Identification of students' conceptual understanding on electrolyte and non-electrolyte solution material using a three tier multiple choice test

by Weny J.a. Musa

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S S Noho*, M Sihaloho and W J A Musa

Study Program of Chemistry Education, Department of Chemistry, Faculty of Mathematics and Science, State University of Gorontalo, Gorontalo, Indonesia

*ardhiissupardi@gmail.com

Abstract. This study aims to identify the percentage of students' conceptual understanding using the Three-Tier Multiple-Choice test on electrolyte and non-electrolyte solutions. The research method used is descriptive quantitative. The instrument used was a Three-Tier Multiple-Choice test. The research subjects were class X IPA MAN 1 Gorontalo City with a total sample of 20 students. The data were processed based on the students' answer patterns which were grouped into categories of understanding the concept, not understanding the concept and misconceptions (misconceptions 1,2, and 3). The results showed that the category of understanding the concept of students was in the low category with a percentage of 28%, did not understand the concept in the high category with a percentage of 54%, and misconceptions were in the low category with a percentage of 18%. Of the 18% students who experienced misconception, the percentage was 8% misconception 1, misconception 2 was 2%, and misconception 3 was 8%.

1. Introduction

Teaching style plays an important role in determining student achievement levels. When the teaching style favored by students does not fit well with the teaching practice or learning environment, negative behavioral reactions and reduced student motivation can be the consequence. If the conflict between teaching styles continues and there is no effort to deal with it, it can create physical, mental, and emotional problems among students. By implementing appropriate learning strategies is a way that can lead to skilled in designing impressive learning for students.

In learning chemistry, there are still many students who experience misconceptions in electrolyte and non-electrolyte solutions. In previous research on misconceptions in electrolyte solution and non-electrolyte solutions using the Three-Tier Multiple-Choice test instrument used by Khaldun (2017). There is a misconception in understanding the material of electrolyte solutions and non-electrolyte solutions in students of 38.68%.

A well-implanted understanding of students' concepts will certainly have an impact on good learning outcomes as well [1]. Concept understanding is a meaningful knowledge that is learned about a topic, including the logical relationship of various specific concepts and ideas [2].

Concept understanding is the student's ability to show that students are able to explain the material that has been studied either with part of the material or the material as a whole using their own language without being fixated on books so that basic concepts must be understood correctly before understanding more complex concepts [3].

Understanding the concept for students is very necessary for those who have experienced the learning process [4]. Understanding a concept is a competency shown by every student in carrying out learning procedures in a flexible, accurate, efficient and precise manner. Understanding shows what a person can do with the information he / she gets, rather than what they remember [5].

There are four principles for increasing students' understanding of concepts, namely attention, relevance, self-confidence, and satisfaction. The attention referred to in this learning process uses relevant learning media, and can involve all students in the question and answer process in the classroom. Relevance is explaining to students what benefits we get after following and obtaining lessons. Then be confident, by fostering trust in students who use methods to convey learning coherently from the easy to the most difficult and fostering student self-confidence by giving praise for the success they have achieved. Finally, the principle of satisfaction is to provide opportunities for students who have been able to understand the concept well to help their friends who have not mastered the concept and give verbal praise for the achievements they have achieved [6].

Conceptual understanding is students' mastery of mathematical concepts, operations, and relations, so it can be concluded that the level of conceptual understanding is a level of understanding of mathematical concepts, operations and relations. The criteria for the level of understanding the concept in this study are divided into: (1) understanding the concept, (2) misconception (misconception 1, misconception 2, misconception 3), and (3) not understanding the concept.

One of the methods commonly used to determine students' understanding of concepts is to use a three-tier multiple choice diagnostic test instrument. This test is a form of test that is commonly used to find out students' understanding of the concept of the material that has been taught. The three-tier test is a test that consists of three levels after the two-tier test. The first level is a multiple choice test. The second level is in the form of multiple choices where students explain their own reasons why they chose the choice at the first level. And the third level is the level of student confidence in their answers at the first and second levels [7].

2. Methods

This research is a descriptive quantitative approach. The descriptive quantitative approach is a type of research that aims to describe systematically, factually, accurately or to describe phenomena in detail. This study aims to identify students' conceptual understanding of electrolyte and non-electrolyte solutions. This research was conducted at MAN 1 Gorontalo, in the even semester of the 2019/2020 school year.

In this study the data were in the form of test results using a three-tier multiple choice test instrument. Each item consists of three levels accompanied by a CRI consisting of 22 items. The data source of this study were students of class X IPA 4 MAN 1 Gorontalo City with 20 respondents. This study used purposive sampling technique which is a sampling technique with certain considerations.

