**Identification misconception of primary school teacher education students in changes of matters using a five-tier diagnostic test**

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**Abstract.** This research was conducted on third grade students (III) semester six, with sample number 84 respondents. The method used in this research is descriptive method. This article identifies the misconceptions of Primary School Teacher Education students by using a five tier diagnostic test research instrument, a question adapted to three chemical representations accompanied by an open reason and a level of confidence in the choice of answers. The categorization of the five tier diagnostic test scoring is divided into four namely, understand the concept, lack of concept, misconception and not understand the concept. Questionnaire in the form of a closed questionnaire is used to determine the factors that cause misconception. The data obtained is misconception has the highest percentage on the concept of substance properties and changes in its form. The highest incidence of misconceptions is due to self-factors. The conclusion is that five tier diagnostic tests can be used to uncover misconceptions of elementary school teachers and assist teachers in presenting lesson material tailored to the chemical representation so that students can understand the concept of the nature of matter and change its form well.

**1. Introduction**

Material particle theory is the foundation stone of the frame of mind in some curriculum of science education that begins at the start of elementary school until the various stages of the next school [1] [2]. Because of the importance of particle theory of the scholars, science education researchers, and teachers will agree that the particulate nature of matter is a major topic in chemistry and the main subject in the science curriculum of elementary, high school, college and college. Researchers have concluded that particulate matter is very important for students to understand the physical life and earth sciences [3] [4]. In particular, it is important for some chemical concepts such as material structure and phase change [5]. Students have difficulty understanding the concept of change of being that is abstract (symbolic). The main barrier to understanding chemistry, however, is the absence of three levels representing matter,
it is that chemical instruction occurs primarily at the most abstract level, the symbolic level [6]. In addition, the literature shows that after understanding the nature of particulate matter, the student is able to pass on the structural material understanding of the material and uses it to describe and explain the characteristics of the various forms of material change and its phases [7].

Quality science education is influenced by the five domains of concept comprehension, process skills, creativity, attitude development and the use of concepts in everyday life [8]. Two of the five domains are closely related to the concept, so it can be seen that conceptual understanding is very important in science education. Before understanding, students will form the concept first. The concept is the basic building blocks where people organize thoughts and communications around them [9].

The concept is an abstract that represents a class of objects of events, activities-activities or relationships that have the same attributes [10]. The concept is a label of objects, symbols or events that have common characteristics or critical attributes. A concept is a mental builder or a representation of a category that allows one to identify an example and not an example [11]. The concept is an object, events, situations, or properties that processes common critical attributes and are designated in some given culture by some accept sign or symbol [12] [13]. Based on the description can be concluded that the concept is a piece of information that has the same characteristics.

The main requirement to learn concepts is the ability to distinguish one concept from another. The ability to distinguish is a prerequisite for learning the concept. The concept will be meaningful if the concept contains information related to other concepts [13]. An understanding of concepts has a very important role for everyone. Understanding the concept is always associated with the purpose of education in the curriculum at every level of education. Understanding the concept of particulate matter and its phase of change is one of the concepts that must be possessed by a teacher and prospective teacher.

The mastery of concepts is the ability that allows a person to do something. This can be interpreted that without mastering certain concepts, people cannot do much and their survival will be disrupted. On the contrary, the mastery of a broad and profound concept such as that of a particular expert, enables a person to exercise her mastery in a variety of purposes [13].

Students can get the concept in two ways: concept formation and concept assimilation [14]. The formation of concepts can be obtained by students before entering school while concept assimilation is obtained during and after school. Students have preconceptions before accepting classroom learning so that it will be unified with the knowledge that students get in the classroom. Students' preconceptions are more easily revamped and the preconceived perceptions will be lost when students are taught the real concept and in accordance with the understanding that scientists have and believe. One of the first sources of difficulty in science learning is due to misconceptions and the notion that science is difficult. For many students, chemistry is seen as a difficult, complex and abstract subject that requires special intellectual talent and too much effort to be understood [15] [16] [17].

In studying chemistry there are three representations that must be mastered by prospective teachers. Based on its characteristics, chemical representations are classified into three levels namely, macroscopic, submicroscopic and symbolic representations [17]. Students find it difficult to understand the concept of change in the form of an abstract (symbolic). The main barrier to understanding chemistry is the absence of three levels of representing the matter, chemical instruction occurs primarily at the most abstract level, the symbolic level [16].

