate and reaction rate expressions, reaction order, factors affecting reaction rate, collision theory, reaction rate equation. The total questions in this study are 20 questions in the form of three-tier multiple-choice. The distribution table of question items for each concept can be seen in Table 2.

Table 2. Distribution of question items for each concept

Num.	Concept	Learning Outcomes	Question Number
1.	Understanding of Reaction Rate and Reaction Rate Expressions	Explain the concept of reaction rate	1,2
2.	Reaction Order	Analyze data to determine reaction order	15,16,17
3.	Factors Affecting Reaction Rate	Analyze factors that influence	7,8,9,10,11

		reaction rates based on data and those related to everyday life	
4.	Collision Theory	Explain the concept of collision	3,4,5,6,12
5.	Reaction Rate Equation	Analyze data to determine reaction rate constants and reaction rate equations. Analyze the relationship between the reaction rate law and the mechanism of a reaction. Analyze data to determine molarity in solution.	13,14,18,19, 20

Based on the data obtained from the three-tier multiple-choice diagnostic test, the misconceptions that occur in students on each concept can be seen in Table 3.

Table 3. Percentage of student misconception on each concept

Num.	Understanding	Percent of Misconception
1.	Understanding of reaction rate and reaction rate expressions	54.25%
2.	Reaction order	62.87%
3.	Factors affecting reaction rate	60.58%
4.	Collision theory	73.70%
5.	Reaction rate equation	52.58%

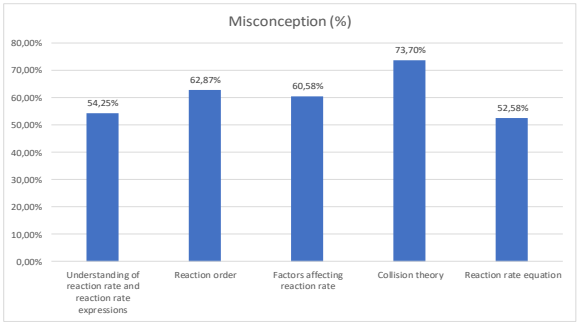

Figure 1. Graph of the percentage of student misconceptions for each concept

According to the aforementioned Figure 1 above, students have the greatest misconception regarding collision theory (73.70%), while the lowest misconception occurs in reaction rate equation concept. Students' incomplete understanding of the idea of collision leads to misconceptions about collision theory, which is consistent with the many incorrect answers given by students despite their high degree of confidence.

CONCLUSION

The following findings were drawn from the research that conducted and its results: misconceptions of XI students at SMA Negeri 2 Percut Sei Tuan on reaction rate material is 61.6%, included in the high category. The percentages of student's misconception in understanding of reaction rate and reaction rate expressions concept have percentage 54.25%, in reaction order concept have percentage 62.87%, in factors affecting reaction rate concept have percentage 60.58%, in collision theory concept have percentage 73.70%, and in reaction rate equation concept have percentage 52.58%.

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