Data collection was done by providing tests and documentation. The test instrument used to identify understanding of the concept in this study was a three-tier multiple choice multiple choice written test. This test is given after students study the material of electrolyte solutions and non-electrolyte solutions. There are 22 items with 3 levels for each item. The first level of Q1 is a question that measures understanding of the concept, the second level of Q2 is a question of reason that supports the answer to Q1, and the third level of Q3 is a question of confidence in Q2. Documentation is needed so that research can be trusted or credible as well as attachments related to research activities

In this study, the data analysis used was descriptive data analysis. Based on the problem formulation that has been stated, the data analyzed is the result of the three-tier multiple choice test.

3. Results and discussion

This research is a quantitative descriptive study that aims to identify the understanding of the concept of class X students in MAN 1 Gorontalo City on electrolyte and non-electrolyte solutions using the Three-Tier Multiple Choice Test instrument. From the results of the research, it was found that students' understanding of the concept of electrolyte and non-electrolyte solutions was obtained, those who

understood the concept were 28%, did not understand the concept of 54% and who experienced misconceptions was 18%.

3.1. Student's conception of definition of electrolyte solution
The result can be seen in the following figure Students who understand the concept of electrolyte solutions are 63%, do not understand the concept by 23% and those who experience misconceptions are 15%. See figure 1 below.
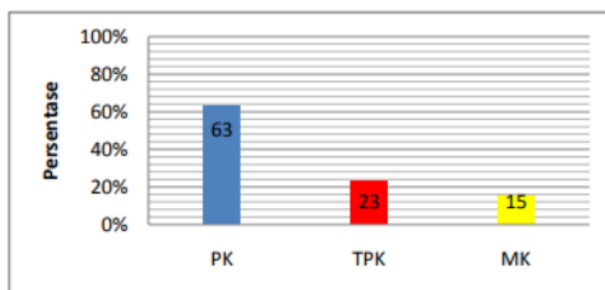

Figure 1. Identification of student understanding concepts on understanding electrolyte solutions.

In addition to not understanding the concept, students also experience misconceptions. Of the 15% students who had misconceptions about the concept of strong electrolyte solutions, 8% were misconception 1, misconception 2 was 2%, and misconception 3 was 5%.

3.2. Student's conception of definition of non-electrolyte solution
Students who understand the concept of non-electrolyte solutions are 75%, do not understand the concept by 20% and who experience misconceptions by 5%. See figure 2 below.
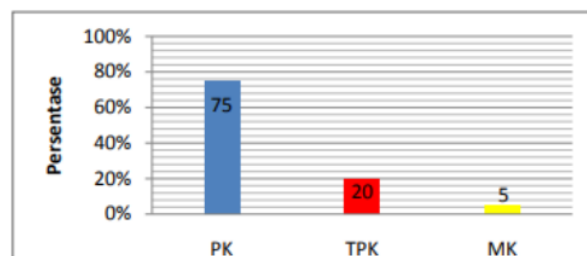

Figure 2. Identification of student understanding concepts on understanding non-electrolyte solutions.

In addition to not understanding the concept, students also experience misconceptions. Of the 5% of students who experienced misconceptions about the concept of non-electrolyte solutions, 0% was misconception 1, misconception 2 was 0%, and misconception 3 was 5%.

3.3. Student's conception of analyzing the properties of electrolyte solutions in some solutions in the environment and solutions in the laboratory
Students who understand the concept of analyzing the properties of electrolyte solutions of several solutions in the environment and solutions in the laboratory are in the low category by 16%, do not understand the concept by 59%, and students who experience misconceptions by 25%. See figure 3 below.
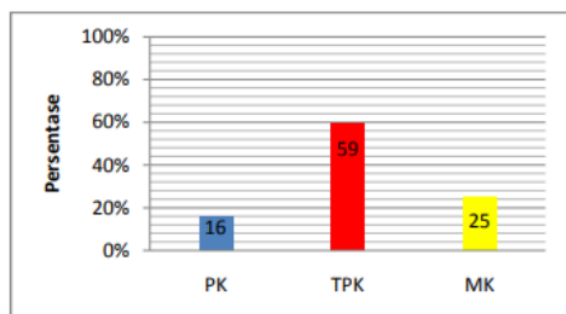
Figure 3. Identification of students' concept understanding on the concept of analyzing the properties of electrolyte solutions in some solutions in the environment and solutions in the laboratory.

Apart from not understanding the concept, students also experience misconceptions. Of the 25% students who experienced misconception, it was obtained 10% misconception 1, 3% misconception 2 and 12% students who experienced misconception.