Misconceptions are conceptions possessed by someone who is distinctly different and often contradictory to a scientific conception. Misconceptions tend to be resistant or difficult to change and tend to survive [13]. Misconceptions are resisters to change, persistent, well embedded in an individual's cognitive ecology, and difficult to extinguish even with the instruction designed to address them [18] [19]. Misconceptions can occur if the process of assimilating prior knowledge before acquiring learning with knowledge acquired by students in the classroom cannot be incorporated. Misconceptions are often reinforced by a reasonably strong student frame of mind that is difficult to change and difficult to fix. Some of children’s early intuitions about the world can be used as a
foundation to build remarkable understanding, even in the earliest grades. Indeed, both building on and refining prior conceptions (which can include misconceptions) is important in teaching science at any grade level [19].

Different ways can be used to identify misconceptions among students such as using concept maps, multiple choice tests, CRI (certainly of response index), and true and false tests. Concept maps can reveal misconceptions, incorrect concepts will be seen because of one conceptual relationship with others give rise to false propositions. The multiple choice test is only capable of detecting that a person is experiencing an error or not to a concept. The correct test is wrong with rectification to identify the misconceptions of student concepts and can be used to identify a cause of misconception, the weakness of this test is the possibility of students trying to avoid writing correction, so that students justify the statement in the matter. The instrument usually consists of two parts, the question of concepts and statements to determine the quality or certainty of response given when answering concept questions [13].

2. Methods

This research uses descriptive method because it wants to get a general description of misconception that occurred in the elementary school teacher education students in the concept of the nature of substances and changes in its form. This research was conducted for 4 months, starting from February until May 2017. The research started by preparing proposal, composing instrument in the form of test and non-test, judgment instrument by expert and doing research to student of Elementary School Teacher Education.

2.1. Sample

The population in this study is all students of Primary School Teacher Education one of the state universities in West Java, with a sample of 3rd level students of 84 students. Sampling by way of purposive sample that is sample aims with characteristic of sample of student of level 3 who have received subject of deepening of IPA Material.

2.2. Instrument

Technique of data collection has been done by using instrument in the form of written test. The test used is a five tier diagnostic test, which is a multiple choice test and an open reason with three confidence levels, confident, doubtful and uncertain. The aims of a level of confidence to identify student misconceptions on the concept of the nature of matter and its change of being. Students' answers are categorized into four categories (a) understand: respondents answer questions incorrect by the answers, (b) partly understand: respondents answer questions correctly, but do not include all the components, (c) misconception: respondents answer questions with answers that are not logical with the wrong information, (d) do not understand: respondents answer questions with the wrong answer or no answer at all. The criteria for selecting the instrument used in this study are (a) the instrument must be justified by the expert, (b) the instrument must be suitable for use in the IPA domain adapted to three chemical representations: macroscopic, submicroscopic and symbolic, and (c) uncovering misconceptions accompanied by reason and level of confidence in answering questions.

3. Results and Discussion

3.1. Result of Recapitulation of Calculation Based on Problem Indicator

Table 1 shows that the average of all questions presented based on the question indicator, misconception contributes the highest value. This proves that students of Elementary School Teacher Education have high misconception. For more details are presented in Table 1.
Table 1. Results Calculation Recapitulation Based on Problem Indicator

| Indicators Problem                                                                 | Understanding Concepts | Partly Understand | Misconceptions | Do not Understand Concepts |
|-----------------------------------------------------------------------------------|-----------------------|-------------------|----------------|---------------------------|
| 1. Identify Solid Properties                                                      | 15.5%                 | 36.9%             | 40.5%          | 7.1%                      |
| 2. Identify Liquid Properties                                                     | 10.7%                 | 42.9%             | 46.4%          | 0%                        |
| 3. Identify Gas Properties                                                        | 7.1%                  | 41.7%             | 47.6%          | 3.6%                      |
| 4. Identifying Properties of Liquid and Gas Solid Substances When Heated          | 4.8%                  | 28.6%             | 29.8%          | 36.9%                     |
| 5. Understanding the Process of Shifting Solid Being Gas (Sublimating)            | 1.2%                  | 59.5%             | 31%            | 8.3%                      |
| 6. Understanding the Process of Changing Gas Being Solid (Deposition)             | 0%                    | 41.7%             | 41.7%          | 16.7%                     |
| 7. Understanding the Process of Changing Liquid Being Solid (Freezing)            | 0%                    | 39.3%             | 60.7%          | 0%                        |
| 8. Understanding the Change of Solid Being Liquid (Melt)                          | 2.4%                  | 35.7%             | 61.9%          | 0%                        |
| 9. Understanding the Process of Changing Gas Being Liquid (Condensing)            | 0%                    | 32.1%             | 64.3%          | 3.6%                      |
| 10. Understanding the Process of Changing Liquid Being Gas (Evaporation)          | 3.6%                  | 36.9%             | 59.5%          | 0%                        |

