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Analysis of Misconceptions of MAN Batu Bara's Class XI Students on Buffer Solution Material Using a Three-Tier Diagnostic Test Instrument

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Abstract:Analysis of Misconceptions of MAN Batu Bara's Class XI Students on Buffer Solution Material Using a Three-Tier Diagnostic Test Instrument. This study aims to determine the misconseptions that occur in the buffer solution using a three-tier diagnostic test instrument. This instrument was developed based on competency indicators of solution buffer materials into 20 questions and was declared valid for use. The research was conducted on 38 students of class witf a proportion of 62,89% wich included several indicators, namely the concept of a buffer solution of 48,69%, distinguishing between a buffer solution and a non-buffer solution of 64,03%, calculating the pH of a buffer solution of a weak acid and a conjugate base of 64,47%, calculating the pH of a buffer solution from a weak base and a conjugate acid of 55,26%, calculating the pH of a buffer solution with the addition of a little acid or base of 55,26%, explaining the use of a buffer solution in life daily amounting to 72,81%, and making a buffer solution with a certain pH of 77,76%. The causes of misconceptions occur due to two factors, namely the lack of interest and preparation of students in receiving chemistry lessons and the text book factor, which is due to student's limitations in using the textbook
Keywords: Misconception, Three-Tier Diagnostic test, Buffer

Abstrak:Analisis Miskonsepsi Siswa Kelas XI MAN Batu Bara pada Materi Larutan Penyangga dengan Menggunakan Instrumen Tes Diagnostik Three-Tier. *Penelitian ini bertujuan untuk mengetahui miskonsepsi yang terjadi pada materi larutan penyangga menggunakan instrumen tes diagnostik three-tier. Intrumen ini dikembangkan berdasarkan indikator kompetensi materi larutan penyangga menjadi 20 soal dan dinyatakan valid untuk digunakan. Penelitian dilakukan kepada siswa kelas XI yang berjumlah 38 siswa. Hasil penelitian menunjukkan bahwa tingkat miskonsepsi termasuk dalam kategori sedang dengan persentase sebesar 62,89 % yang meliputi beberapa indikator, yaitu konsep larutan penyangga sebesar 48,69%, membedakan antara larutan penyangga dan bukan larutan penyangga sebesar 64,03%, menghitung pH larutan penyangga dari asam lemah dan basa konjugasi sebesar 64,47%, menghitung pH larutan penyangga dari basa lemah dan asam konjugasi sebesar 55,26%, menghitung pH larutan penyangga dengan penambahan sedikit asam atau basa sebesar 55,26%, menjelaskan peranan larutan penyangga dalam kehidupan sehari-hari sebesar 72,81%, dan membuat larutan penyangga dengan pH tertentu sebesar 77,76%. Penyebab miskonsepsi terjadi karena dua faktor yaitu faktor kurangnya minat dan persiapan siswa dalam menerima pembelajaran kimia dan faktor buku teks, yaitu karena keterbatasan siswa dalam menggunakan buku paket tersebut.*

Kata kunci: *miskonsepsi, Tes Diagnostik Three-Tier, Larutan Penyangga*

▪ INTRODUCTION

Chemistry, a science major that examines matter, change, and vitality, not only overcomes difficulties in comprehending students' ideas, but also improves general student proficiency (Rahmawati, 2018). Therefore the material being taught is arranged sequentially and relates to one another so that it is easy to understand (Safitri, 2016). In some materials, mastery of learning topics depends on their understanding of previous material. The nature of chemicals like this allows conceptual errors to occur in students.

Misconception is the understanding of a concept that is not the same as the scientific understanding of experts caused by errors in delivering or receiving material (Desiria, 2017). Misconceptions have an unfavorable impact on learning outcomes and achievement of curriculum change objectives. If there is an error in understanding a concept, it is impossible for students to be able to analyze concepts and have an impact on the achievement of learning objectives, so that it adversely affects student learning outcomes and achievements (Azura, 2017).

One of the chemical materials that is prone to misconceptions is buffer solutions because in the buffer solution material there are many concepts both theoretically and in calculations that students need to understand, especially in the concept of acid-base calculation which resembles the calculation concept of a buffer solution. Buffer solutions are chemical substances that are abstract and complex. The abstract nature of this buffer solution material is the microscopic aspect contained in the solution, then the complex nature lies in its relationship to the previously studied material which is a prerequisite in studying the buffer solution material. These prerequisite materials include acid-base and equilibrium (Maratusholihah, 2017).

