J-PEK (Jurnal Pembelajaran Kimia), p-ISSN: 2528-6536, e-ISSN: 2579-5945 OJS
Vol. 8, No. 1, June 2023, Page 1-7 Universitas Negeri Malang

Analysis of 7th-grade Students' Misconceptions of Acid-Base

Freddy Tua Musa Panggabean*[1], Lia Angraini Simanjuntak[2], Rizky Agassy Sihombing[2], Sherly Christina Octavia[2], Jenita Tambunan[2]

[1]Chemistry Education Study Program, State University of Medan, Indonesia

[2]Natural Science Education Study Program, State University of Medan, Indonesia

**Corresponding author: freddypanggabean@unimed.ac.id*

Abstract: In the classroom, students have several barriers that affect learning outcomes and learning experiences. Generally, the obstacles that occur are the misconceptions experienced by students. Teachers' error causes many students to have misconceptions about the concept and lack practice questions related to the idea. This research was conducted to see and describe the students' misconceptions about understanding acids, bases and salts. This descriptive research uses test questions about acids, bases and salts and uses the CRI method to analyze data. The results show that students who lack understanding are 13.83%, good understanding 18.68%, and students with misconceptions 67.49%.

Keywords: Learning Barriers, Misconception, students' difficulty in chemistry, properties of salt solution

INTRODUCTION

Science education is a unit that involves various elements to obtain information and achieves a change closely related to the environment of human life. In a narrow sense, science is a scientific discipline consisting of physical and life sciences (Maryanti et al., 2021). Science or natural science is a body of knowledge that contains a collection of observations and research that explain what, why, and how a phenomenon occurs. Chemistry is a branch of science that studies the properties of compounds and the reactions of substances change. One chemical topic taught in junior high school is acid, base and salt. This topic is essential for a student to master because it contains the basic chemistry concept. In reality, many students have difficulties and problems understanding the concept. The difficulty arises from the characteristics of chemistry that are not only abstract and complex (Lathifa, 2018).

Misconceptions or misunderstandings are erroneous perceptions of what is universally accepted. Therefore, some researchers advocate that teachers should know typical students' misconceptions about the topic they teach (Anjasari, 2018). The misconceptions experienced by every student at school can be different for different reasons. Therefore, teachers need to recognize misconceptions and the causes that occur in each student (Yuliati, 2017). Misconceptions can come from several sources, such as from teachers who convey wrong concepts, from students, and also from inappropriate teaching methods. The causes of misconceptions are caused by the condition of students, teachers, textbooks, and the context and teaching methods. The state of misconception, if left unchecked, will, of course, be dangerous, considering that if this condition is allowed to persist, it will have an impact on the acceptance of the next concept.

However, in identifying misconceptions, it is difficult to distinguish between students who have misconceptions, who guess the answer because they do not understand the concept (lack of knowledge), and who understand the concept well. For that, a technique that is sensitive to distinguish among them (Lathifa, 2018). Students from daily life experiences can obtain misconceptions. Misconceptions in science can be described as ideas from students' life experiences or unstructured informal education. Misconceptions can be caused by the initial concepts that students have; rationally, students build misconceptions, which happen continuously (Dewi & Wulandari, 2021).

The subject of acid, base and salt titrations involves abstract and complex concepts, such as determining samples' concentrations, pH, and ions in solution. Acid and base concepts are essential concepts in both primary and secondary curricula. There have been numerous studies on these concepts in the literature. These studies show that learners at all levels have common misconceptions (Widarti et al., 2017). A teacher needs to implement suitable learning strategies to identify and reduce misconceptions. Misunderstandings of acid, base and salts will destroy the system of student understanding of science education as a whole, considering the concepts of acid, base, and salts are related.

METHOD

Instrument

This study uses a quantitative approach to describe and analyze student misconceptions about the concept of acids, bases and salts. The research aimed at clarifying students' misconceptions about acids, bases and salts and was conducted in the 7th Grade of SMP Negeri 12 Medan. Fifteen students, seven boys and eight girls, with an average age of 12 years involved in this study. The study used an instrument in the form of a questionnaire that would be given to students directly and provided four answer choices based on a Certainly of Response Index (CRI). The research questionnaire was prepared using study literature, obtained indicators or sub-indicators, and then arranged into a grille of research instruments. Previously, one expert validated the instrument (expert judgment).

