EXPLORING THE CORRELATION BETWEEN META COGNITION AND COGNITIVE RETENTION OF STUDENTS USING SOME BIOLOGY TEACHING STRATEGIES

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EXPLORING THE CORRELATION BETWEEN METACOGNITION AND COGNITIVE RETENTION OF STUDENTS USING SOME BIOLOGY TEACHING STRATEGIES

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Abstract. *This research was conducted during one semester in four different classes that were taught biology by using four different teaching strategies: Problem-based learning (PBL), Jigsaw, PBL integrated with Jigsaw (PBLJigsaw), and direct teaching. This research explored the correlation between metacognition (metacognitive awareness and metacognitive skills) with cognitive retention of students in the four different strategies, and compared the four regression lines whether or not they are parallel. There was no correlation between metacognitive awareness and cognitive retention in the four teaching strategies in biology classroom, while the correlations between metacognitive skills and cognitive retention were significant. The results of the analysis of variance related to the regression equation in the four different strategies were parallel and did not coincide; the regression line of PBLJigsaw strategy was at the highest position. It indicated that this strategy has the potency to empower metacognitive skills and simultaneously increased cognitive retention.*

Key words: *metacognitive awareness, metacognitive skills, cognitive retention, problem-based learning, jigsaw, regression line.*

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Introduction

Metacognition in general is emphasis on awareness of one's thinking about the thinking process itself. According to Flavell (1999), metacognition was thinking about thinking. Metacognition was knowledge of learning yourself or about how to learn (McCormick, 2006). Hacker (2009) and Downing et al. (2009) divided metacognition into three types of thinking namely metacognitive knowledge, metacognitive skills and metacognitive experience. Meanwhile, according to Flavell (1979), metacognition consisted of metacognitive knowledge and metacognitive experience or metacognitive regulation. Metacognitive knowledge referred to obtaining knowledge about cognitive processes (Anderson & Kathwohl, 2001), knowledge that can be used to control cognitive processes. Metacognitive knowledge consisted of sub-components, namely (1) declarative knowledge, (2) procedural knowledge, and (3) conditional knowledge (Schraw & Dennison, 1994; Schraw & Moshman, 1995; Schraw, 1998; Peirce, 2003). Anderson & Kathwohl (2001) stated that metacognitive knowledge in general is the same with the awareness and knowledge of the person's self-cognition. Therefore, it can be said that metacognition is awareness of what is known and what is unknown. Metacognitive experience is processes that can be applied to control cognitive activities and to achieve the cognitive objectives.

Metacognitive skills were conceptualized as an interconnected set of competencies for learning and thinking, and skills that required for active learning, critical thinking, reflective assessment, problem solving, and decision making (Dawson, 2008). According to Lee and Baylor (2006), there were four keys of metacognition skills, namely planning, monitoring, evaluating, and revising. First, planning is an activity that is done carefully regulating the whole process of learning. Behavior plan consists of a set of learning objectives, sequence learning, learning strategies and expectations of the study. Second, monitoring refers to moderate activity on learning progress. Moni-

toring activities are monitoring during learning activities. Third, self-evaluation of the learning process includes an assessment of progress learning activities. Fourth, revising of the learning process itself includes the modification of the previous goal plan, teaching strategies, and other teaching approaches. Thus, a person's cognitive activities such as planning, monitoring, and evaluating the completion of a particular task were naturally metacognition (Whitebread et al., 2009).

Metacognition makes students become independent learners that can manage and plan their learning process. Bakracevic (2006) suggested that metacognition was an important building bloc of learning to learn. Learners who have mastered the ability metacognition proven to be an independent learner, honest, and dare to try, so they tend to excel in learning (Efklides 2006; Eggen & Kauchak, 1996). Besides, Eggen & Kauchak, (1996) suggested that the development of skills in students is a valuable educational purpose, since the skills can help them become self-regulated learners. Self-regulated learners are responsible for their own learning progress and adapt their learning strategies reaching demands completely.

Schraw & Dennison (1994) stated that the learners who skillfully do assessment against themselves are aware of their ability to act more strategies and are better than those who are not skilled to do assessment themselves. According to Anderson & Krathwohl (2001), metacognition was useful: (1) to make the students more aware of and responsible for their own knowledge and ideas, (2) to make the students to be able to think and to solve the problems, (3) to identify the various types of metacognitive strategy to plan, monitor, and regulate their cognition, (4) to help students find a variety of learning strategies that can be used to memorize the course material, to look for the meaning of the text, or to understand from the lessons in the classroom or from reading a book, and (5) to help the student to prepare for the test by owning self-knowledge.

