THE RELATIONSHIP BETWEEN STUDENTS' METACOGNITIVE KNOWLEDGE AND METACOGNITIVE AWARENESS IN CHEMISTRY

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Abstract. *The 2013 curriculum requires students to demonstrate metacognitive proficiency. The alignment of knowledge and metacognitive awareness can assist students in achieving the learning objectives in the national curriculum. This study aimed to ascertain whether there was a correlation between metacognitive knowledge and metacognitive awareness among students. This study employed a correlational design research methodology. The instruments used to gather data including a set of 5 questions involved in testing students' metacognitive knowledge. Meanwhile, The Metacognition Awareness Inventory (MAI) which comprised of 52 items was employed to assess metacognitive awareness. The correlation between metacognitive knowledge and awareness can be measured using the Product Moment correlation coefficient. The findings of this study indicated that there was a positive correlation between metacognitive knowledge and awareness yet it was relatively low (0.110).*

Keywords: *metacognitive awareness, metacognitive knowledge, chemistry*

INTRODUCTION

Chemistry subject consists of abstract concepts which requires higher metacognitive competence of individuals to master it. Metacognitive knowledge can be defined as knowledge about cognition in general, awareness of something and knowledge about one's own cognition. Metacognitive knowledge refers to how a person acquires knowledge about cognitive processes, or in the similar meaning is knowledge that can be used to control their cognitive processe. While metacognitive awareness is the result of their steps and stages of thinking so far in solving the problems they face (regulation) [1].

Metacognitive knowledge consists of declarative knowledge that can determine the state of one's beliefs about what is learned; procedural knowledge which illustrates how the knowledge is processed and how it helps someone achieve the learning goals; and conditional knowledge which directs someone to identify the appropriate time and reasoning of knowledge used. In line with this, procedural knowledge can also be defined as knowledge about the procedure taken to solve problems [2]. Finally, students recognize the knowledge used in organizing procedures flexibly, accurately, and efficiently from the beginning untill the end of the process of thinking. Procedural knowledge emphasizes on how the sequence of stages and concept applied during problems solving activities [3].

Metacognitive knowledge encompasses strategic knowledge; knowledge of cognitive processes, including contextual and conditional knowledge and self-knowledge [4]. Students who have low metacognitive knowledge abilities can optimize declarative knowledge well, but might have not been able to optimize procedural and conditional knowledge [5]. Furthermore, there is a clear concept declares that conditional knowledge is less complex than procedural knowledge, and procedural knowledge is easier to acquire than declarative knowledge [6].

Metacognitive awareness enables students to establish connections between chemical concepts and to apply these concepts in solving problems. Metacognitive awareness is needed to help students reflect on what they have or have not mastered in chemistry, so that they can

further regulate themselves in the upcoming learning process. It is believed that chemistry problems can be solved with metacognitive involvement [7]. Relevant with this idea, it is expected that students who have adequate metacognitive awareness level are also great learners and have ample knowledge, which resulted in the improvement of their learning outcomes. Metacognitive awareness is characterized by several indicators, namely: planning, information processing strategies, monitoring of understanding, improvement strategies and evaluations need to be carried out. These competences reflected the inseparatable enterprise between the knowledge they have in cognitive structure and the metacognitive awareness of the knowledge itself [8].

A significant enhancement in the area of metacognitive capabilities as a results of educational process, affecting not only the individual but also the educational institution and wider society [9]. The 2013 national curriculum identifies metacognitive knowledge as a key component for students to attain a more advanced levels of cognitive development. Therefore, learning strategies should focus on the achievement of students' metacognitive competences. Students with higher metacognitive competences can overcome problems in both classroom and daily life contexts [10].

Therefore, students need to have good understanding about the properties of metacognitive knowledge and awareness which will further assist them to shape the appropriate caharacters themselves. The purpose of this study was to determine the nature of the relationship between metacognitive knowledge and metacognitive awareness among students in chemistry classroom.

METHOD

This research was conducted in one of the public high schools in South Jakarta in the academic year 2017/2018, from November 2017 to January 2018. In this research, correlational research method design was used. Correlational research aims to determine the relationship between one variable and other variables [11], that is students' metacognitive knowledge and awareness.

The population in this study were students of class XII Science. Sampling was done using purposive sampling technique with a total of 68 students.

The instruments used for data collection were 5 written-test questions and The Metacognition Awareness Inventory (MAI) questionnaires. The metacognitive knowledge interument test was developed by Rompayom, et.al [12] and the metacognitive awareness questionnaire was adapted from Schraw and Denisson [13].

The adapted MAI questionnaire was content and construct-validated prior use by two expert lecturers. Data resulted from the empirical validation was analysed using SPSS version 22.0. The reliability of the instrument was also analysed using the Pearson product moment correlation technique.

The research data were categorized into two types of dataset, the independent variable (metacognitive knowledge) and the dependent variable (metacognitive awareness). Normality, homogeneity, and linearity tests of population were identified using SPSS version 22.0. The hypothesis testing was carried out using the product moment correlation test to investigate the relationship between these two variables [11].

