The student metacognitive skills and achievement in chemistry learning: correlation study

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Abstract. The purpose of this correlation research was to determine the correlation between student metacognitive skills and student achievement. The sample consisted of 180 students grade 10 from all students of class X Senior High School 1 Kasihan. Saturated sampling technique was used to determine the sample used. Metacognitive Awareness Inventory (MAI) questionnaire was used to measure the level of student metacognitive skills. MAI questionnaire consisted of 18 statements with a 5 point Likert scale that ranging from “strongly agree” to “strongly disagree”. The student achievement was measured using the achievement test instruments on ionic bonds and covalent bonds learning. The data were analyzed by using product moment correlation. Result of research indicated that there was very low correlation between metacognitive skills and student achievement. The correlation between student metacognitive skills and student achievement was positive and significant. In other words, if the metacognitive skill is high, then the student achievement are also high.

1. Introduction

Chemistry learning plays a central role in science and often entwined with other branches of science like biology and physics. Because of chemistry topics are closely related to structure of matter, many students regarded the chemistry learning abstract and difficult to understand [1,2,3]. The chemical bonds are being part of abstract chemical matter [11]. The concept of chemical bonds related to other chemical topics, such as chemical equilibrium. The student incompetence in chemistry learning is caused by their difficulties in problem solving. Students are often confuse in solving abstract topics. Another student incompetence in chemistry learning also related to aspect intelligibility, such as teacher did not ask students’ reasons, this causes their thinking skills to be reduced [1].

The metacognitive skills are one of the thinking skills that needed by students in problem solving [15]. There are many studies discussed about student metacognitive skills. The result of the study showed that problem based learning affected the metacognitive skills and could train learners to develop their reasoning skills in solving problems [7]. The metacognitive skills can also deliver learners to control their learning activities, and then they can learn about chemistry problem solving. The students who have metacognitive skill indicate their ability to think about ideas explicitly and understand chemistry concepts well [8].

The metacognition is divided into two components: metacognitive knowledge and metacognitive regulation. The metacognitive regulation related to control the learning activities that control people’s
thinking and learning [6]. There are five sub-components of metacognitive regulation: planning, information management, monitoring, debugging and evaluation. Planning refers to plan or select strategies that used before learning takes place. Information management refers to skills and strategies to process the information. Monitoring refers to awareness of progress in learning. Debugging refers to strategies used to correct comprehension and performance errors. And evaluation refers to take a look at the outcome and determining if the learning outcome matches our learning goals and effective [6]. A good metacognitive skills will produce a good achievement in learning.

The academic achievement is a feedback from teaching and learning activities and demonstrated at the end of a period of learning. An achievement is obtained by students in the learning process can be poured with numbers and in the application of daily life to the knowledge gained. High or low achievement indicate the success of the teacher in delivering the subject matter in the learning process. There are many factors that influence the good learning achievement in the school. A study indicated that the motivation in learning activities will affect student achievement. The cognitive value of learning achievement in the two different subjects classified as very well [9,10]. Despite the importance of student motivation, other personal variables such as attitudes should also be considered to improve in academic achievement [11]. The importance of teacher and student relationship will make student achievement be more effective. Between teacher and student should be supportive and positive in learning process [12]. Research results of Ikwuka and Samuel obtained that the teachers instructional strategies for teaching such as using computer animation in learning abstract chemistry concept will increase students understanding of the concepts [13]. This strategy will help student to increase their academic achievement and enhance the effective learning.

Various studies have been conducted to investigate student achievement of several different variables. However, in general, research only focuses on increasing motivation and chemical concepts. So in this case the researcher wants to examine the correlation between students’ metacognition skills and student achievement.

2. Methods
The research type of this study is a correlation study. The population were all students of class X science in SMAN 1 Kasihan which consisted of 6 classes with 180 students. The research sample was determined using saturated sampling technique.

The metacognitive skills measured through Metacognitive Awareness Inventory (MAI) questionnaire. The MAI consists of 18 statements which participant’s rate on a 5-point (range from “strongly agree” to “strongly disagree”) Likert scale. In this study, metacognitive skills were classified into 3 subcomponents subsumed under two broader categories, knowledge of cognition and regulation of cognition. The 3 subcomponents are conditional, planning and evaluation. The scores for subcomponents were calculated by adding the scores on statements related to each sub-component.