Data Collection Techniques

This study uses three data collection techniques in accordance with the form of a quantitative approach, and the data sources used are the observation and questionnaire methods. Observation guidelines are the process of examining documents that can provide precise and accurate information, so guidelines are needed to direct the examiner to aspects that must be carried out systematically. The questionnaire used in this study was in the form of multiple-choice questions consisting of 10 inquiries related to acids, bases and salts. In addition, data collection was also carried out through interviews with students regarding difficulties understanding the concepts of acids, bases and salts. The interview guide used was structured using open-ended questions.

Data Analysis Technique

The level of students' ability to understand the concepts of acids, bases and salts was measured using the Certainty of Response Index (CRI). It is obtained by linking the CRIs (CRI for wrong answers) per item with the correct fraction (number of students who answered correctly) on each

question. The percentage of students' answers and CRI Index are grouped into Categories of Understanding (U), Misconceptions (M), and Don't Understand (DU).

RESULTS AND DISCUSSION

Fifteen students participated in this study. A diagnostic test is given regarding the acid and base, followed by an interview. Based on results processing and analyzing data from multiple choice test results with reasoned criteria Certainty of Response Index (CRI), obtained the percentage of concept understanding category students on acid-base material such as Figure 1.

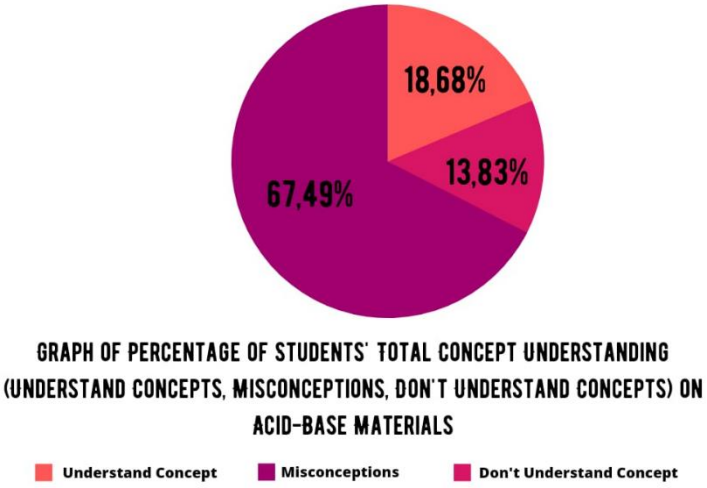

Figure 1. Students' understanding

Based on Figure 1, it can be seen that 18.68% of students understand the concept, 67.49% have misconceptions, and 13.83% of students do not understand the concept. Students who experience misconceptions are higher than the percentage of students who know the concept, with students who do not understand the concept of acid-base materials. The percentage of the total category of students' concept understanding becomes the basis for the portion of students' understanding of concepts in each indicator shown in Figure 2.