Based on the results of interviews conducted at MAN Batu Bara with a class XI chemistry teacher, it was revealed that student learning outcomes in the buffer solution material were 68 which indicated that the score was still below the criteria of minimum achievement score of 81 for the buffer solution material. And teachers are also less open to their students' understanding of the buffer solution material, therefore a test is needed to detect the level of students' understanding of the buffer solution material. The test used in this study is a three-tier diagnostic test.

When misconceptions occur on students and not If you pay attention, it will have an effect more and more concepts not understood by students and unable to answer questions given and finally impact on low yields Study (Saputri, 2016)

▪ METHOD

Location and Time of Research

This research was conducted at MAN Batu Bara which is located on Jl. Independence Pioneer No. 76 Fifty, Fifty Cities, Kab. Coal, North Sumatra. With the research time for even semester T.P 2022/2023, namely October 2022 to February 2023.

Population and Sample

The population in this study were students of class XI MAN Batu Bara for the 2022/2023 academic year. And the sample used is class XI IPA 1 MAN Batu Bara as many as 38 people, with the sampling technique used is purposive sampling.

Research Desain

This research uses descriptive research type. In this study, researchers collected data and were supported by qualitative data sources as a complement which were then described (Sugiyono, 2016).

Research Instruments

The instrument used in this study was a three-tier multiple choice diagnostic test item whose function was to identify students' misconceptions

Research procedure

The research procedure was carried out through a preparatory stage which included observation and interviews at schools, literature studies, and instrument preparation. The implementation phase includes instrument validation, instrument revision and conducting research. And at the closing stage the data obtained will be analyzed and the percentage of students' misconceptions about the buffer solution material will be sought.

Data analysis technique

Students' misconceptions about buffer solution material can be identified by analyzing the research data descriptively. The grouping of misconceptions can be seen in the table below:

Table 1. Grouping Misconceptions

No	Stage 1	Stage 2	Stage 3	Category
1	Correct	Correct	Certain	Understand
2	Correct	Correct	Not Sure	Guess
3	Correct	Incorrect	Not Sure	Guess
4	Correct	Incorrect	Certain	Misconception
5	Incorrect	Incorrect	Not Sure	Not Understand
6	Incorrect	Correct	Not Sure	Guess
7	Incorrect	Correct	Certain	Misconception
8	Incorrect	Incorrect	Certain	Misconception

(Source: Septi Maulina, Yudi Kurniawan dan Rizki Muliyani, 2017)

Percentage analysis was carried out to see how many students had misconceptions and students who did not know the concept using the percentage technique as follows:

$$P = \frac{a}{Ja} \text{ x } 100\%$$

Information :

P = percentage of students who understand the concept, do not know the concept and have misconceptions

a = the number of students who understand the concept, do not know the concept and have misconceptions

Ja = total number of students

After categorizing student test results and calculating the percentage of students who experience misconceptions, then the criteria for misconceptions are in table 2.

Tabel 2. Criteria for Misconceptions

Misconceptions Persentage	Criteria for Misconceptions
0 < Misconception ≤ 30%	Low
30 < Misconception ≤ 70%	Currently
70 < Misconception ≤ 100%	High

▪ RESULT AND DISCUSSION

Understanding Misconceptions

Understanding of different concepts with scientific concepts can cause misconceptions (Kose, 2008). Misconception is a conception someone who doesn't fit scientific concept recognized by the expert (Suparno, 2013)

Misconceptions can take shape initial concept, a relationship error incorrect between concepts, intuitive notion or outlook wrong. In detail, misconceptions can is (a) Meaning that is not accurate about the concept of (b) Usage wrong concept (c) Classification wrong examples aboutapplication of the concept (d) Meaning different concepts (e) Chaos different concepts (f) Hierarchical relationship of concepts which is not true (wafiyah, 2012).

After learning in school, often students build concept that deviates from the concept correct. The wrong concept called a misconception. Kindly detail, a misconception is inaccurate notion ofconcept, the use of that concept wrong, the classification examples are wrong about the application of the concept, different meanings of concepts, and hierarchical relationship of concepts which is not true (Wahyuningsih, 2013).

Misconceptions are resistant. It happens because of each individual build permanent knowledge with experience. It means that misconceptions can only occur reduction or reduction but not can be eliminated completely (Sadia, 2004). This matter in line with the results of the study Chairunnisa, Muhibbuddin, & Khairil (2016) that not completely student misconceptions can eliminated, there are also misconceptions students who are still resistant.