RESULTS AND DISCUSSION

The research results are presented as follows.

Normality Test

The results of the normality test of metacognitive knowledge and metacognitive awareness data are shown in Table 1.

Table 1 Results of the Normality Test of Metacognitive Knowledge and Metacognitive Awareness Data Score

Data		Kolmogorov-Smirnov
	α	Sig.
Metacognitive Knowledge	0.05	0.135
Metacognitive Awareness		0.100

According to table 1, we can see that statistical analysis results of both metacognitive knowledge and awareness have a Sig. value >

0.05. which showed that the score of both variables were normally distributed in the population.

Homogeneity Test

The homogeneity test used the *Levene Statistics* test. The results of the homogeneity test of each variable are shown in Table 2.

Table 2. Results of Homogeneity Test

Variable	A	Sig.
Metacognitive Knowledge	0.05	0.981
Metacognitive Awareness	0.05	0.960

Table 2 shows that Sig. of the Levene's test results of both metacognitive knowledge and metacognitive awareness were greater than 0.05. Thus, it can be said that the data is homogeneous.

Linearity Test

The linearity test used *Deviation of Linearity* through SPSS version 22.0 program. The results of the linearity test show that the Sig. value of metacognitive knowledge along wtih metacognitive awareness was 0.888 (>0.05). Thus, it can be said that there was a linear mathematical relationship between two variables.

Hypothesis Test

The results of the Pearson correlation test can be seen in Table 3.

Table 3 Results of the Hypothesis Test of Metacognitive Knowledge with Metacognitive Awareness

Data	Statistics	
	M. Knowledge	M.Awareness
Correlation coefficient	0.110	0.110
p-value (2-tailed)	0.926	0.926

Table 3 shows that the correlation coefficient of the two variables was 0.110, indicating a very weak relationship.

Based on the calculation of the product moment correlation coefficient, a coefficient of determination of 1.21% was obtained. This shows that metacognitive knowledge contributed to the metacognitive awareness. Yet, there are other factors that needs to be further considered, including level of students' academic intelligence, special talents, language skills, imagination skill, and learning style.

Discussion

Data analysis identified that metacognitive knowledge was weakly correlated with metacognitive awareness. This finding showed a contradictary idea towards prrevious study result which mentioned that metacognitive knowledge did not play a crucial role in both problem solving and the development of metacognitive awareness [14].

Students with better metacognitive knowledge tend to have a higher metacognitive awareness level, and vice versa [15]. So it is also reccommended that if teachers are about to improve students' metacognitive knowledge, they should work on steps to develop students' metacognitive awareness first [16]. Students with a low level of metacognitive knowledge tend to find difficulties in achievening a higher level of cognitive awareness. This will be reflected in their struggling to find the best strategies and methods in problem solving process. In addition, prior research emphasized that students with a higher level of metacognitive awareness were able to use more relevant strategies in dealing with daily-life situations [17]. In average, students who scored better in the Metacognitive Awareness test showed a better problem solving skills respectively [18].

Most students were not able to find a relationship between the strategies they used in problem solving activities and the skills they gained. This is because they did not master learning strategy related with a better metacognitive awareness to solve metacognitive knowledge problems. Meanwhile, the ability to solve problems was not only determined by the accuracy of the solutions obtained, but also by students' competences to identify the problem, to find relevant alternative strategies and to evaluate

the problem solving procedures and results [19].

The integration of metacognitive knowledge and metacognitive awareness in problem solving procedures were closely related to their cognitive activities [20]. However, students were usually found it difficult to integrate their metacognitive knowledge with metacognitive awareness. This was because many factors other than metacognitive awareness influenced their metacognitive knowledge development. When the students failed to recognize their intellectual strengths and weaknesses, were uncapable to manage information well, and did not have a qualified resource of information about the topic discussed, these conditions would have led them to the failure of achieving expected learning outcomes [21].

Although metacognitive awareness is widely known as an important factor influencing metacognitive knowledge, there are still some other unidentified factors that might influence the development of metacognitive knowledge. These unanswered questions might resulted in the osbtacles found by students in making decision regarding suitable learning strategies used in their learning [8]. However, teachers could help students in facilitating and supporting the learning process thorugh thye selection of relevant learning strategies, methods, learning environments, tasks, etc. This idea was in line with Herlanti [15], that apart from metacognitive awareness, the quality of a teacher's teaching methods influences students' academic outcomes.

CONCLUSION

According to the results of the study, it can be concluded that there was a relationship between metacognitive knowledge and metacognitive awareness. The correlation between metacognitive knowledge and metacognitive awareness is very weak (0.110). These results indicated that students' metacognitive knowledge and awareness need to be further improved by considering external factors that might have had negative effects on the two variables. This effort would enable teacher in assisting their students to be more competent in solving Chemistry problems.

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