



Identification Chemistry Pre-Service Teacher's Misconceptions on The Topic Atomic Structure

Rika Siti Syaadah^{1*}, Maria Paristiowati¹, and Hayyun Lisdiana¹

¹Department of Chemistry Education, Faculty of Mathematics and Science, Universitas Negeri Jakarta, Jl. Rawamangun Muka Raya No.11, Jakarta 13220, Indonesia

*derriikaa@gmail.com

Abstract. This study aimed to identifying pre-service teachers' misconceptions in atomic structure through three-tier diagnostic test. Misconceptions are inaccurate understandings held by students which often became obstacles in learning (Duit & Treagust, 2008). Students those who have misconceptions about atomic structure will have difficulty to understanding others chemical materials are related to atomic stucture. The study employ survey as a methodology which involved 138 pre-service chemistry teachers. The instrument used in this study was a 10 questions three-tier diagnostic test compiled by Treagust. Results showed pre-service teachers held misconceptions about atomic size (64,493%), particle of an atom and element (60,507%), atom in periodic table (73,9%), element symbol (41,66%). Based on findings it is recommended to implement teaching strategies and assesment that relate to material characteristics.

Keywords: pre-service teachers, misconceptions, atomic structure, diagnostic-test, three-tier

1. Introduction

Most of student in senior high school to university believe that chemistry is difficult subject (Reid, 2008; Cardelini, 2012 and Woldeamnuel *et al*, 2014). Chemistry are often considered as a difficult subject because students are requires to understand about macroscopic, sub-microscopic and symbolic (Johnstone, 1991). Chemistry also deals with abstract things (Kozma and Russel, 1997; Taber, 2013; Gilbert *et al.*, 2009) such as atomic structure, molecular interaction that's makes chemistry close to difficult subject (Johnstone, 2000). Chemistry also involves complex calculation that requires a strong of mathematical principles (Barbera, 2011). Besides that, chemistry is sometimes considered as a difficult subject caused by requires significant amount of information (Bodner, 1986), needs high level of problem solving (Taber, 2002; Ferguson; 2008) and demand laboratory skills (Hofstein *et al*, 2004). This explanantion is according to (Gabel, 1999, and Nakleh, 1992) opinion those state that chemistry is subject that hard to understand because of the abstract concept and has its own language (Johnstone & Cassels, 1978; Cassels & Johnstone, 1983; Byrne, Johnstone & Su, 1994).

These difficulties may cause students to have misconceptions. Misconceptions are unscientific concepts held by students (Ozmen, 2014; Bensley, 2015). Misconcep-

tions can also be interpreted as wrong beliefs obtained from everyday experience (Verkade *et al.*, 2018). In other words, misconceptions can also be interpreted as wrong beliefs caused by prior knowledge (Smith *et al.*, 1993). Misconceptions can be caused by many things such as abstract concepts of chemistry (Chang, 2004; Hutahaean *et al.*, 2024), learning strategies (Aikenhead, 2003) or the learning source used (Greenberg, 2009). Misconceptions that students already have will be difficult to eliminate (Smith, 1993). There is negative effect of misconception in learning activity such as student misconception led students to implement prior knowledge in wrong context (Chi, 2008; Carey 2009), students can't link their prior knowledge with new information (Vosnidaou, 2013) poor academic performance because chemistry requires basic conceptual ability correctly to answer a question (Taber, 2011), difficulty to achieve conceptual change (Posner, 1982). So, misconceptions have become an important concern in chemistry education.

The Quality of education can be determined by teacher's quality (Darling, 2000; Hanushek, 2010). Pre-service teachers will be chemistry teachers in future, therefore identifying misconceptions of chemistry pre-service teachers is important. Because it's related to their competence as a teacher. Firman (2013) states that assessment is one of stages of learning activity for collecting and analysis information for making decisions. Assessment that have been carried out usually use an objective test to ensure students learning outcomes and are lack to describe student's conceptual abilities as a whole.

Diagnostic test are essential tools that can be applied to diagnose misconception held by students (Treagust, 1988). Diagnostic test can leads teacher to select appropriate learning strategies that relate to chemistry concept characteristic (Driver and Easley, 1978). Atomic structure is one of fundamental topic it's linked to others chemistry topics. Atomic structure is one abstract topic in chemistry in this topic students often have a misconception. Two-tier and three-tier diagnostic test have been widely used in research to diagnose misconception held by students while learning chemistry (Chung *et al.*, 2003; Shaffer, 2005, Griffard and Wanderse, 2010, Rakhmalinda *et al.*, 2024; Treagust and Hadlam, 1987).

2. Method

This study was aimed to identify chemistry pre-service teacher's misconception by using three-tier diagnostic test instrument. The first tier explain about student's concept of atomic structure, the second tier explain about students reason and the last tiers explain student level of confidence. This study employed as a survey with 138 pre-service chemistry teachers dominated by first level and second level. Groves *et al.* (2009) said that survey is most common method to collect data from a variety subjects efficiently and effectively. Creswell (2014) emphasizes that surveys are useful to describe characteristic of population. The instrument were used was develop by Treagust, there are ten three-tier question. The instrument has been validated by the expert before it was administered.

3. Result and Discussion

Identifying misconceptions is first step towards minimalize and correct it in learning activities. There are a lot of variation to measure student has a correct concept or misconception, for example is ask their level of confident in their answer after fill each question given. Based of answer variety can be classified as below:

Table 1. The pattern of three-tier diagnostic test

Answer (1 ST Tier)	Reason (2 nd Tier)	Confidence (3 rd Tier)	Category
True	True	Sure	Scientific Concept
True	True	Unsure	Lucky Guess
True Wrong	Wrong True	Unsure Unsure	Guessing
Wrong	Wrong	Unsure	Lack of Knowledge
True Wrong Wrong	Wrong True Wrong	Sure Sure Sure	Misconception

Based on that category this study found a result as below:

Table.2 The Type of Answer on Each Question

No of Question	Category	Percentage
1	Scientific Knowledge	61,594%
2	Guessing	34,78%
3	Guessing	32,609%
4	Misconceptions	90,582%
5	Misconceptions	79,71%
6	Misconceptions	54,348%
7	Misconceptions	93,478%
8	Misconceptions	81,159%
9	Scientific Knowledge	97,826%
10	Scientific Knowledge	70,29%

Ten diagnostic three-tier instrument that given to responden categorized into four sub-topic of atomic structure, namely: atomic size (64,493%), particle of an atom and element (60,507%), atom in periodic table (73,9%), and element symbol (41,66%). From these findings students held a medium category of misconception on sub-topic of particle of an atom and element and element symbol. Whereas for atomic size and atom in periodic table student have a quite high level of misconceptions.

4. Conclusion

Based on the result of the study that had been done it could be concluded that 138 chemistry pre-service teachers had medium and high category misconception with the following percentages: 51,08% and 69,19%.

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