The Analysis of Basic Chemistry Mastery of Students of Prospective Chemistry Teacher of State University Makassar (Study on Chemical Bonding)

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Abstract. This research is a descriptive study that aims to analyze the mastery of basic chemistry of prospective chemistry teacher students on chemical bonding. The Subjects were students of Chemistry Study Program, State University of Makassar that enrolled in 2016 that consisted of ICP (International Class Program) and non-ICP Program. The instrument used is Three-Tier multiple-choice test of chemical bonds that consist of 20 items. The average percentage of ICP students who understand, lacked understand, and misconceptions for all indicators are: 47.00, 21.5, and 31.5, respectively while for non-ICP students are 43.90, 25.20, and 30.90 respectively.

1. Introduction
The success of education is determined by the quality of teachers. The role of teachers is very important in determining the quality of education. This can be seen from [1]: ”The teacher is the single most important factor affecting student learning at all classroom levels”. Many factors influence the success of education, but the teacher is a very big key factor role [2]. The same thing is stated by [3], which states teachers are the most decisive instrument of successful learning. In addition, according to him, the most important competence of teachers is professional competence, especially the mastery of subject matter. Subject matter is one of three dimensions of professional knowledge of teachers [4]. Other dimensions are pedagogical content knowledge and curriculum knowledge. Subject matter consists of concepts and relations of construction through professional inquiry in science and scientific inquiry process. The are correlation between teacher’s mastery of subject matter with the teaching competences [5]

One of the difficulties experienced by chemistry teachers is the difficulty of mastery of subject matter [6]. One of the courses that must be followed by chemistry education students is basic chemistry basic. The amount of material in the basic chemistry lectures is overwhelming and the lecture time is limited. This course is presented in the first semester. Basic chemistry courses have a very fundamental role because it is the basis for other lectures in the Chemistry Department.

There are two programs in Chemistry Education Program of Makassar State University of Indonesia that are International Class Program (ICP) and non-ICP program. The language used in learning in the ICP Program is English and Bahasa Indonesia. The language used in non-ICP programs is Bahasa Indonesia. One of the topics studied in basic chemistry is chemical bonding. This topic is very important because it is a central part in studying chemistry. It is therefore interesting to analyze basic chemical capabilities in both programs. The results of the analysis can be used as a reflection for the improvement of learning especially for the development of learning devices.
2. Research Methodology

This research is a descriptive research that aims to analyze the mastery of basic chemistry of students of Chemistry Education Program of Mathematics and Natural Science Faculty of Makassar State University of Indonesia. Subjects in this study are students of class of 2016 consisting of 32 students ICP and 34 non-ICP students. The instrument used in this study is a basic chemistry mastering test consisting of 20 multiple-choice items of Three-Tier Test for the subject matter of chemical bonding. The test has been validated by chemistry education experts.

The data has been collected and then analyzed descriptively for the types of student mastery. To categorize the type of student school chemical mastery obtained from the Three-Tier multiple choice test used Table 1.

| Step 1 | Step 2 | Step 3 | Category         |
|--------|--------|--------|-----------------|
| 1      | True   | Sure   | Understand      |
| 2      | True   | Not Sure | Lacked Understand |
| 3      | True   | Sure   | Misconcepsy     |
| 4      | True   | Not Sure | Lacked Understand |
| 5      | Falls  | True   | Misconcepsy     |
| 6      | Falls  | True   | Lacked Understand |
| 7      | Falls  | True   | Misconcepsy     |
| 8      | Falls  | Not Sure | Lacked Understand |

3. Result and Discussion

Results obtained from the Three-Tier Multiple Choice Test for chemical bonding can be seen in Table 2. The Three-Tier multiple choice test of the subject matter of chemical bonding is based on eight indicators: (1) Explain the tendency of an element to achieve its stability, (2) To describe the valence electron arrangement of noble gas atoms (duplet and octets) and valence electrons instead of noble gases (Lewis structure). (3) Explain the process of ion bonding formation (4) Explain the process of formation of single, double, and triple covalent bonding, (5) Describe the properties of ionic compounds and the properties of covalent compounds, (6) Explain the process of the formation of coordination covalent bonding of some compounds, (7) investigating the polarity of some compounds and their relation to electronegativity, (8) Explaining the process of forming metal bonding and their relation to the physical properties of the metal.

