# CHAPTER I

# INTRODUCTION

## 1.1. Research Background

Chemistry is a science subject that studies many abstract concepts and some of the attemps explain chemical phenomenon in daily life. The main purpose of chemistry lessons is to acquaint students with nature or everyday phenomena and help them to understand what is going on in nature: all guidelines for chemical education, schoolbooks and most curricula should aim at achieving this goal. In addition, the principles of psychology require to offer phenomena which children and students have observed on their own. Based on these observations, they will find initial explanations and will develop their cognitive structure.

The most important subjects of lectures in chemistry education can be presented in a kind of ”pie-chart”:

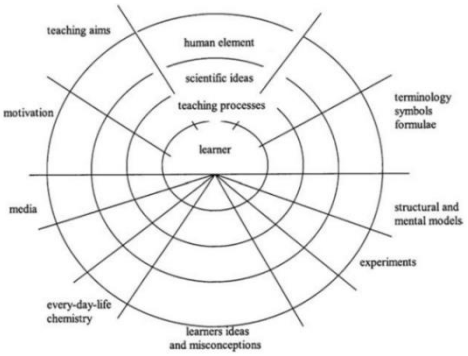


**Figure 1.1** Main Subject of A Lecture in Chemistry Education

For that Figure 1.1 we can conclude that on educational process is explaining about learners ideas and misconceptions, experiments, structural and mental models, terminology symbols formulae, teaching aims, motivation, media, and everyday life chemistry meanwhile the centered diagram is for learner in the categories like learner, teaching process, scientific ideas, and human element. Finally there should be reflections on the human element or context to each

subject as Mahaffy has proposed. There are free sectors in that diagram – for more chemistry education subjects to reflect upon in the next research.

Based on Hazari, their experience of beginning of courses in chemistry education, would-bechemistry teachers are often not clear about their own or students‟ preconcepts or misconceptions. They are not aware of how important it is to know more about these concepts and how to integrate them into chemistry education at school. Research in students‟ conceptions in chemistry is based on the constructivist approach to learning, in which students construct their own cognitive structure. According to this approach of learning, learners generate their own meaning based on their background, attitudes, abilities, experiences etc, before, during and after instruction. Since students do construct or build their own concepts, their constructions differ from the one that the instructor holds and has tried to present. This is also supported based on observations of internship III researcher where students do not fully understand the relationship between materials in chemistry learning.

As in the historical development of the redox concept, the definition of oxygen transfer in beginners‟ lessons changes to electron transfer in advanced lessons as soon as the subject of atomic structure is discussed. After the introduction of the oxygen definition, there is a belief that oxygen has to be involved in every redox reaction. The reason for this is, first of all, the syllable – ox, which is semantically strongly associated with the name oxygen (oxygenium, oxide), and with combustion reactions in air or oxygen which are carried out in the introductory lessons. Further tests by Sumfleth and Stachelscheid were association tests; due to many answers, the same misconceptions were found. The interesting thing was the frequency with which individual terms and correlating explanations were given. A third of those questioned explained the term redox reaction purely tautologically: „„a redox reaction is an addition of reduction and oxidation; consists of an oxidation and a reduction““. In the association test, the term oxidation was used much more often (58%) than reduction (43%) or redox reaction (41%) and was associated with oxygen. In association with combustion, students also mention oxidation (21%) much more often than reduction (3%) or

redox reaction (5%). Again, the terms oxidizing agents and reducing agents are mainly tautologically explained (15% of students). Only 6% of the students report that oxidizing agents gain electrons and that they themselves are reduced and vice versa. So, the main concept of redox matter changes meaning up to four times, namely redox based on oxygen transfer, redox based on hydrogen transfer, redox based on electron transfer and redox based on changes in oxidation number. Changes in the meaning of this concept and the completion of redox problems that require many stages make students difficult to solve redox reaction problems (Anshory, et al, 2016).

Many of research and development about instruments that used to detecting misconceptions has been done. There‟s three ways to detect misconceptions: (1) basic multiple choice; (2) two tier multiple choice and; (3) three tier multiple choice (Masykuri et al., 2019). One of the techniques that can be used to identify the location student misconceptions are instruments three-tier multiple choice. Three-tier multiple choice technique is a combination from two-tier techniques and Certainty of techniques Response Index (CRI) with the confidence rating, which measures the level of confidence of the respondents to their answers in the first two tiers. Confidence rating can be regarded as an individual‟s "internal, estimated belief" in his or her own accuracy (Renner & Renner, 2001, p. 23). The utilization of confidence rating in testing has its origins in the field of psychology (see review of Echternacht, 1972), where individuals are requested to assess the accuracy of their performance in cognitive tasks (Stankov & Crawford, 1997). Confidence ratings may reflect the strength of students‟ conceptual understanding, as well as their alternative conceptions (quoted in Caleon & Subramaniam, 2010). Three-tier multiple choice is one the type of diagnostic test used to differentiate between students who are lack of knowledge (do not understand concept) with experienced students misconception. This is one of the advantages of this instrument because basically in the world of education it is very important to differentiate the level of understanding students so that the method can be selected proper teaching in the process classroom learning. Therefore, three-tier diagnostic test (Three-tier multiple choice) is

considered more accurate to identify student misconceptions because it comes with questions belief (Wulandari et al., 2019).

