ANALYSIS OF STUDENT MISCONCEPTIONS ON THE MOLE CONCEPT MATERIAL USING A THREE TIER DIAGNOSTIC TEST INSTRUMENT

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ABSTRACT

These misconceptions can occur due to students' low understanding of basic mathematics which is sustainable in the previous school. This study aims to determine the percentage of students' misconception level through the Three-Tier test instrument on the mole concept material of class X at SMAN 18 Medan. Data collection techniques were carried out by conducting interviews and observations to teachers and distributing written tests in the form of three-tier diagnostic tests consisting of 25 multiple choice questions. The data that has been obtained shows that there are misconceptions in class X students in the material of mole concept. The results of this study showed that Class X students of SMA NEGERI 18 MEDAN had 53.41% misconceptions, 34.94% understood the concept, and 11.65% didn't understand the concept.

Keywords: misconceptions; chemistry learning; diagnostic tests

INTRODUCTION

Chemistry has a lot of learning material that is very broad and deep so that there are often misunderstandings that make fear and doubt in mastering concepts when learning it (Baunsele, dkk, 2020). Students will experience misconceptions or conceptual errors, when students' understanding is different from the understanding of scientists or the scientific community who have conducted research (Effendy, 2009; Lestari, et al., 2021). Misconceptions are concepts that do not match the scientific explanation with the understanding accepted by students in the field. Another definition, misconception is the understanding of concepts through explanations that are not theoretically acceptable. Some studies suggest that misconceptions occur because students only store and understand the knowledge they know without connecting with concepts that have been reviewed by scientists so that the results do not match (Suharto, 2016; Karim, et al., 2022).

The cause of misconceptions in students is due to the provision of concepts or facts outside of the teacher so that students get incomplete concepts or facts and cause confusion in learning. One way to find out students' misconceptions is to use a Three Tier Multiple Choice diagnostic test instrument that can help teachers find students' misconceptions in learning. By using this test, material that is mastered or not mastered by students can be seen so that teachers can more easily analyze it. The Three-Tier Multiple Choice diagnostic test instrument is effective for identifying whether students understand the concept, do not understand the concept, do not understand the concept, misconceptions

and guesses (Aini et al., 2017; Lestari, et al., 2021).

According to Wiyono, et al in (Jusriana, et al., 2022) stated that the Three-Tier Multiple Choice diagnostic test instrument is an assessment instrument that can be used to identify the level of understanding experienced by students by determining the proportion experienced by students whether what happens is not understanding the concept (misconception). Three-Tier Multiple Choice has three levels, the first level is multiple choice questions, the second level is the reason for the answer, and the third level is the confidence level of the learner's answer. Misconception detection will be supported by teacher interviews.

Based on the results of interviews and observations conducted by researchers to Chemistry Teachers of SMAN 18 Medan, it can be said that students often experience misconceptions or errors in learning chemistry, especially in the material of the concept of mole. In the interview and observation, the educator said that there are 3 concepts that are misunderstood in learning it with students, namely Understanding the Concept of Mole, Atomic Mass and Molar Mass, and Volume of Gas Mass. These misconceptions can occur due to students' low understanding of basic mathematics and the frequent use of different languages when students conduct discussions or group work in learning.

Three-Tier Multiple Choice Diagnostic Test Instrument in SMAN 18 Medan has never been used at all in school learning, especially in chemistry learning. This is what convinces researchers to use this test instrument in analyzing and seeing how misconceptions occur in the learning. Th e misconceptions that will be carried out are assisted by technology that is increasingly sophisticated and has been worldwide in various countries, namely google forms that can be filled in at leisure by several teachers and students.

Based on the explanation above, the researchers conducted a study to determine the percentage of students' misconception level through the Three-Tier test instrument on the mole concept material of class X at SMAN 18 Medan.

METHOD

This research was conducted from January to June 2024 at SMAN 18 MEDAN with the address at Jl. Wahidin No.55 C, Pandau Hulu I, Kec. Medan Kota, Medan City, North Sumatra 20211 by students in class X even semester of the 2023/2024 academic year. The type of research used must get a product that is considered feasible because it has passed validation and instrument trials that meet the requirements. This research uses qualitative data with participants 34 students of class X even semester SMA Negeri 18 Medan.

Qualitative data used in the form of an assessment between yes and no in the sum per item, responses and suggestions for improvement from the validators on the three tier multiple choice diagnostic test instrument on the mole concept material. The three tier multiple choice diagnostic test has 30 questions (30 first level questions, 30 second level questions and 30 third level questions) that have been validated. The data analysis technique used in this study is based on the results of student answers either at the first level, second level, or third level.

