

CHAPTER I

INTRODUCTION

1.1 Background

Misconceptions in the biology context of science education have become one of teachers' most serious problems (Prayitno et al., 2022). Misconceptions are often found among teachers and students. They are used to direct learning, which can significantly hinder students from properly learning scientific concepts. These false beliefs are not mere errors but are based on alternative frameworks that students develop through personal experience or prior knowledge (Gurel et al., 2015). The digestive system topic is among the basic biological concepts that are more likely to be mistaken by students, especially at a junior high school level. In identifying and analyzing these misconceptions, the four-tier diagnostic test has become a tool that can bring more subtlety to understanding than traditional assessment tools (Halim et al., 2018). The four-tier diagnostic test is an advanced diagnostic assessment tool to diagnose students' misconceptions about various scientific concepts. The development of this assessment test complements the existing two-tier and three-tier tests, which have numerous limitations (Ermawati, 2020).

Numerous studies have highlighted the need to diagnose misconceptions in biology (Kiray & Simsek, 2021). The four-tier diagnostic test helps diagnose teacher misconceptions on science topics. This technique can measure students' choices and confidence levels by their reasoning power. The first level consists of multiple choice answers, with four multiple choices and one important answer to choose from. The second level contains the level of student confidence in choosing answers. The third level discusses the reasons for answering the question. This test has four choices of reasons and one important answer to choose from. The fourth is the level of student confidence in choosing scientific reasons (Wahyuni et al., 2021).

However, misconceptions about the digestive system must be considered more because it is a very complex and fundamental structure in understanding biology. Studies like those by (Andariana et al., 2020) and (Bulunuz et al., 2014; Kumandaş et al., 2019) have shown that even at higher educational levels, students struggle with misconceptions about biology topics. These misconceptions can range from misunderstandings about the role of specific organs to confusion about the processes involved in digestion and nutrient absorption. As Wola et al. (2020) explain, misconceptions still exist because of poor teaching strategies. This need must be addressed by developing a four-tier diagnostic test that measures effectiveness in analyzing misunderstandings regarding the topic. With this concept, the complex digestive system often involves flawed processes (Yang et al., 2015).

Addressing misconceptions in the early years of junior high school science education is instrumental in laying a solid foundation for further learning. According to (Tompo et al., 2016), the use of models of discovery-inquiry learning is an efficient technique that can reduce the misconceptions about science learning among middle school students. Furthermore, diagnostic models and tools such as the four-tier test help educators adapt their teaching to confront and correct misconceptions directly. As discussed by (Basheer et al., 2018), formative assessment checks further support this approach by continuously teaching student understanding and providing feedback. The four-tier diagnostic test has proven helpful in identifying misconceptions and designing instruction.

According to (Kaniawati et al., 2019), Diagnostic instruments applied to students have made standard procedures easier. This four-tiered test provides sophisticated and detailed feedback, allowing educators to pinpoint where misconceptions exist. Knowledge of the four-tiered diagnostic test underscores its effective use in various disciplines. The usefulness of the four-level diagnostic test to test misconceptions on various topics and educational levels was also mentioned by (Kartimi et al., 2021) and (Aripiyani et al., 2023). The review by (Çelikkanlı & Kızılcık, 2022) in developing and

implementing a four-tier diagnostic test is essential because it allows for a deeper understanding of students' beliefs and misconceptions. Educators can adapt their teaching strategies by identifying the specific nature of misconceptions to address them more effectively. This discovery is essential in science because fundamental misunderstandings can hinder future learning, which is likely beneficial for biology education (Lukman et al., 2022).

1.2 Research Problem

Based on this background information, this research focuses on the following central question: “Using a four-tier diagnostic instrument, what misconceptions do middle school students most often have about the digestive system?” This central question is explored further through two specific research questions:

1. What is the level of students' conception of the topic of the digestive system?
2. What is the level of students' misconceptions about the digestive system?