| Indicator | ICP Students (%) | Non ICP Students (%) | Average |
|-----------|------------------|----------------------|---------|
|           | U     | LU    | M   | U    | LU   | M   | U    | LU   | M   | U    | LU   | M   | U    | LU   | M   | U    | LU   | M   |
| 1         | 69.36 | 9.79  | 20.85 | 66.67 | 13.33 | 20.00 | 68.02 | 11.56 | 20.43 |
| 2         | 71.28 | 10.64 | 18.09 | 74.07 | 7.41  | 18.52 | 72.68 | 9.03  | 18.31 |
| 3         | 69.50 | 9.93  | 20.57 | 59.26 | 17.28 | 23.46 | 64.38 | 13.61 | 22.02 |
| 4         | 59.57 | 9.93  | 30.50 | 30.86 | 20.99 | 48.15 | 45.22 | 15.46 | 39.33 |
| 5         | 44.68 | 38.30 | 17.02 | 33.33 | 44.44 | 22.22 | 39.01 | 41.37 | 19.62 |
| 6         | 25.53 | 24.47 | 50.00 | 27.78 | 24.07 | 48.15 | 26.66 | 24.27 | 49.08 |
| 7         | 17.02 | 36.17 | 46.81 | 24.07 | 31.48 | 44.44 | 20.55 | 33.83 | 45.63 |
| 8         | 19.15 | 32.98 | 47.87 | 35.19 | 42.59 | 22.22 | 27.17 | 37.79 | 35.05 |
| Average   | 47.25 | 21.5  | 31.5  | 43.90 | 25.20 | 30.90 | 45.45 | 23.35 | 31.20 |

Table 2. Result of the Three-Tier Multiple Choice Test for chemical bonding of Students
U: understand  
LU: lacked understand  
M: Misconcepsy

The highest understanding of ICP students is on the second learning indicator, namely: describing the valence electron arrangement of noble gas atoms (duplet and octets) and valence electrons instead of noble gases (Lewis structure). The lowest understanding is on the seventh indicator of learning, namely: investigate the polarity of some compounds and their relation to electronegativity. For indicators that are lacked understood by ICP students is the fifth learning indicator, namely: explain the properties of ionic compounds and the properties of covalent compounds. The most misconceptive indicator by ICP students is on the sixth learning indicator, which is: explain the process of covalent coordination formation in some compounds.

The highest understanding of non ICP students is the same as ICP students, on the second indicator of learning: describing the valence electron arrangement of noble gas atoms (duplet and octet) and valence electrons instead of noble gases (Lewis structure). The lowest understanding is also on the seventh indicator of learning, namely: Investigate the polarity of some compounds and their relation to electronegativity. For indicators that are lacked understood by non ICP students are also the same as ICP students is the fifth learning indicator, namely: explain the properties of ionic compounds and the properties of covalent compounds. The most misconceptive indicator by non ICP students is on the fourth and sixth learning indicators, namely: explain the process of forming single, double, and triple covalent bonds and explain the process of covalent coordination formation in some compounds. The average percentage of ICP students who understand, lacked understand, and misconcepcy for all indicators are 47.0, 21.5, and 31.5. The average percentage of non-ICP students who are understand, lacked understand, and misconceptions for all indicators are 43.90, 25.20, and 30.90. Overall ICP and non-ICP students, the average percentage of students who understand, lacked understanding, and misconceptions were 45.45, 23.35, and 31.20, respectively.

From this data, it can be seen that for the chemical bonding, the percentage of students who understand is still low therefore it is advisable to better equip students about chemical bonding learning. The misconception on chemistry learning is not only in prospective chemistry teacher but also in high school students. There are various misconceptions on the chemistry of high school students [7,8]. Other studies at the twelfth grade high school conducted in Oman also show some misconceptions [9]. In pre-service science teachers' found several misconceptions and misconceptions unrelated to their attitudes [10]. The less understanding also put forward by [11] which states students have difficulty in naming the compound. Misconceptions and poor understanding by prospective students and prospective teachers indicate that learning chemistry in schools and universities needs to be continuously improved. If the students' basic chemistry understanding is good then they will more easily understand other part of chemistry.

4. Conclusion and Suggestion

From the results of analysts that have been done can be seen that for chemical bonding, the average percentage of ICP students who understand, lack understand, and misconception for all indicators are 47.0, 21.5, and 31.5 while for non-ICP students are 43.90, 25.20, and 30.90. The average percentage of students who understand, lack understanding, and misconceptions are 45.45, 23.35, and 31.20. Because the students' understanding is still low, it is suggested to the lecturer of basic chemistry course to develop their learning especially in the making of intruction tools. Further research needed to fine misconception of prospective chemistry teacher in other topyes of basic chemistry.

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