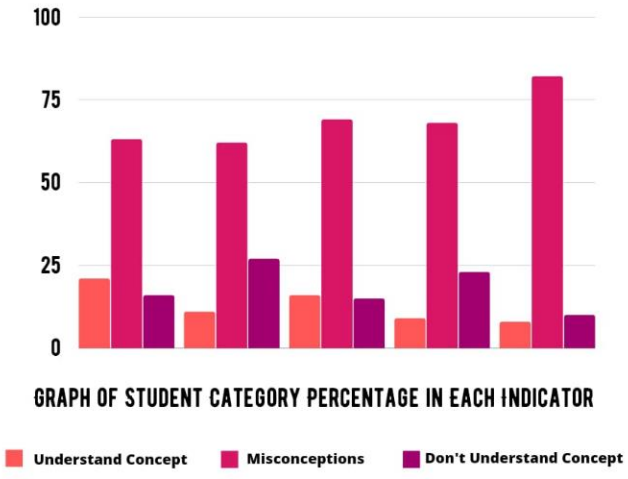

Figure 2. Student Category and Indicators

Figure 2. shows that students experience misconceptions, do not understand the concept, and understand the concept of all the indicators of the acid-base material being tested. The highest percentage of students understand the concepts in indicator 1, identifying the properties of acids, bases and salts based on the characteristics of the solution 19.10% of students and the lowest in indicator 5, mentioning the names of natural ingredients used to identify acid-base properties and salts at 2.90% student. The highest percentage of students with misconceptions in indicator 5 mentions natural ingredients used to identify the properties of acids, bases and salts at 79.4%, and the lowest at indicator 3 identifies acids, bases, and salts based on the characteristics of the solution at 67.60 % of students. The highest percentage of students did not understand the concept in indicator 4, mentioning the name of the tool used to identify the acid-base and salt properties of 23.50% students and the lowest in indicator 1, identifying the properties of acid, base and salt based on the characteristics of the solution by 10.30% students. The percentage of students with misconceptions and who do not understand the concepts in each indicator is shown in Figure 3.

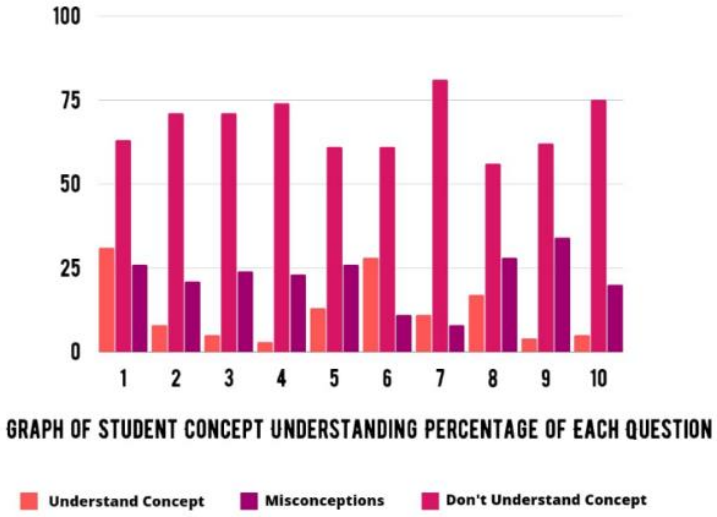

Figure 3. Student Understanding of Questions

Based on Figure 3., it can be seen the percentage of students for each question on acid-base material. The highest percentage for the concept understanding category lies in question number 1 on indicators identifying the nature of acids, bases and salts based on the characteristics of the solution by 29.4%. The lowest in question number 4 on indicators classifying acid, base and salt solutions using litmus paper indicators and number 10 on the indicator mentions natural ingredients used to identify acid, base and salt properties of 2.9%. The highest percentage of misconceptions are in questions 7 and 10, at 79.4%. While the lowest in 1, 6 and 8 with 64.7%. The highest percentage for the category of not understanding the concept is in questions 3, 8 and 9 at 23.5% and one at 5.9%. Factors causing students' misconceptions of acid-base material based on the results of interviews with students who experience misconceptions, the percentage results of students for each causal factor are shown in Figure 4.