Several researches of the correlation between metacognition with academic achievement have been frequently reported related to the implementation of certain teaching strategy. Results of research by Coutinho (2007), Rahman (2010), Ardila (2013), Mustaqim et al. (2013), and Bahri and Corebima (2015) revealed that metacognitive skills contributed to the students' cognitive learning outcomes. Correspondingly, Zimmerman (1990) stated that the self-regulated learning had a strong relationship with academic achievement. The result of research from Pintrich & De Groot (1990), Salili et al. (2001), Kuntjojo (2012), and Mustaqim, et al. (2013) proved that metacognitive skills contributed to students' motivation.

Moreover, theoretically, metacognition is believed to have a correlation with cognitive retention of students. According to Anderson & Krathwohl (2001), retention was the ability to remember the subject matter until a specified period is the same as the material being taught. Remembering is taking the necessary knowledge of long-term memory. This is in line with Dahar (1991) research results, which explained that retention was related to the length of learned learning material saved in memory. Retention is the amount of acquisition of learning outcomes that are still able to remember or reproduced by learners after a certain time in its memory. Memory process was the activity in the brain caused by environmental experience, when the process stops, and the effect was still lagging behind traces in the brain (Hergenhahn & Oslon, 2009). Furthermore, Hergenhahn & Oslon (2009) stated that if one defines learning as a potential modification of behavior that comes from experience, each occurrence could be viewed as a learning experience. Howard (2004) stated that metacognitive skills were believed to play an important role in cognitive activities including comprehension, communication, attention, memory, and problem solving. This showed that metacognition has associated with retention capabilities as a successful learning.

Based on the background, the problem was only a few information about the correlation between metacognition (metacognitive awareness and metacognitive skills) with cognitive retention. The previous researches only reported its correlation without comparing the regression line between different strategies especially in biology classroom. It is believed that the use of appropriate teaching strategy to empower students' metacognition, can simultaneously improve cognitive retention of students. The use of different biology teaching strategies may display different correlation between students' metacognition with cognitive retention. Learning biology can be carried out by various teaching strategies, such as Problem-based learning (PBL), cooperative Jigsaw, PBL integrated with Jigsaw (PBLJigsaw), and also direct teaching. Skaalvik & Skaalvik (2010); Baran & Maskan, (2011); and Kristiani et al. (2015) reported that there have been many reports of correlation between the variables and other variables in different conditions and different fields of knowledge. Thus, it is also possible too that there are different correlations between metacognition with cognitive retention of students in various teaching strategies in biology classroom.

Purpose of Research

This research was carried out to explore the correlation between metacognition (metacognitive awareness and metacognitive skills) and cognitive retention of students using four different teaching strategies and to compare the four regression lines of the teaching strategies whether or not they are parallel. The research questions are formulated as the following:

1. How is the correlation between metacognition (metacognitive awareness and metacognitive skills) and cognitive retention of students using four different teaching strategies in biology classroom?
2. Are the four regression equations of the four strategies similar or different?

The results of this research can provide more relevant information for the biology teacher to select appropriate teaching strategies that not only enhance students' cognitive learning outcomes, but also can empower students' metacognition and increase cognitive retention. The results of this research also provide information for curriculum developers and policy makers with more insights relating to metacognition and cognitive retention of students.

Methodology of Research

General Characteristics of Research

This research was a correlational research to explore the correlation between metacognition and cognitive retention of the students using four different teaching strategies in biology classroom. Four teaching strategies were PBL, jigsaw, PBLJigsaw, and direct teaching. Students' metacognition as the predictor consisted of metacognitive awareness and metacognitive skills, and the cognitive retention of the students as the criterion. This research was conducted for one semester, academic year 2014/2015. The research took place at the Faculty of Mathematics and Science, State University of Makassar, Indonesia.

Sample of Research

The sample was representative. The population of this research was all of the first year students of Faculty of Mathematics and Natural Science, The State University of Makassar, Indonesia (Department of Biology, Physics, Chemistry, and Mathematics) academic year 2014/2015 as many as 288 students. The sample of this research consisted of 136 students selected randomly, distributed on four groups. Each group was taught by different teaching strategies. Four teaching strategies were PBL, jigsaw, PBLJigsaw, and direct teaching. Four groups were equal according to the equality test. The instrument of equality test was valid and reliable. The data of the equality test were analyzed by analysis of variance (ANOVA) using SPSS ver. 18. The result of this analysis showed that all classes were equal ($p > 0.05$). This research had been approved by an ethical clearance from ethical committee at State University of Makassar. This process aims to protect the rights of humans so that no harm occurs to either as a result of research.