Several previous studies to find out the misconception of redox reaction already done by Wulandari et al., 2019; Masykuri et al., 2019; Nurrohmah et al., 2018; and Nurlela et al. 2017 with different methods and results each other. Wulandari et al., 2019 discussed the biggest misconception on sub-indicator application and equation redox reaction with 46,89%. Masykuri et al., 2019 discussed the misconception only sub-indicators on redox concept based on losing and gaining oxygen, increase and decrease in oxidation number and reducing agent and oxidizing agent concept. Nurrohmah et al., 2018 discussed and got misconception of students using CBT system with RDT software on the redox reaction material. Nurlela et al., 2017 discussed the misconception using Two-Tier Multiple Choice with CRI (Certain Response Index).

Based on the description that has been described above, the researcher needs to be done research that aims to identify students' misconceptions with using a three-tier multiple choice on the redox concept material in class X. The researcher lifted the research with the title: **Development of Three Tier Instrument Test With Certainty Response Index (CRI) to Detect Misconception in Learning Redox Reaction.**

### 1.2. Problem Identification

Based on the background of the problem stated above, the problem can be identified as follows:

1. The students‟ misconception in chemistry education at senior high school especially redox reaction material due main concept of redox matter changes meaning up to four times.
2. Interpretation of students‟ new knowledge based on their own knowledge.
3. The development of an objective test instrument to detect student misconceptions using the Three Tier Instrument Test with Certainty of Response Index (CRI) rarely being applied in the chemistry learning assessment process.

### 1.3. Research Scope

To make this study obtain specific results, the researcher focused the research on the material redox reaction to identify students‟ misconception of senior high school students grade X with Three-Tier Instrument Test and Certainty of Response Index (CRI).

### 1.4. Problem Formulation

The formulations of this research are:

1. What the analysis of teaching learning chemistry process in each schools?
2. What the result of eligibility categories of the objective test instrument to detect misconceptions by Three-Tier Instrument Test with Certainty of Response Index (CRI) on redox reaction material which is reviewed from expert validation?
3. What the result percentage of students‟ misconception in each sub-concepts of redox reaction material based on Three-Tier Instrument Test with Certainty of Response Index (CRI) objective test instrument?
4. What the causes of students‟ misconception of redox reaction material in grade X based on Three-Tier Instrument Test with Certainty of Response Index (CRI) objective test instrument?

### 1.5. Problem Limitation

The limitation of the problem in this study are:

1. The development of this misconception detection instrument based on Three-Tier Instrument Test with Certainty of Response Index (CRI) and only includes redox reaction material.
2. Development of test instruments only measures the cognitive aspects of students which include C1 (knowledge), C2 (comprehension), C3 (application), and C4 (analysis) in learning redox reaction material.
3. The feasibility category of the test instrument is measured from the results of validity, reliability, difficulty level, difference power, and distructor.

## 1.6. Research Objectives

The objectives of this research are:

1. To know the analysis of teaching learning chemistry process in each school before making the Three-Tier Instrument Test with Certainty of Response Index (CRI) on redox reaction material.
2. To determine the eligibility categories of the objective test instrument to detect misconceptions by Three-Tier Instrument Test with Certainty of Response Index (CRI) on redox reaction material which is reviewed from expert validation.
3. To determine the result percentage of misconception in each sub-concepts of redox reaction material based on Three-Tier Instrument Test with Certainty of Response Index (CRI) objective test instrument.
4. To determine the causes of students‟ misconception of redox reaction material in grade X based on Three-Tier Instrument Test with Certainty of Response Index (CRI) objective test instrument.

## 1.7. Research Benefits

The benefits expected and intended to be achieved in this study are as follows:

1. For students

   Knowing more the material about redox reaction by doing the exercise.
2. For educators

   Knowing of a students‟ misconception detection instrument on redox reaction material as a source and reference in developing instruments to determine the level of student understanding and one solution to solve problems in high school chemistry learning curriculum 2013.
3. For researchers

   Knowing the development process as well as the knowledge of researchers in designing and developing instruments of chemistry.

## 1.8. Operational Definitions

1. Research and Development

   Research and development (R&D) is a general term for all those investigative activities that an educational institute conducts with the intention of making a discovery that can either lead to the development of new educational products (e.g. curricula, learning materials) or procedures (e.g. teaching or assessment procedures), or to improvement of existing educational products or procedures (Ahmad, 2019).

2. Misconception

   The misconception is inappropriate or different concepts with that concept and understanding believed to be true by the scientific community or an expert in the field (Wulandari et al., 2019).

3. Instrument Test

   Instrument test is a systematic procedure for measuring a sample of an individual's behavior, such as multiple-choice, performance test, etc. (Brown, 1971).

4. Three-tier Instrument Test

   Three-tier diagnostic test instrument multiple choice (TTMC) is one type of diagnostic test can be used to identify understanding the concept of learners. The format a TTMC diagnostic test instrument was prepared in three levels, namely: level one is a multiple-choice, level two question test contain reasons based on the answers already selected, level three loads sure or not in choosing the answer level one and level two. Third level used to differentiate answers wrong students, for their lack of knowledge and misunderstanding (Hidayati et al., 2019).

5. Certainty of Response Index (CRI)

   Certainty of Response Index (CRI) requires the respondents to provide their own choice, concepts or laws to determine the answer. CRI is usually based on a certain scale. For example, a six-point scale (0–5), where 0 means not understanding (total guess) and 5 means absolutely confident the principle of knowledge (Hasan et al., 1999).