1. Collecting student answers and categorizing them

The first data analysis technique categorizes the test results based on students' understanding into several categories, namely understanding the concept, not understanding the concept, and misconceptions according to the criteria.

2. Analyzing Student Answer Results

To calculate the value of student learning outcomes on the Three-Tier diagnostic test instrument by calculating cognitive scores at levels 1 and 2 according to the guidelines using the formula:

$$N = \frac{\sum student\ score}{maximum\ score} \times 100$$

Description :

N = Score

$\sum Student\ Score$ = Number of correct scores obtained (level 1 and 2)

Maximum Score = Total correct score of all questions (score 50)

3. Making Percentages of Each Category

The second data analysis technique is to determine the percentage of each category of students' level of understanding, namely understanding the concept, not understanding the concept, and misconceptions.

$$\% PK = \frac{PK}{N} \times 100\%$$

$$\% TPK = \frac{TPK}{N} \times 100\%$$

$$\% M = \frac{M}{N} \times 100\%$$

Description:

PK = Group of students who understand the concept

TPK = Group of students who do not understand the concept

M = Group of students who have misconceptions

N = Number of students

4. Determining the Percentage Level of Student Misconception Level

The third analysis technique, identifying on the items and each concept what students have misconceptions and classifying the level of student misconceptions according to the percentage level in table 1 below.

Table 1. Misconception Level Category

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

RESULTS AND DISCUSSION

Based on the results of the Three-Tier diagnostic test on the mole concept material assisted by Google Forms, the level of students' conceptions is grouped into three categories, namely Understanding the Concept (PK), Not Understanding the Concept (TPK), and Misconception (M) on each item conducted in class X-7. The results of the concept category can be seen in table 2 as follows.

Tabel 2. Percentage of Students' Concept Understanding on Each Question Item

Test Number	Decision for each question (%)			Total
	PK	TPK	M	
1	61,77	8,82	29,41	100
2	79,41	5,88	14,71	100
3	35,3	8,82	55,88	100
4	29,41	11,77	58,82	100

5	52,94	8,82	38,24	100
6	52,94	5,88	41,18	100
7	41,18	8,82	50	100
8	32,35	11,77	55,88	100
9	41,18	8,82	50	100
10	29,41	20,59	50	100
11	41,18	14,71	44,11	100
12	29,41	11,77	58,82	100
13	26,47	5,88	67,65	100
14	41,18	8,82	50	100
15	32,35	5,88	61,77	100
16	20,59	5,88	73,53	100
17	32,35	14,71	52,94	100
18	32,35	5,88	61,77	100
19	20,59	14,71	64,7	100
20	26,47	14,71	58,82	100
21	35,3	8,82	55,88	100
22	14,71	29,41	55,88	100
23	23,53	20,59	55,88	100
24	32,35	14,71	52,94	100
25	8,82	14,71	76,47	100
Average	**34,94**	**11,65**	**53,41**	**100**

Based on the Three-Tier diagnostic test instrument in the form of multiple choice that has been given to students, the results obtained show that the percentage of students' misconception category is higher than the percentage of the category of understanding the concept and not understanding the concept, which is 53.41% and is included in the category of moderate level of misconception. Meanwhile, the percentage of conceptual understanding and non-conceptual understanding categories is 34.94% and

11.65%. The results of the Three-Tier diagnostic test showed that most students had misconceptions on the mole concept material.
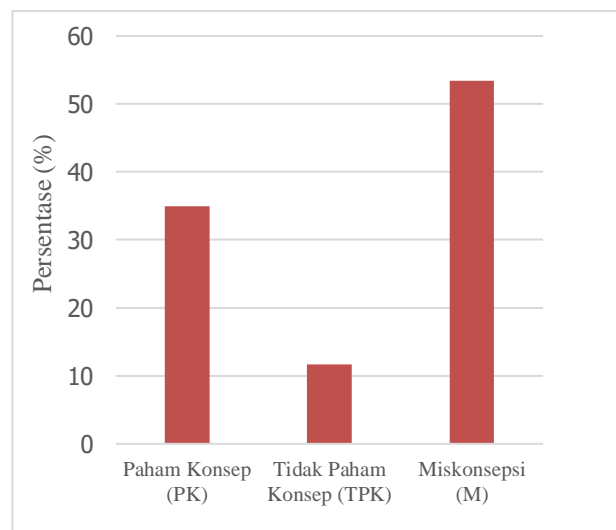

Figure 1 Percentage Chart of Students' Conception Levels

Student Misconceptions in Each Subchapter of Mole Concept Material

The data that have been obtained from the three-tier diagnostic test are described to determine the level of misconceptions on each concept on the mole concept material. The data obtained are described in table 4 below.