Instrument and Procedure

Students' metacognition measured in this research consisted of metacognitive awareness and metacognitive skills. The students' metacognitive awareness was measured by a Metacognitive Awareness Inventory (MAI) as much as 52 items adapted from Schraw & Dennison (1994). Metacognitive awareness consists of metacognitive knowledge and metacognitive regulation. The indicators of the metacognitive knowledge involved (1) declarative knowledge, (2) procedural knowledge, and (3) conditional knowledge. The indicators of the metacognitive regulation involved (1) planning, (2) information management strategy, (3) monitoring, (4) correction, and (4) evaluation. The inventory/questionnaire used Likert scale consisting of 4 points scale, namely strongly agree, agree, disagree, and strongly disagree.

The students' metacognitive skills were measured by essay test integrated to the students' cognitive retention test consisting of 24 numbers developed by the researcher. The rubrics used in this research were a metacognitive skills and cognitive retention rubric. Metacognitive skills rubric was used to determine the score of students' metacognitive skills adopted from Corebima (2009) which consists of 8 scales (0-7). Cognitive retention also developed to determine the cognitive retention score adapted from Hart (1994) which consists of 5 scales (0-4).

The instruments were validated by the expert and empirical validation before used. Expert validation consisted of content and construct validity. Content validity is the accuracy of an instrument in terms of the content of the instruments, estimated in accordance with the curriculum. Construct validity refers to the appropriateness of the results of the measuring instrument with the ability to be measured. Empirical validity was conducted on 70 students of the second year of Faculty of Mathematics and Science, State University of Makassar, Indonesia. Reliability of the essay test was also examined. Reliability refers to the degree of test scores which are free from measurement error or an index that indicates the extent to which a measuring instrument is trustworthy or reliable. The instruments of research were valid and reliable.

The MAI and essay tests for metacognitive skills measurement were given at the beginning of research (pre-test) and end of research (post-test). Essay test for cognitive retention was given at the end of research (post-test) and two weeks after post-test.

Data Analysis

The hypothesis testing began with the prerequisite testing to know if the data distribution was normal and homogeny. Simple linier regression was used to analyze the correlation between metacognitive awareness and cognitive retention, and the correlation between metacognitive skills and cognitive retention of the students in each teaching strategy in biology classroom. Analysis of variance related to regression equation was used to uncover the parallelism and the coincidence among the regression lines, as well as to see which strategy has the highest correlation between metacognition and cognitive retention of the students. Data were analyzed with SPSS ver. 18.

Results of Research

In this research, the metacognition measured was metacognitive awareness and metacognitive skills. This research was exploring the single correlation between metacognitive awareness and metacognitive skills with cognitive retention of students in biology classroom.

The Correlation between Metacognitive Awareness and Cognitive Retention of Students in Biology Classroom

The results of the data analysis related to the correlation regression equation between metacognitive awareness and cognitive retention of students in the implementation of direct teaching are illustrated in Table 1.

Table 1. The regression correlation coefficient of metacognitive awareness and students' cognitive retention (dependent variable) in direct teaching

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	p
(Constant)	58.655	2.508		23.387	< 0.001
Metacognitive Awareness	-0.184	0.499	-0.063	-0.369	0.715

The results of the data analysis in Table 1 show that the correlation between metacognitive awareness and cognitive retention of students in the implementation of direct teaching was not statistically significant, meaning that there is no correlation between metacognitive awareness and cognitive retention of students.

The results of the data analysis related to the correlation regression equation between metacognitive awareness and cognitive retention of students in the implementation of jigsaw are illustrated in Table 2.

Table 2. The regression correlation coefficient of metacognitive awareness and students' cognitive retention (dependent variable) in jigsaw.

	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	39.763	2.449		16.237	< 0.001
Metacognitive Awareness	0.105	0.334	0.059	0.314	0.756

The results of the data analysis in Table 2 show that the correlation between metacognitive awareness and cognitive retention of students in the implementation of jigsaw was not statistically significant, meaning that there is no correlation between metacognitive awareness and cognitive retention of students.