1.3 Operational Definition

1. Four-Tier Diagnostic Instrument

The four-tier diagnostic test is a sophisticated assessment tool designed to test students' misconceptions and knowledge in specific subjects, particularly in science education. It has four stages of questions, each designed to dig deeper into students' thinking and conceptual understanding, going beyond typical multiple-choice exams. The four-level test has four different levels of questions. The first level assesses cognitive knowledge, the second level assesses confidence in answering questions about cognition, the third level tests reasoning abilities, and the fourth level assesses confidence in responding to reasoning-based arguments. FTDT questions can correctly correct concepts and are the result of the development of a three-tier multiple choice consisting of four levels: the first level in the form of multiple-choice questions, the second level in the form of confidence in answering questions at the first level, the third level of reasons for choosing the first level answers, and the fourth level. The confidence rating on the second and fourth tiers can help to understand whether a student's correct answer

is based on a guess or whether a student's incorrect answer indicates a lack of knowledge. Using this diagnostic test, conceptual levels are categorized into groups, which are then given labels such as Scientific Knowledge (SK), False Positive (FP), False Negative (FN), Misunderstanding (M), and Lack of Knowledge (LK).

2. Students' Conception

Student conceptions refer to students' ideas, perceptions, or beliefs regarding various ideas or phenomena. These concepts can be true or false and are shaped by their previous experiences, instructions, and personal reflections. Gaining a comprehensive understanding of students' ideas is of the utmost importance in education because it allows educators to recognize any misunderstandings and provide appropriate instruction to correct them. Often, students come to class with ideas that may not be entirely correct. Therefore, identifying these misconceptions early is critical to correcting them.

3. Misconceptions

Misconceptions are false or misleading conceptions, beliefs, or understandings that a person has about various ideas or circumstances. This may be due to several things, including general experience, gut feeling, cultural norms, or inadequate training. Misconceptions are fundamental in educational contexts because they can hinder learning and the acquisition of correct knowledge. Accurately identifying these concepts is an essential first step. This study will use the term "misconceptions" to refer to ideas contradicting scientifically established hypotheses, as commonly used in the literature.

1.4 Limitation of Problem

Limitations are in place to ensure the research accomplishes the following objectives as follow:

1. Digestive System

The research is aimed at students who have studied topics taken from the national curriculum, namely the Merdeka Curriculum. The topic includes micronutrients, minerals and zinc, absorption and disposal.

2. Four Tier Diagnostic Test

A diagnostic test to determine students' responses to the four test levels. This diagnostic test involves respondents filling out an accessible instrument. The four-level test is a tool to assess students' conceptions. It is divided into four categories: main question, main question confidence level, reasoning, and reasoning confidence level. However, the confidence ratings only consist of sure and not sure; we will never know the main reason if the students have misconceptions because we cannot identify the root of the problem.

3. Grade 8th Junior High School Students

The data and conclusions obtained in this study are particular to the sample group participating.

1.5 Research Objective

The objectives of this research are as follows:

1. To analyze the students' conception of the digestive system topic.
2. To analyze the students' misconception of the digestive system topic.

1.6 Research Benefit

1. Teacher

Teachers can use the findings from this research to help address and correct students' misconceptions about the digestive system.

2. Student

Students can use the findings of this study to reflect and gain knowledge of the digestive system to develop their conception abilities, which can reflect their misconceptions.

3. For other Researchers

The research of this study can be a scientific contribution to further research on the development of abilities to reflect their misconception.

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 explains students' understanding of science, misconceptions of science, the four-tier tests as diagnostic instruments, and content analysis of the digestive system in junior high school students.

3. Chapter III: Research Method

This chapter explains how to collect data for research purposes, including research methods and design, population and samples, operational definitions, research instruments including instrument analysis, data analysis, and research procedures.

4. Chapter IV: Results and Discussion

This chapter describes the results and discusses research data.

5. Chapter V: Conclusions, Implication, and Recommendations

This chapter contains research results, implications, and recommendations for other researchers who are interested in this research topic.