Average Percentage 4.5% 39.5% 48.3% 7.6%

Misconceptions tend to be resistant or difficult to change and tend to persist. Misconceptions are resistant to change, persistent, well embedded in an individual’s cognitive ecology, and difficult to extinguish even with the instruction designed to address them [20] [21]. Misconceptions can occur if the process of assimilating prior knowledge before acquiring learning with knowledge acquired by students in the classroom cannot be incorporated. Misconceptions are often reinforced by a reasonably strong student frame of mind that is difficult to change and difficult to fix. Next Generation Science Standards also refers to student ideas in precisely this way: “Some of the children's early intuitions about the world can be used as a foundation to build remarkable understanding, even in the earliest grades”. Indeed, both building on and refining prior conceptions (which can include misconceptions) is important in teaching science at any grade level [22] [23].

More than 40% of elementary school teacher education students have misconception on the concept of solid, liquid and gas properties. In the science history was known that separated by particle-free spaces [23]. Only after discovery of vacuum, the concept of the discontinuous nature of the matter can be accepted by the scientific community. The lack of time to introduce the concept of misconceptions related to particle concepts [24] [25] [26]. Misconceptions also arise when students are in the stage of combining new learning concepts (plants make their own food) with old known concept (plants get food from the soil). Situations like these can create conceptual conflict in the minds of students [27]. This happens because the preconceptions of the students are not in accordance with accepted scientific concepts. Misconceptions are conceptions possessed by someone who is distinctly different and often contradictory to a scientific conception [13].
Less understanding of concepts in science learning will lead to future difficulties because the concept is the basic framework where people organize thoughts and communications around them [9]. The mastery of concepts is the ability that allows a person to do something [13]. This can be interpreted that without mastering certain concepts, people cannot do much and their survival will be disrupted. On the contrary, the mastery of a broad and profound concept such as that of a particular expert, enables a person to exercise his / her mastery in a variety of purposes.

3.2. Factors of Misconceptions

The results showed that the highest cause of misconceptions is self. Misconceptions are difficult to change and tend to survive so the cause of the ultimate misconception lies with oneself.

![Figure 1. Factors of Misconceptions Student Teachers Program Primary School](image)

Many teachers, it may be that one of them does not understand the concept well that will give to his students. This may make the student misconception if the mistake of poor teacher understanding is passed on to the student. Many concepts in biology are interconnected and this is the key to understanding other concepts [27]. Learning process is believed by cognitive experts as a process that is influenced by the concept and is believed to be existing and owned students [28]. Therefore, not only losing integration in the topic but also the presentation of the less fit topics in textbooks affects further understanding of the students.

4. Conclusion

More than half of the respondents have misconceptions on the concept of substance properties and changes in shape, the highest misconceptions occur in the sub-concept of the nature of the gas substance and the change of the form from the gas to liquid (condensing). The five tier diagnostic test instrument can reveal the misconceptions experienced by Primary School Teacher Program students on the concept of substance properties and changes in the form of substances. Misconceptions occur in every sub-concept of nature and change of substance. Factors causing misconceptions are the concepts studied, the material being studied, the teacher, the source book and oneself. Based on the results of the calculation of the questionnaire then obtained the highest cause factor misconception in the student is due to self. The results of research indicate that the need of learning and teaching science with better quality. Good teaching based on three chemical representations sequentially starting from the macroscopic, submicroscopic and symbolic levels of the Primary School Teacher Program students.
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