The results of the data analysis related to the correlation regression equation between metacognitive awareness of students and their cognitive retention in the implementation of PBL are illustrated in Table 3.

Table 3. The regression correlation coefficient of metacognitive awareness and students' cognitive retention (dependent variable) in PBL.

	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	50.013	2.883		17.349	< 0.001
Metacognitive Awareness	-0.425	0.554	-0.132	-0.767	0.448

The results of the data analysis in Table 3 show that the correlation regression equation between metacognitive awareness and cognitive retention of students in the implementation of PBL was not statistically significant, meaning that there is no correlation between metacognitive awareness and cognitive retention of students.

The results of the data analysis related to the correlation regression equation between metacognitive awareness and cognitive retention of students in the implementation of PBLJigsaw are illustrated in Table 4.

Table 4. The regression correlation coefficient of metacognitive awareness and students' cognitive retention (dependent variable) in PBLJigsaw strategy.

	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	42.760	2.187		19.556	< 0.001
Metacognitive Awareness	0.055	0.299	0.032	0.184	0.855

The results of the data analysis in Table 4 show that the correlation regression equation between metacognitive awareness and cognitive retention of students in the implementation of PBLJigsaw was not statistically significant, meaning that there is no correlation between metacognitive awareness and cognitive retention of students.

The Correlation between Metacognitive Skills and Cognitive Retention of Students in Biology Classroom

The results of the data analysis related to the correlation regression equation between metacognitive skills and cognitive retention of students in the implementation of direct teaching are illustrated in Table 5.

Table 5. The regression correlation coefficient of metacognitive skills and students' cognitive retention (dependent variable) in direct teaching.

	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	49.589	3.123		15.879	< 0.001
Metacognitive Skills	1.396	0.364	0.549	3.830	0.001

The results of the data analysis in Table 5 show that the correlation regression equation between metacognitive skills and cognitive retention of students in the implementation of direct teaching was statistically significant, meaning that the contribution of metacognitive skills and cognitive retention of students is 30.1% and the contribution of the factors other than metacognitive skills is 69.9%.

The results of the data analysis related to the correlation regression equation between metacognitive skills and cognitive retention of students in the implementation of jigsaw are illustrated in Table 6.

Table 6. The regression correlation coefficient of metacognitive skills and students' cognitive retention (dependent variable) in jigsaw.

	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	40.874	1.962		20.827	< 0.001
Metacognitive Skills	0.996	0.248	0.604	4.012	< 0.001

The results of the data analysis in Table 6 show that the correlation regression equation between metacognitive skills and cognitive retention of students in the implementation of jigsaw was statistically significant. The contribution value related is 0.365, meaning that the contribution of metacognitive skills and cognitive retention of students is 36.5% and the contribution of the factors other than metacognitive skills is 63.5%.

The results of the data analysis related to the correlation regression equation between metacognitive skills and cognitive retention of students in the implementation of PBL are illustrated in Table 7.

Table 7. The regression correlation coefficient of metacognitive skills and students' cognitive retention (dependent variable) in PBL.

	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	39.663	1.282		30.949	< 0.001
Metacognitive Skills	1.384	0.181	0.799	7.645	< 0.001

The results of the data analysis in Table 7 show that the correlation regression equation between metacognitive skills and cognitive retention of students in the implementation of PBL was statistically significant. The contribution value related is 0.639, meaning that the contribution of metacognitive skills and cognitive retention of students is 63.9% and the contribution of the factors other than metacognitive skills is 36.1%.

The results of the data analysis related to the correlation regression equation between metacognitive skills and cognitive retention of students in the implementation of PBLJigsaw are illustrated in Table 8.

Table 8. The regression correlation coefficient of metacognitive skills and students' cognitive retention (dependent variable) in PBLJigsaw.

	Unstandardized Coefficients		Standardized Coefficients	t	p
	B	Std. Error	Beta		
(Constant)	44.652	1.269		35.178	< 0.001
Metacognitive Skills	1.450	0.114	0.911	12.702	< 0.001

The results of the data analysis in Table 8 show that the correlation regression equation between metacognitive skills and cognitive retention of students in the implementation of PBL was statistically significant. The contribution value related is 0.830, meaning that the contribution of metacognitive skills and cognitive retention of students is 83.0% and the contribution of the factors other than metacognitive skills is 17.0%.

Anova Test of the Regression Equation of the Correlation between Metacognitive Skills and Cognitive Retention of the Students in Four Teaching Strategies

Table 9. Summary of the ANOVA test result of the regression equation of the correlation.