Identification of Misconceptions

Based on the results of student tests on the three-tier multiple choice diagnostic test, the results will be grouped into four categories, namely Understanding Concepts (PK), Misconceptions (MK), Guessing (MB), and Not Understanding Concepts (TPK). It can be calculated the percentage of students who understand concepts, misconceptions, guess, and do not understand concepts according to the question numbers which can be seen in table 3

Table 3. Data Percentage of Understanding Category of Each Indicator

Questions number	**Questions Indikator**	**Understanding Level Category**			
		Understand	**Misconception**	**guess**	**Not Understand**
1		60,52 %	34,21 %	2,63 %	2,63 %

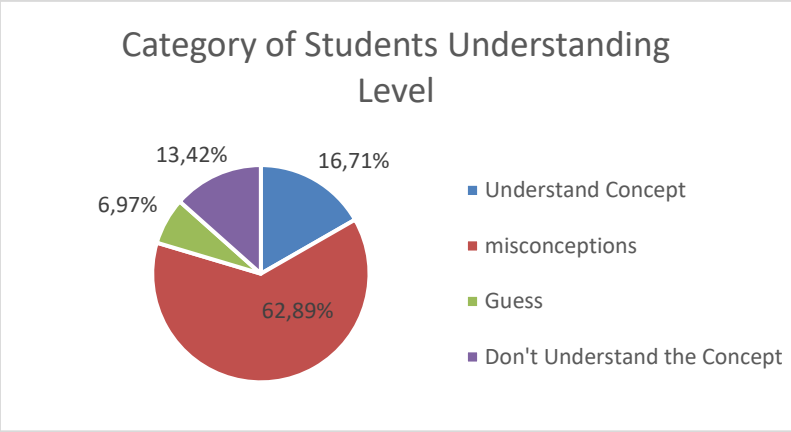
Questions number	Questions Indikator	Understanding Level Category			
		Understand	**Misconception**	**guess**	**Not Understand**
2	Explain the concept of buffer solution	34,21 %	63,16 %	0 %	2,63 %
Average		**47,37 %**	**48,69 %**	**1,32 %**	**2,63 %**
3	Distinguish between buffer solution and non-buffer solutions	13,16 %	60,52 %	10,53 %	15,79 %
4		10,53 %	78,95 %	2,63 %	7,89 %
5		34,21 %	52,63 %	7,89 %	5,26 %
Avarage		**19,30 %**	**64,03 %**	**7,02 %**	**9,65 %**
6	Calculate the pH og a buffer solution of a weak acid and its conjugate base	23,68 %	60,52 %	7,89 %	7,89 %
7		0 %	78,95 %	5,26 %	15,79 %
8		34,21 %	31,57 %	15,79 %	18,42 %
9		2,63 %	86,84 %	5,26 %	5,26 %
Avarage		**15,13 %**	**64,47 %**	**8,55 %**	**11,84 %**
10	Calculate the pH of a buffer solution from a weak base and its conjugate acid	2,63 %	65,79 %	2,63 %	28,94 %
11		21,05 %	55,26 %	10,53 %	13,16 %
12		21,05 %	44,74 %	7,89 %	26,32 %
Avarage		**14,91 %**	**55,26 %**	**7,02 %**	**22,81 %**
13	Calculate the pH of a solution with the addition of a small amount of acid or a small amount of base	21,05 %	55,26 %	7,89 %	15,79 %
Avarage		**21,05 %**	**55,26 %**	**7,89 %**	**15,79 %**
14	Explain the role of buffer solutions in everyday life	10,53 %	65,79 %	7,89 %	15,79 %
15		10,53 %	84,21 %	0 %	5,26 %
16		5,26 %	68,42 %	18,42 %	7,89 %
Avarage		**8,77 %**	**72,81 %**	**8,77 %**	**9,65 %**
17		5,26 %	73,68 %	5,26 %	15,79 %

Questions number	Questions Indikator	Understanding Level Category			
		Understand	**Misconception**	**guess**	**Not Understand**
18	Make a buffer solution with a certain pH	5,26 %	73,68 %	5,26 %	15,79 %
19		7,89 %	52,63 %	15,79 %	23,68 %
20		10,53 %	71,05 %	0 %	18,42 %
Avarage		**7,24 %**	**77,76 %**	**6,58 %**	**18,42 %**
Overall percentage average		**16,71 %**	**62,89 %**	**6,97 %**	**13,42 %**

In the category of understanding the concept, the largest percentage is in question number 1, which is 60.52% and the smallest percentage is in question number 7, which is 0%. In the category of misconceptions, the largest percentage is found in question number 9 which is 86.84% and the smallest percentage is found in question number 8 which is 31.57%. In the category of guessing the largest percentage is found in question number 16 which is equal to 18.42% and the smallest percentage is found in question number 2, 15 and 20 which is equal to 0%. In the category of not understanding the concept, the largest percentage is in question number 10, which is 28.94% and the smallest percentage is in questions number 1 and 2, which is 2.63%.