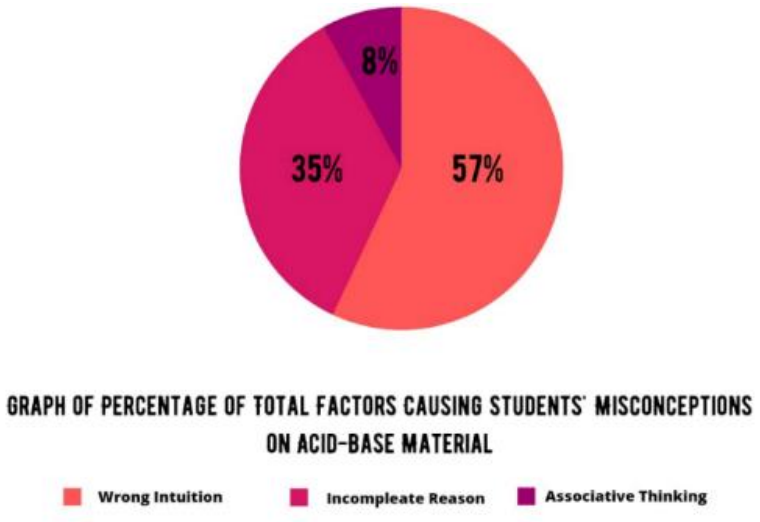

Figure 4. Factors Causing Student Misconception

The factors that cause misconceptions include incorrect intuition (IS), associative thinking (PA), and incomplete reasoning (ATL), and the lowest is in question numbers 5 and 8, by 47.1%. Factors that cause misconceptions that come from wrong intuition (IS) are the highest factors that cause students' misconceptions, with an average of 54.32%. False Intuition (IS) is a feeling from someone who spontaneously expresses an attitude or idea about something before being objectively and rationally investigated. Students are classified into the category of wrong intuition (IS) if students answer with right or wrong reasons. The concept's origin comes from personal or friends (cheating) and has a complete/incomplete notebook.

Based on the results of research conducted by Sesen & Tarhan (2011), it was found that the teacher-centred learning method can cause some misconceptions experienced by students. Meanwhile, by using the active-learning learning method, students assume that this learning method can improve the ability to analyze, synthesize, and connect learning materials with everyday life so that students get direct visualization. Meanwhile, based on research conducted by Hoe & Subramaniam (2016) argues that students need illustrations of learning materials to help for students to understand learning materials. For example, requiring a pH chart so students can understand the levels or numbers that limit or indicate acid, base, or salt levels.

Students' misconceptions can be caused by incomplete or erroneous reasoning because the information obtained is incomplete. The highest causes of misconceptions came from incomplete reasons (ATL) at 47.1%, in question number 6 and the lowest in questions 3 and 4 at 20.6%. Insufficient reason (ATL) is the second-factor causing students' misconceptions, with an average of 33.14%. Incomplete reasons (ATL) are expressions or ideas about concepts that are incompletely outlined by students caused by incomplete information obtained, resulting in students drawing wrong conclusions. In addition, students cannot apply the concepts learned in solving a problem and relate them to one another. This results in students drawing wrong conclusions and can lead to misconceptions. Based on the rubric of student interviews, students are classified into the category of incomplete reasons (ATL) if students answer with true or false reasons from teachers or books and have unfinished notebooks.

Based on the rubric of student interviews, students are classified into Associative Thinking (PA) categories. The highest cause of misconceptions comes from associative thinking (PA) at 17.6%

in questions 6 and 8 and the lowest in questions 9 and 10 at 2.9%. Associative thinking (PA) is the lowest factor causing students' misconceptions, with an average of 12.54%. Associative thinking (PA) is a student's disclosure of words and terms used by the teacher to be associated with other students. Following the statement of Suprapto (2020) that in the learning process, students associate different words and terms with those conveyed by the teacher because these words and terms have different meanings in everyday life. If students answer with wrong or correct reasons, the concept's origin comes from the teacher or book and has a complete notebook.

The factors causing the misconceptions studied came from students, teachers and learning resources (worksheet). Based on this, it is essential for teachers always to know the misconceptions in their students. Teachers are expected to provide direction and design learning according to the method so that student learning outcomes will be more optimal. Habiddin et al. (2022) stated that it is necessary to explain the terms in acid, base, and salt learning materials for students. Other studies focusing on uncovering the difficulty of students of acid-base have been carried out in many cohorts (Amala & Habiddin, 2022; Ardina & Habiddin, 2023; Febriani et al., 2018; Habiddin et al., 2021, 2022; Putri et al., 2016).

