CHAPTER I
INTRODUCTION

1.1 Background

Education is an activity to change a person's mindset with the aim of changing their life for the better (Tumanggor et al., 2020). These goals in education can be achieved through learning activities. Learning is a process that a person experiences to create a relationship between the knowledge they have and the new knowledge they obtain. Learning can be done through formal, informal, and non-formal education. One provider of formal education is a school. Schools have two very important components, namely teachers and students. Students can gain knowledge from teachers through learning (Hidayat et al., 2020). Learning is an activity that is a process of interaction between students, educators, and learning resources in a learning environment. Learning is carried out between students and educators in an effort to convey and receive knowledge using various learning methods and resources so that the learning process can be carried out efficiently and effectively in achieving learning goals. The success of a lesson is seen in the achievement of the learning objectives that have been set. Learning itself creates interaction between the teacher and students in order to achieve the learning objectives that have been set, where the teacher conveys information in the form of knowledge to students, and students are expected to understand and master the material that has been presented by the teacher (Mediartika & Aznam, 2018). In learning, there are often problems between teachers and students. Students in the learning process have a basis for building understanding based on their own concepts; this also often happens in chemistry learning in high school. As the constructivist philosophy points out, knowledge is built by students themselves with the help of teachers (Bayuni et al., 2018). The teacher teaches learning material, and students understand the material presented according to their own abilities (Hidayat et al., 2020). Educators and academics have characterized several conceptual shifts that individuals undergo as a result of their intuitive beliefs, life experiences, cultural influences, and learning and teaching processes (Soeharto & Csapó, 2022).

Chemistry is a branch of natural science that studies the properties of matter, the structure of matter, changes in matter, laws, concepts, and theories. Chemistry is a science that contains successive and tiered concepts. If students do not understand the initial concept, then they will have difficulty understanding more complex concepts. Chemistry lessons also contain many abstract concepts (Ekawisudawati et al., 2021). This abstract concept is what makes students have different perceptions of understanding chemical material and consider chemistry to be a difficult lesson to understand (Kustiarini et al., 2019). According to Orgill & Sutherland in Putri & Laksono (2022), when explaining chemistry material, teachers tend to emphasize the computational aspect compared to the conceptual aspect, which in the end can make it difficult for students to understand various chemical concepts correctly. The study of science entails learning about natural events and related concepts, as well as acquiring the ability to explain them scientifically. Primary education lays the groundwork for many important scientific concepts. When children enter primary school, they bring ideas and explanations for daily phenomena and concepts utilized in science (Härmälä-Braskén et al., 2020). Difficulties like this result in students having an understanding that is not in accordance with the actual concept or is often referred to as a misconception. (Putri & Laksono, 2022).

Misconceptions are discrepancies in students' understanding of a concept with the scientific understanding formulated by scientists in their field (Suyono, 2020). According to several research findings, the sources of misconceptions in science education include student counseling, teacher/student handbooks, and insufficient explanations (Halim et al., 2019). Misconceptions can also be interpreted as different understandings, which sometimes may not be in accordance with scientific concepts (Putri & Subekti, 2021). Misconceptions often occur during the learning process. Misconceptions are resistant to change and tend to persist. Misconceptions are resistant to change, long-lasting, deeply established in an individual's cognitive ecology, and difficult to eradicate even with training tailored to address them. Misconceptions might arise if the process of assimilation of prior knowledge to learning is not integrated with knowledge gained by pupils in the classroom. Misconceptions are frequently maintained by a rather strong student mindset, which is difficult to change and cure (Bayuni et al., 2018). Therefore, efforts are needed to evaluate whether students have

mastered the concepts correctly or not so that misconceptions do not occur continuously. The occurrence of misconceptions has an impact on students' understanding of subsequent material. One of the misconceptions in chemistry learning that occurs among students is the buffer solution material. Buffer solution material is important material, and it is hoped that students will have good mastery of concepts and mathematical skills because buffer solution material contains some prerequisite material for an initial understanding of the concepts of stoichiometry, equilibrium, and the concept of acids and bases (Fitriza et al., 2021). Research conducted (Ginting & Ginting, 2023) shows that students' learning results and interest in buffer solution material using a problem-based learning model assisted by e-modules have increased, so this can help reduce the level of misconceptions about the material. These materials really influence students' understanding of buffer solution learning (Stephanie et al., 2019). Based on the results of an interview conducted with one of the chemistry teachers at SMA Negeri 1 Girsang Sipangan Bolon, at this school there has never been any research on misconceptions in learning. And when the researcher interviewed one of the chemistry teachers, he found that one of the most common materials with misconceptions in learning chemistry in class XI were buffer solution. In buffer solution material, the difficulty experienced by students, which gives rise to misconceptions in this material, is in calculating the pH value of a solution. This may happen because students do not understand the concept of a given compound being categorized as an acid buffer or base buffer, thus causing problems for students in deciding which formula to use to answer the questions asked. Several studies that have been carried out state that the concepts that often have misconceptions regarding buffer solution material are that the most frequent misconceptions are the concept of calculating the pH of buffer solutions and the lowest is definition of buffer solution and the properties of buffer solutions (Nurhidayatullah & Prodjosantoso, 2019; Stephanie et al., 2019; Genes et al., 2021; Firdaus et al., 2022).