Model	Sum of Squares	Degrees of Freedom	Mean Square	F	p
Regression	22297.24	7	3185.321	34.587	< .001
b3,b5	268.387	2	134.1935	1.45710454	0.237
b2,b3,b4,b5	2291.196	6	381.866	4.14639072	0.001
Residual	11788.33	128	92.096		

ANOVA test result indicates that the value of b3, b5 is 0.237 ($p>0.05$), but the value of b2, b3, b4, b5 is 0.001 ($p<0.05$). Those values prove that the regression lines related to the correlation between the metacognitive skills and their cognitive retention are parallel to each other, as well as do not coincide.

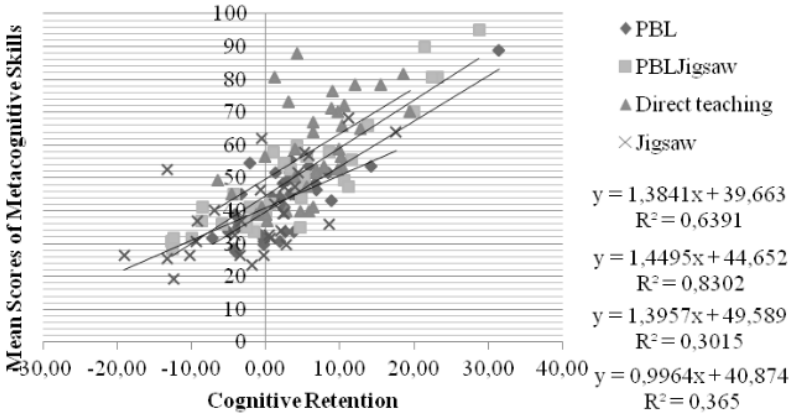

Figure 1: Regression line of metacognitive skills and students' cognitive retention (dependent variable) in four teaching strategies.

Figure 1 showed the graph of the ANOVA test related to regression equation of correlation between metacognitive skills and cognitive retention in the four different teaching strategies appears that the regression line of PBLJigsaw is the highest than those of the other three strategies.

Discussion

The results of research showed that there was no correlation between metacognitive awareness and cognitive retention of students at different teaching strategies (PBL, jigsaw, PBLJigsaw, and direct teaching) in biology classroom. On the other hand, metacognitive skills significantly correlated with the cognitive retention in four teaching strategies in biology classroom. This is in line with Danial's (2010) research finding which found that there was no correlation between metacognitive awareness and concept mastery of Basic Chemical course, but there was a correlation between metacognitive skills and concept mastery of Basic Chemistry course. The other findings of this research, regression line between metacognitive skills and cognitive retention of students in four teaching strategies are parallel and not coincide.

The difference in a relationship where metacognitive awareness does not correlate to cognitive retention of students, while metacognitive skills related to student retention, allegedly due to different types of measuring instruments used to measure these two variables of metacognition. Metacognitive awareness measured by inventory/questionnaire (MAI), and metacognitive skills measured by essay test that was integrated with the cognitive retention test. The result of this research was different from the research findings by Rahman (2010) which showed that there was a correlation between MAI score with a learning achievement test scores. In this research, the use of MAI proved to be less accurate in measuring metacognitive awareness variable. This is in line with the research results by Bahri (2010) and Muhiddin (2012) which reported that the use of MAI to measure metacognitive awareness caused the data obtained tend to show metacognitive awareness of students decreased after following the lecture. The finding research of Bahri and Corebima (2015) showed the use of inventory or other types of questionnaires for the Indonesian population is relatively not able to record accurately the ability of respondents.

The research findings by Bahri and Corebima (2015) also reported that the use of questionnaires proved less accurate to measure learning motivation of student variable. Antika (2015) reported that metacognitive skills variable measured by the essay test was contributed much more on cognitive learning outcome than other variables that were measured using a questionnaire. It reveals that the use of essay tests tends to be more accurate for measuring metacognitive skills than other questionnaires previously vastly used to measure the awareness and metacognitive skills variables, although the questionnaires have been validated. Related to this statement, Drew et al. (2008) explained that in educational research, data were generally obtained by using instruments addressed to the students, so when there was an intervention during data collection process, the data obtained might differ with the real conditions. Therefore, an instrument to measure metacognitive awareness should be constructed well so that the information obtained was accurate.

