

CHAPTER I

INTRODUCTION

1.1 Background

Over the past three decades, there has been growing international interest in studying how learners view the natural world and their resulting conception. The concept and ideas that pupils had before and after instruction has been the focus of studies in scientific education. Most studies find that students usually have ideas about science concepts that differ from the teachers and are accepted as correct by the community. Understanding the concept is essential for each student. Students build a concept in their minds based on their experiences or in the educational process at school (Gurel et al., 2015). Because every student has different experiences, they may have the concept of right or wrong from scientific conceptions (Samsudin et al. 2018).

According to Tiandho (2018), a misconception is a cognitive structure that students have, but it is different from the concept it should have. Meanwhile, according to Gurel et al. (2015) Misconceptions of science are individual knowledge about science obtained from education or everyday events that not correct with the scientific concepts. From some of these definitions, it can be synthesized that misconceptions are individual knowledge that is incompatible with the concept as a whole scientific. Misconceptions that occur in students must be removed immediately because it will have a negative impact on students in the future (Lestari et al., 2019). Then, if students' misconceptions are not removed, there is a high possibility that these students will experience misconceptions again in more complex concepts. Misconceptions can appear in science lessons, including in biology subjects.

According to research that has been done by Soeharto et al. (2019) regarding common misconceptions in science topics, the topic of diffusion and osmosis occupies the second number of common misconceptions in biology subjects and in several studies in the field of biology education, it was found that there were still many students who had misconceptions about the concepts of diffusion and osmosis

(Oztas, 2014). The concepts of diffusion and osmosis may be challenging to understand by the students because these concepts require students to visualize and conceptualize the chemical process at the molecular level. Most diffusion and osmosis concepts are closely related to the concept found in physics and chemistry subject. Thus, to understand the concepts of diffusion and osmosis, students must understand and be able to relate concepts in biology, chemistry, and physics subjects. Johnstone and Mahmoud (1980) reported that the concepts of diffusion and osmosis are biological concepts that are difficult to understand.

Misconception can be identified in several ways. A diagnostic test is an instrument that is easy to understand and work on by students (Wijaya, 2013). We can use diagnostic tests to diagnose students who experience misconceptions and do not understand a concept (Jubaedah et al., 2017). The type of diagnostic test suitable for use is the multiple-choice diagnostic test (Anggrayni & Ermawati, 2019). Multiple choice diagnostic test is a test that provides several alternative answers to a question and students are asked to choose the most correct answer from the alternative answers given (A'yun & Nuswowati, 2018). There are several types of multiple-choice diagnostic tests, ranging from one level to four levels. The four-tier diagnostic test is created from updating the three-tier diagnostic test. The update in question is adding a reason component for choosing an answer (Hermita et al., 2017). There should be more use of the four-level multiple-choice test. This is because, according to research by Soeharto et al. (2019) the most commonly used multiple-choice diagnostic test at junior high school level is currently at the two-tier to three-tier level. Whereas, according to research by Nurulwati & Rahmadani (2020), the four-level diagnostic test is more accurate and has specific results than the three-level diagnostic test in analyzing the results of the combination of student answers.

Research on students' conceptions of science subjects, particularly on diffusion and osmosis, has been carried out at various levels of schools in Indonesia and abroad. For example, Oztas (2014) investigated high school student's knowledge of the concepts of diffusion and osmosis, while Odom (1995) focused his research on

high school and college students on the same concepts. Similar research has also been conducted in Indonesia, such as by Tanziyah (2015) on high school students. Overall, almost all studies that have been conducted have found that students still experience misconceptions and need a better understanding of the concepts of diffusion and osmosis at various levels of education. However, it should be noted that research to identify misconceptions about the concepts of diffusion and osmosis at the junior high school level is still rare. This is due to the lack of schools that use the Cambridge curriculum, which includes these concepts to be taught to junior high school students.

Thus, because the concepts of diffusion and osmosis are fundamental concepts for comprehending many essential life processes (Oztas, 2014) and there is still little research on students' conception related to this concept at the junior high school level, it is necessary to develop an instrument to analyze students' misconceptions about diffusion and osmosis using a Four-Tier Test diagnostic instrument so that misconceptions can be identified and solved. So, effective and appropriate learning can be adopted to help students understand scientific concepts (Suparno, 2013). With this effort, it is hoped that students can develop a better and more accurate understanding of the concepts of diffusion and osmosis so that their ability to understand science as a whole can increase.

1.2 Research Problem

Based on the above background context, the research problem is "What are junior high school students' misconceptions about diffusion and osmosis as measured by a four-tier test instrument?" The research problem leads to the formulation of two research questions that the research aims to address.