One way to detect misconceptions is to use diagnostic tests. Diagnostic tests are used to determine students' weaknesses and strengths in learning (Mubarak et al., 2016). An instrument is used to assess students' conceptual comprehension. The diagnostic multiple-choice question approach, which includes reasons and confidence questions, is a useful tool for helping pupils understand concepts more deeply.

Questions can be formatted as two-tier, three-tier, or four-tier diagnostic tests (Istiyono et al., 2023). The four-tier diagnostic test is a development from three-tier test, where the development is based on the level of confidence in choosing reasons. The weakness of the three-tier diagnostic test is that when students are asked about their level of confidence in the first and second stages simultaneously, it is not clear whether students have different levels of confidence between the first and second stages in answering the questions. So, the interpretation of this three-tier diagnostic test can be too low for those who don't understand the concept, and it can also be too high for those who understand the concept. Until now, there have been difficulties in distinguishing students who experience misconceptions from those who do not understand the concepts in the lesson. If you don't differentiate between the two, it will be difficult to determine the next step because correcting misconceptions is not the same as correcting students who don't understand the concept Therefore, a three-tier diagnostic test was developed, namely a four-tier diagnostic test assisted by CRI, which consists of: the first tier contains multiple choices consisting of four distractors and one answer key; the second tier contains the level of confidence of students in choosing the answer in The first tier, the third tier, contains students' reasons for answering questions, and the fourth tier is the level of confidence in choosing the reason answer (Diani et al., 2019). The first tier of the four-tier tests is the content tier, and it describes the respondents' knowledge. The second tier assesses the respondent's confidence in his or her response to the content tier. The third tier is the reason, which includes the reasoning behind the answer to the primary inquiry. The fourth layer of confidence asks whether the respondent is confident in his or her response to the third tier (Kiray & Simsek, 2021). Certainty Response Index (CRI) is one way to differentiate between understanding a concept, misunderstanding a concept, and not understanding a concept. CRI is the level of certainty in students' answers to the questions given. The CRI value (0–5) shows the level of confidence in answering the questions given. A CRI value < 2.5 indicates a lack of student confidence in answering questions. The following are the criteria set based on the CRI value: 0 is a totally guess; 1 is an almost guess; 2 is not sure; 3 is sure; 4 is almost certain; and 5 is certain. The number 0 indicates the lowest level of self-confidence that students have; this shows that students do not understand the concept being stated. The number 5 shows that

students' confidence in answering questions is the highest; this shows that students understand the concept being stated (Sadhu et al., 2017).

Based on the above description, the researcher is interested in conducting research with the title "**Analysis of Student Misconceptions In Learning Buffer Solution Material Using Four-Tier Test with Certainty of Response Index Method**".

1.2 Problem Identification

Based on the description of the background of the problem that has been explained, several problems can be identified as follows:

1. There are misconceptions in chemistry material in high school.
2. Students have difficulty understanding the concepts given by the teacher compared to actual concepts.
3. There has never been any research regarding student misconceptions.
4. Tests have never been carried out to detect misconceptions in students.
5. There is a misconception regarding the buffer solution material.

1.3 Scope of Problem

Based on the background and problem identification above, the scope of the problem in this research is Analysis of Students' Misconceptions in Learning Buffer Solution Materials Using Four Tier Test with Certainty Response Index (CRI) Method in class XI Science at SMA Negeri 1 Girsang Sipangan Bolon.

1.4 Problem Limitations

In order for research to be more directed and focused, it is necessary to consider the limitations of the problems in the research, namely:

1. The materials tested are buffer solution material.
2. The instrument used is a Four Tier Test with Certainty Response Index (CRI) Method.
3. Instruments used to measure student misconceptions.
4. This research was conducted at SMA Negeri 1 Girsang Sipangan Bolon in class XI Science.

1.5 Problem Formulation

Based on the background of the problem, the problems in this research can be formulated as follows:

1. What is the percentage of misconceptions among students in buffer solution material using the Four Tier Test with Certainty Response Index (CRI) instrument among students at SMA Negeri 1 Girsang Sipangan Bolon?
2. Which material concepts from buffer solutions that has the highest misconceptions?

1.6 Research Objectives

Based on the problem formulation above, the objectives of this research are:

1. To describe the percentage level of misconceptions of class XI students at SMA Negeri 1 Girsang Sipangan Bolon on each concept of buffer solution material based on the Four Tier Test with Certainty Response Index (CRI) instrument.
2. To describe the highest categories of misconceptions on buffer solution materials in class XI students at SMA Negeri 1 Girsang Sipangan Bolon.

1.7 Research Benefits

The results of this research are expected to provide benefits, including:

1. For teachers

   As a reference in order to improve the quality of teaching and learning chemistry, especially on buffer solution materials.
2. For researchers

   Increase insight into scientific skills, especially chemistry learning research, as well as experience to find out misconceptions that occur in students.
3. For other researchers

   As input in order to conduct further relevant research.
4. For readers

   As an additional insight to find out scientific data regarding student misconceptions that occur on the buffer solution materials.