3.4. Student's conception of classifying electrolyte solutions based on their electrical conductivity
Students who understand the concept of grouping electrolyte solutions based on their electrical conductivity are 18%, do not understand the concept of 66% and those who experience misconceptions are 16%. See figure 4 below.
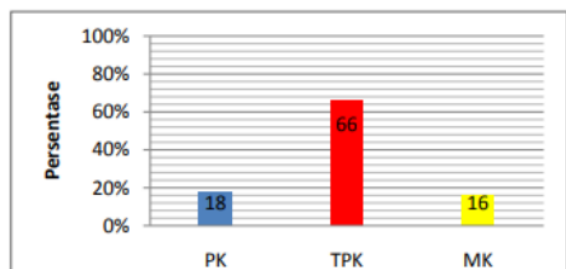

Figure 4. The percentage of identification of students' concept understanding on the concept of grouping electrolyte solutions based on their electrical conductivity.

Apart from not understanding the concept, students also experience misconceptions. From 16% of students who experienced misconception, 8% were misconception 1, misconception 2 was 2%, and misconception 3 was 6%.

3.5. Student's conception of types of chemical bonds and ionization reactions of a substance
Students who understand the concept of analyzing the types of chemical bonds and ionization reactions of a substance by 6%, do not understand the concept of 71% and misconceptions by 23%. See figure 5 below.
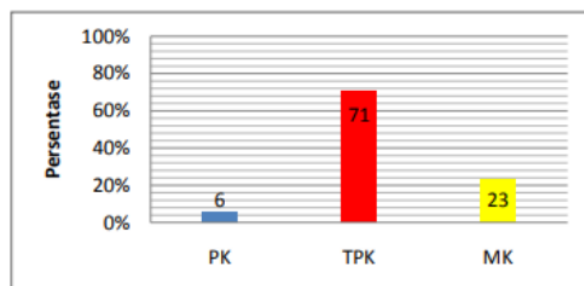
Figure 5. The percentage identification of students' concept understanding on the concept of analyzing the types of chemical bonds and the ionization reaction of a substance.

Apart from not understanding the concept, students also experience misconceptions. Of the 23% students who experienced misconception, 8% were misconception 1, misconception 2 was 2%, and misconception 3 was 13%.

3.6. Student's conception of determining the degree of ionization
Students who understand the concept of determining the degree of ionization by 13%, do not understand the concept by 60%, and misconceptions by 27%. See figure 6 below.
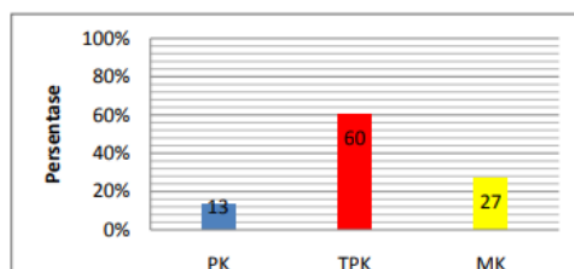

Figure 6. Identification of students' concept understanding on the concept of determining the degree of ionization.

Apart from not understanding the concept, students also experience misconceptions. Of the 27% students who experienced misconception, it was found that 18% had misconception 1, misconception 2 was 4% and misconception 3 was 5%.

3.7. Student's conception of summarizing the function of electrolytes in the human body and how to overcome electrolyte deficiencies in the body
Understanding the concept of students about concluding the function of electrolyte solutions in the human body and how to overcome electrolyte deficiencies in the body by 3%, who do not understand the concept by 80%, and misconceptions by 18%. See figure 7 below.
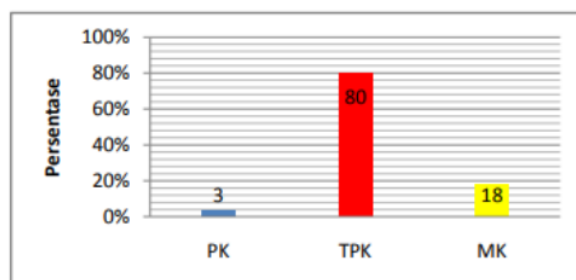
Figure 7. The percentage of students' concept understanding identification on the concept concludes the function of electrolyte solutions in the human body and how to overcome electrolyte deficiency in the body.

Apart from not understanding the concept, students also experience misconceptions. From 18% of students who experienced misconception, 8% were misconception 1, misconception 2 was 0% and misconception 3 was 10%.

4. Conclusion

Based on the results of the research, the identification of students' conceptual understanding using the three-tier multiple choice test can be concluded that the conceptual understanding of students in the material of electrolyte solution and non-electrolyte solution for class X IPA 4 in MAN 1 Gorontalo City is included in the medium category with a percentage of 28%, does not understand the concept. included in the high category with a percentage of 54%, and misconceptions included in the low category with a percentage of 18%. From the misconception, 18% of students were divided into three categories, namely misconception 1, misconception 2, and misconception 3. Student misconception with very high category occurred in misconception 1 by 8% and misconception 3 by 8%. Misconception 2 is included in the low category, which is 2%.

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