1. What are the conceptions of students about diffusion and osmosis?
2. What are some misconceptions held by junior high school students about diffusion and osmosis?

1.3 Operational Definition

1. Four-Tier Diagnostic Instrument

The four-tier diagnostic test is an instrument that can be used to analyze students' conceptions consisting of four questions. The first tier is the main question to determine student knowledge, the second tier asks for the confidence level for the main question, the third tier is the reason for the main question, and the fourth tier asks for the confidence level for the third-tier reasoning questions. The first and third-tier questions are multiple-choice questions with four answer options. The second and fourth-tier questions are multiple choice questions with two answer options that are sure and not sure to ask students' confidence levels in answering questions and reasons. Misconception can be measured if students answer incorrectly on the first and third tier questions but students have confidence in answering these questions. Then the combination of each student's answer in answering the questions will be analyzed and categorized based on the rubric previously made in the research by Kiray & Simsek, (2021) which are Scientific Knowledge (SK), False Positive (FP), False Negative (FN), Misconceptions (MC), and Lack of Knowledge (LK).

2. Students' Conception

Students' conception refers to the individual understanding, beliefs, and mental representations that students have about a particular subject or topic. It encompasses their ideas, perspectives, and conceptualizations of various concepts or phenomena (Yokoyama & Miwa, 2020). Students' conceptions can influence how they perceive, interpret, and make sense of new information or experiences. These conceptions can be influenced by prior knowledge, personal experiences, cultural backgrounds, and educational contexts (Purdie & Hattie, 2014). Students may develop different conceptions, ranging from accurate and well-informed to misconceptions or alternative conceptions that deviate from established scientific or academic understanding. According to research by Kiray & Simsek (2021), students' conceptions level can be divided into five categories, namely Scientific Knowledge (SK), False Positive (FP), False Negative (FN), Misconceptions (MC), and Lack of Knowledge (LK). Students' conceptions can be identified using a four-tier test diagnostic instrument.

3. Misconceptions

Misconceptions refer to inaccurate or incomplete ideas about a concept or a process that is commonly held and persistent (Suprano, 2013). Misconceptions can be formed as a result of exposure to inaccurate information, faulty reasoning, or misinterpreting material (Kiray & Simsek, 2012). Misconceptions can hinder student learning and understanding of a topic. Misconceptions can be seen if students are wrong in answering questions on the first-tier question and in giving reasons for their answers to the third-tier question but have a high level of confidence in choosing to determine the answer.

1.4 Limitation of Problem

Several limitations are applied so that the research can run under the objectives as follow:

1. Research Subject

The results and conclusions obtained in this research refer specifically to the sample group involved in the research.

2. Four Tier Test

This research uses a four-tier test instrument, students provide answers and reasons for these answers and choose a level of confidence sure and not sure in the answers and reasons they choose, so in this research, it's not been able to determine where the misconceptions experienced by students come and what affects the confidence level of students from only by using this instrument.

3. Diffusion and Osmosis Concept

The concept in this research refers to the diffusion and osmosis in diffusion and osmosis topic for 7th-grade junior high school students in the Cambridge international curriculum.

1.5 Research Objective

The objectives of this research are as follows:

1. To analyze students' conception on diffusion and osmosis topic.
2. To analyze students' misconceptions on diffusion and osmosis topic.

1.6 Research Benefit

1. Teacher

This research helps increase teachers' knowledge about misconceptions in science topics, helping teachers to find appropriate learning methods to minimize misconceptions and finding better learning strategies to remove misconceptions in science subject, especially in diffusion and osmosis concepts.

2. Students

This research is helpful for students to discover the misconceptions that arise in the concepts of diffusion and osmosis so that students can strengthen their understanding to prevent and avoid common misconceptions found in this research.

3. Further Research

The data and results of this research can be helpful for researchers interested in researching students' conception understanding about diffusion and osmosis topics, as well as assessment instruments as guides and references for future research.

1.7 Organizational Structure of Research Paper

1. Chapter I: Introduction

This chapter states the background of the research, research problem, research questions, limitation of the problem, research objectives, research benefits, and the organization of the research paper.

2. Chapter II: Literature Review

This chapter consists of the explanation of students' understanding of science, students' misconceptions of science, the four-tier tests as diagnostic instruments, and content analysis of diffusion and osmosis in the national middle school.

3. Chapter III: Research Method

This chapter explains the process for obtaining data to be used for research purposes including research method and design, population and sample, operational definition, research instrument with the instrument analysis, data analysis, and research procedure.

4. Chapter IV: Results and Discussion

This chapter explains the results and discusses the data that has been obtained from the research.

5. Chapter V: Conclusions, Implication, and Recommendations

This chapter consists of the research conclusion, the implications of the research, and recommendations for other researchers who have interested in this research area.