CONCLUSIONS

This study shows a student's lack of understanding of the concept of the material with a percentage value of 13.83%, students who understand the concept at 18.68%, and students' misconceptions by 67.49%. A large number of student misconceptions are caused by several factors, such as the teacher's error in describing the concept of learning material and the lack of practice questions that relate to the concept of the material. This study implies that chemistry teachers should consider more active learning to engage students in chemistry class and mainly design a proper approach for teaching acid-base.

REFERENCES

Amala, F., & Habiddin, H. (2022). Pemahaman Konsep dalam Topik Sifat Asam Basa Larutan Garam: Studi Pada Siswa SMA di Blitar. *Jurnal Zarah*, *10*(2), 91–100. https://doi.org/10.31629/ZARAH.V10I2.4321

Ardina, D., & Habiddin, H. (2023). Acid-base properties of salt solution: Study at a secondary school in Banyuwangi. *AIP Conference Proceedings*, *2569*(1), 30018. https://doi.org/10.1063/5.0112074

Dewi, E. P., & Wulandari, F. (2021). Identification of Misconceptions in Science Learning During the Covid-19 Pandemic Using the CRI (Certainty of Response Index) Method for Primary school Students. *Jurnal Penelitian Pendidikan IPA*, *7*(SpecialIssue), 145–150.

Febriani, G., Marfu'ah, S., & Joharmawan, R. (2018). Identifikasi Konsep Sukar, Kesalahan Konsep, Dan Faktor-Faktor Penyebab Kesulitan Belajar Hidrolisis Garam Siswa Salah Satu Sma Blitar. *J-PEK (Jurnal Pembelajaran Kimia)*, *3*(2), 35–43. https://doi.org/10.17977/um026v3i22018p035

Habiddin, H., Akbar, D. F. K., Husniah, I., & Luna, P. (2022). Descubriendo la comprensión de los estudiantes: Evidencia para la enseñanza de las propiedades ácido-base de la solución salina. *Educación Química*, *33*(1), 64–76. https://doi.org/10.22201/FQ.18708404E.2022.1.79488

Habiddin, H., Atikah, A., Husniah, I., Haetami, A., & Maysara, M. (2021). Building scientific explanation: A study of acid-base properties of salt solution. *AIP Conference Proceedings*, *2330*(1), 20047. https://doi.org/10.1063/5.0043215

Hoe, K. Y., & Subramaniam, R. (2016). On the prevalence of alternative conceptions on acid–base chemistry among secondary students: insights from cognitive and confidence measures. *Chemistry Education Research and Practice*, *17*(2), 263-282.

Lathifa, U. (2018). Correcting Students' Misconception In Acid And Base Concept Using Pdeode Instruction Strategy. *Unnes Science Education Journal*, *7*(2), 170-177.

Maryanti, R., & Nandiyanto, A. B. D. (2021). Curriculum Development in Science Education in Vocational School. *ASEAN Journal of Science and Engineering Education*, *1*(3), 151-156.

Putri, A. K., Afandy, D., & Su'aidy, M. (2016). Pengaruh Penerapan Strategi Pembelajaran Praktikum Menggunakan Diagram Ve Terhadap Hasil Belajar Siswa Pada Materi Hidrolisis Garam. *J-PEK (Jurnal Pembelajaran Kimia)*, *1*(2), 15–18. http://journal2.um.ac.id/index.php/j-pek/article/view/764

Sesen, B. A., & Tarhan, L. (2011). Active-learning versus teacher-centered instruction for learning acids and bases. *Research in Science & Technological Education*, *29*(2), 205-226.

Suprapto, N. (2020). A Systematic Review of Self-Efficacy among University Students as Pre-service Teachers in Science Education. *Journal for the Education of Gifted Young Scientists*, *8*(4), 1387-1396.

Widarti, H. R., Permanasari, A., & Mulyani, S. (2017). Undergraduate Students' Misconception On Acid-Base and Argentometric Titrations: A Challenge to Implement Multiple Representation Learning Model With Cognitive Dissonance Strategy. *International Journal of Education, 9*(2), 105-122.

Yuliati, Y. (2017). Miskonsepsi Siswa Pada Pembelajaran IPA Serta Remediasinya. *Jurnal Bio Education*, *2*(2), 50-58.