In table 3 above it can be seen the percentage of students' understanding of each indicator question. In the category of understanding the concept, the highest average score was on the indicator question explaining the concept of a buffer solution, which was 47.37%, and the lowest average was on the indicator question for making a buffer solution with a certain pH, which was 7.24%. In the category of misconceptions, the highest average score was in the indicator questions for making a buffer solution with a certain pH, namely 77.76% and the lowest average in the indicator questions explaining the concept of a buffer solution, namely 48.69%. The guessing category has the highest average score on the question indicator explaining the role of a buffer solution in everyday life, namely 8.77% and the lowest average on the question indicator explaining the concept of a buffer solution, namely 1.32%. In the category of not understanding the concept, it has the highest average score on the indicator for calculating the pH of a buffer solution from a weak base and its conjugate acid, which is 22.81% and the lowest average on the indicator question explaining the concept of a buffer solution, which is 2.63%.

Overall student test answer percentage score. The category of students who understand the concept of the buffer solution material shows a percentage of 16.71%, the category of misconceptions is 62.89%, the category of guessing is 6.97%, and the category of not understanding is 13.42%. Based on the data on student test answers according to the level of understanding category for each question number, the overall percentage comparison results for each category on salt hydrolysis material can be obtained, which can be seen in the following diagram:



Picture 1. Graph Comparison Percentage Level of Understanding the Concept

Based on the data above, it can be seen that the level of misconceptions about buffer solution material in class XI IPA 1 at MAN Batu Bara is in the medium category, which is 62.89%.

Cause of Misconception

Misconceptions can happen due to misinterpretation of natural phenomena or events. The misconception acquired in sedentary schools and attached. Common misconception develop with the process learning. If misconceptions do not realized, there would be confusion on students. In the end it will be a barrier for students on futher learning process (Murni, 2013).

Misconceptions can occur in school or outside school. Misconceptions in students are caused by an error in the perception of the concept that appears, confusion between impressions and existing memories in the brain as long as remember, do not check the truth of that generalization acquired, or overly confident of result of one of the observations or conceptual thinking (Setiawati et al, 2014).

Factors that cause student misconceptions, including the wrong initial concept, stages of cognitive development do not according to the concept being studied, limited student reasoning and wrong, the ability of students to catch and understand the concepts learned, use of colloquial terms wrong, and student interest to learn the given concept and taught (Dwi, Rahayu &Erman, 2013)

There are many sources that allows development misconception.first, not all experience leads to conclusions or the correct result in every respect students see. Second, when people parents or other family members raced with a child's question, rather than admit that it isn't know the answer, they are more either gave the wrong answer. Other sources of misconception include media and teachers. Main issue are all the above sources considered trustworthy and students accept everything that is taught (Thompson et al, 2006).

Misconceptions can be acquired from the experience of students in everyday life, even beforenthey start school or through movies, parents, and people around them, schoolbooks, and lack of teaching in class or from incompetent teachers the subject matter being taught (Yangin, 2014). Misconceptions of children after school learning can because of the ideas that are formed from everyday experience students bring to class,

views incomplete or clumsy by students during learning in class, and the wrong concept of that disseminated by teachers from textbooks (Yip,1998).

▪ CONCLUSION

Based on the results of the research and discussion above, it can be concluded that: (1) Students' misconceptions about the buffer solution material are included in the upper middle category with a percentage of 62.89%. The students' misconceptions are found in all the indicators of the questions, namely with the largest percentage on the indicator for making a buffer solution with a certain pH with a percentage of 77.76%, the indicator explaining the role of a buffer solution in everyday life has a percentage of 72.81%, the indicator for calculating the pH of the solution buffer of a weak acid and its conjugate base has a percentage of 64.47%, the indicator distinguishing between a buffer solution and not a buffer solution has a percentage of 64.03%, the indicator for calculating the pH of a buffer solution from a weak base and its conjugate acid has a percentage of 55.26% , the indicator for calculating the pH of the solution with the addition of a little acid or a little base has a percentage of 55.26%, and finally the indicator with the smallest percentage of misconceptions, namely the indicator explaining the concept of a buffer solution has a percentage of 48.69%. (2) The causes of students' misconceptions at MAN Batu Bara are caused by two factors, namely: the students' own factors which include the lack of interest and preparation of students in receiving chemical material during the learning process and the textbook factor, namely due to students' limitations in using the textbook.

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