Table 3 Percentage of Student Conception on Each Concept

Question Indicator	Criteria (%)			Total (%)
	PK	**TPK**	**M**	
Pengertian Konsep Mol	51,77	8,82	39,41	100
Massa Atom dan Massa Molar	37,26	10,78	51,96	100

Volume Massa Gas	25,41	13,63	60,96	100

Based on the test data above, the highest level of misconception in students is found in the third question indicator (the third concept), namely about the volume of gas mass of 60.96% in the category of moderate level of misconception. While the lowest level of misconception in students is found in the indicator of the first question (the first concept), namely regarding the understanding of the concept of mole at 39.41% in the category of low level of misconception. Students have difficulty in understanding the concept of gas mass volume in the material of the mole concept because the learning is too monotonous and the questions given use more basic mathematical understanding in determining the volume of gas mass.

Based on the results of research conducted at SMAN 18 MEDAN, it was found that the misconceptions experienced by students in class X-7 on the material of the concept of mole amounted to 53.41% and was included in the moderate category. This shows that some students have misconceptions on the concept of mole. The Three-Tier diagnostic test results show that students make mistakes in choosing answers or reasons or even both simultaneously with a high level of confidence in these choices. This is what is stated as a misconception because the high level of confidence is not in line with the students' answers or reasons which turn out to be less precise.

The results of the tests that have been carried out can be seen through the learning outcomes obtained by the students. These results show that only a few students scored above the KKM. The low student scores obtained are related to the percentage of misconceptions experienced by students because these misconceptions have an impact on student learning outcomes. The results of this study are the same as previous research which states that misconceptions experienced by students occur due to delays or delays in the process of receiving new knowledge. If misconceptions are not immediately corrected, it will result in more material in chemistry lessons that is not understood thoroughly.

During the research process, the researcher stated that there were several factors that caused the misconceptions. The most dominant factors are books or media used, facilities in the classroom, learning methods used by educators, and conditions or lesson hours applied at the school. In this study, students or learners who play a role have different thinking abilities and an attraction to learning that is not the same.

Some of the most dominant factors will be explained in detail. The number of books or media used in learning the mole concept material. One of the books used is a textbook that comes from the school. It can be seen in the attachment that the book has writing that is difficult to understand and some concepts have distorted meanings to attract students to read, so teachers use other books to provide knowledge that is easy to understand. Students do not know how to read and learn from a book. They read quickly which results in not understanding new concepts properly (Suparno, 2013). The results obtained by reading books are based on students' perceptions and are not done.

Another cause of misconception is the facilities in the classroom which are related to the learning methods used. The class had a room that was not spacious, hot, and a projector that could not be used regularly. The small space made it difficult for the teacher to conduct the discussion method. When conducting the discussion method, students often use different languages or outside of Indonesian in giving opinions to other students or groups. This also results in misconceptions. Therefore, the method that teachers often use is the lecture and writing method. The method is done with students only reading and memorizing the material. The lecture method is not suitable because it provides little opportunity for students to express their opinions so that students experience misconceptions in identifying and explaining the material. The method of memorizing material without understanding the concept first will lead to poor learning outcomes.

The conditions or lesson hours used can also cause misconceptions. The subject at the time of the study was conducted in the last 2 lessons before going home from school and had passed the tiring lesson hour, namely sports. This causes students to be less focused or easily sleepy, there is indifference in learning, and commotion before the school dismissal bell rings. Based on preconceptions or initial concepts obtained by students, it is not in line with the results of the study which show a high percentage of student misconceptions. Students feel confident with their concepts, but in reality, misconceptions are still found.

The way that can be done in overcoming student misconceptions is to use cognitive conflict strategies. Cognitive conflict is a condition in the mismatch between the concepts owned by someone with newly acquired information does not match each other. This cognitive conflict stimulus can help the assimilation process in learning to be more meaningful to students' intellectuality so that it can raise doubts about the conceptions of students who experience misconceptions.

CONCLUSION

Based on the results of research and data analysis that has been done, it can be concluded that students X-7 SMA NEGERI 18 MEDAN experience misconceptions of 53.41%, understand the concept of 34.94%, and do not understand the concept of 11.65% on the material of the concept of mole. The most students in understanding the concept is in question number 2 and number 1 with the number of students 27 people and 21 people which results in a percentage of 79.41% and 61.77%. Students who experience misconceptions produce an average of 53.41% as many as 25 questions with 34 students. Misconception with the highest category is found in number 25 at 76.47% with a total of 26 students on the indicator of Gas Mass Volume question with the flow of learning objectives is to calculate the number of moles with the number of particles, mass and volume of substances.

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