3. Results and Discussion
The result of the correlation test between student’s metacognition skills and student’s achievement used to analyse the relationship between metacognition skills and learning outcomes. Through the test, the correlation between sub-components of metacognitive skills which consists of conditional knowledge, planning and evaluation and the student achievement can be known. The results of the correlation test between metacognitive skill and student achievement obtained by using Tinn-R application. The correlations on the conditional knowledge sub-component are presented in Figure 1 below.
Based on the figure 1, the dots describe the distribution of the data between student achievement and metacognitive skills (conditional). Closer distribution of dots to the line the correlation between student achievement and metacognitive skill will be stronger. Based on the figure 1, it can be concluded the many of data contributions that not approach the line. In indicated that the correlation between conditional and student achievement included in very low category. The magnitude of the correlation value can be seen in the Table 1 as follow.

| Indicator           | Df  | p-value | Correlation coefficient |
|---------------------|-----|---------|-------------------------|
| Conditional knowledge | 179 | 0.307   | 0.0759                  |

The table 1 means that there was a positive correlation between the conditional knowledge and student achievement. The relationship between conditional knowledge and student achievement was significant, but included in very low category. The results of the correlation test between metacognitive skill and student achievement on planning aspect are presented in Figure 2 below.

![Figure 1. Correlation between conditional and student achievement](image1)

**Figure 1.** Correlation between conditional and student achievement

![Figure 2. Correlation between planning and student achievement](image2)

**Figure 2.** Correlation between planning and student achievement
Based on the figure 2, it can be concluded that the data contributions not approach the line. It is indicated that the correlations between planning and student achievement included in very low category. The magnitude of the correlation value can be seen in the Table 2 below.

**Table 2. The Correlations Test between Planning and Student achievement**

| Indicator  | Df | p-value | Correlation coefficient |
|------------|----|---------|-------------------------|
| Planning   | 179| 0.848   | 0.0144                  |

The Table 2 showed that there is a positive correlation between the planning aspect and student achievement. The relationship between the component of planning aspect and student achievement was significant, but included in very low category. The results of the correlation tests between metacognitive skill and student achievement on evaluation aspect are presented in Figure 3 below.

**Figure 3. Correlation between evaluation and student achievement**

Based on the figure 3, it can be concluded that the many of data contributions that not approach the line. Indicated that the correlation between evaluation and student achievement included in very low category. The magnitude of the correlation values can be seen in the Table 3 below.

**Table 3. Correlation Test between Evaluation and Student achievement**

| Indicator | Df     | p-value  | Correlation coefficient |
|-----------|--------|----------|-------------------------|
| Evaluation| 179    | 0.0256   | 0.1725                  |

The table 3 showed that there is a positive correlation between evaluation aspect and student achievement. The relationship between the component of evaluation aspect and student achievement was significant, but included in low category. And the highest correlation was obtained by evaluation aspect followed by conditional and planning.

Related to the low correlation showed in this study might be caused by student metacognitive skills that still not fully adequate to regulate their cognitive skills and realize their weaknesses so that the expected student achievement are not successful. Metacognitive abilities of students must be continuously practiced in learning process. There is one way to become better at metacognition is to practice it. Metacognitive skills developed learning process to be more meaningful, effective, and students can develop their thinking skills in learning [14].
Sen indicated that student metacognitive skills and self-efficacy beliefs were indirectly and positively correlated with their achievements [15]. Students who had high self-efficacy and metacognition will make themselves better to achieve their expected. The component of cognition planning arrangements included in setting goal, activating the relevant resources, and selecting the appropriate strategies [13]. In the previous study, it was found that chemistry education students with a low level in solving problem employed planning skill to identify a problem, to determine a goal, and to compile strategy [17].

The development of metacognition occurs in the same manner as intelligence with children who learning more about themselves, strategies and tasks, as they get older. It is not an automatic process but a result of long-term development of the cognitive system and as both a product and producer of cognitive development. Although we know that as children get older they gradually develop more metacognitive knowledge, we know a little about how this knowledge is acquired. The metacognitive knowledge related to what people know about their cognition, how they used procedures or strategies, and why or when to use that strategies. The metacognitive knowledge is needed for cognitive people with many tasks, goals, experiences and activities. [18].

A study by Schraw stated that metacognition is a key for individual to organize their cognitive skills and specify their weaknesses and develop them into the new cognitive skills and then the learning can be more effective. In the classroom practice, measuring student metacognitive skills can help teachers to find out how well students can learn science in order that the teachers are able to support students to improve their abilities. In addition, this metacognitive skill can lead students to be more knowledgeable of their own cognition, can make students to think more about their own learning, and finally help students to take responsibility for their own learning. This study was the first step in trying to understand student’s metacognitive knowledge in chemistry classroom. The further research should be extended to metacognitive control which focuses on how students regulate their own learning.

4. Conclusion
It can be concluded that there is a positive correlation between metacognitive skills and student achievement on ionic bond and covalent bond material. The relationship between metacognitive skills and student’s achievement significant are included in low category. The implication of this study is the metacognition skills of students must be continuously practiced so the students can use their thinking process to achieve the student achievement.

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