This study results also showed that the correlation regression line of metacognitive skills and cognitive retention in PBL strategy, jigsaw, PBLJigsaw, and direct teaching in biology classroom was significant. The result of data analysis also showed that there was a positive value of the correlation coefficients in four teaching strategies. It means that the increasing of students' metacognitive skills score always followed by the increasing of the cognitive retention. The implications of these findings were the empowerment of metacognitive skills of students in the classroom because the metacognitive skills are contributing to improve cognitive retention. It was confirmed by Howard (2004) that metacognitive skills played an important role in cognitive activity including memory.

Metacognition played an important role in the learning process (Flavell, 1979) and a strong predictor of academic success (Dunning et al., 2003; Countinho, 2007). It is supported by Busari's (2013) research showed that self-regulation is more potential contributor to academic achievement. Similarly, mentioned by Uno (2008) that students' metacognitive skills would train the students to regulate and control what they learned. Danial (2010) reported that there was a correlation between metacognitive skills with the concepts mastery. Students who have high metacognition skills will demonstrate understanding of the concept also high.

Based on that correlation, then allegedly metacognition also relates to the retention, because retention is a mastery of concepts stored in memory within a certain time. In addition, metacognition involves the ability to think while retention relates to the ability of memory of a person. If student realizes what they think (metacognitive awareness), the ability to remember information that it has received the longer survive. Therefore, if metacognition is high then retention will also be high. This statement is in line proposed by Anderson & Krathwohl (2001), that if the

purpose of learning was to cultivate the ability of retaining the same subject matter as the material being taught, the minimal cognitive process was given. It is further mentioned, the knowledge needed one of them is metacognitive knowledge. Knowledge "remember" metacognitive is essential as a preparation for meaningful learning and resolve the problems, such knowledge is used in more complex tasks. This means that all three cognitive activities can improve understanding of the concepts that will have an impact on retention. Metacognition is a thinking activity that involves mental processes and requires the ability to remember and understand, on the contrary to be able to remember and understand the necessary mental process is called thinking. According to Sanjaya (2008), the ability to think by someone was definitely followed by the ability to remember and understand.

The big contribution of metacognitive skills to the cognitive retention of students, especially in the PBL and PBLJigsaw proved that the increase of the cognitive retention was caused by metacognitive skills empowerment. Clark and Grandy (1984) and Kristiani et al. (2015) supported this statement and explained that the cognitive learning as the final component of learning is influenced by external and internal conditions of students. Thus, if the metacognitive skills are internal factors, then the amount remaining on the use of four types of teaching strategies that may constitute external factors, internal factors besides metacognitive skills, or a combination of external factors and internal factors besides metacognitive skills that contribute to the cognitive retention of students. Other factors beyond the metacognitive might be teacher factor (Cooper & McIntyre, 1996), motivation and learning styles factor (Curry, 1990), cognitive style factor (Moore & Dwyer, 2001), critical thinking skills factor (Muhiddin, 2012), and scientific attitude factor (Kristiani et al., 2015) also must be considered in biology classroom.

Other research findings are related to differences in the relationship of metacognitive skills and cognitive retention of students in the use of different biology learning strategies. The results of the ANOVA test shows that the regression equation between metacognitive skills and retention of students in the fourth cognitive learning strategies are parallel and do not coincide. It means that the improvement rate of cognitive retention of students in the four strategies is equal, but the amount of improvement of cognitive retention among the teaching strategies differs. Thus, this situation indicates the improvement of students' cognitive retention caused by metacognitive skills in the four strategies. Similarly, Siswati (2014) reported that the rate of improvement in students' cognitive learning result with different academic abilities in several learning models was the same, but the amount of cognitive learning result improvement in those teaching models was different.

The different amount of cognitive retention improvement was caused by the use of different learning strategies. Baran and Maskan (2011) also conducted the research that investigated correlation between variables in different conditions. Krstiani et al. (2015) reported that the application of different biology learning strategies have different effects on the relationship between the scientific attitude of students with cognitive learning outcomes. While Baran & Maskan, (2011) reported that a significant relationship and differences were found in the student's academic self-concept related to gender and family background difference. These findings provide information that different situations may give different results. Corebima (2010) argued that the empowerment of metacognitive skills in learning could conduct either through habituation of metacognitive learning strategies as well as through the implementation of appropriate teaching strategies.

The graph of the ANOVA test related to regression equation of correlation between metacognitive skills and cognitive retention in the four different teaching strategies appears that the regression line of PBLJigsaw is the highest than those of the other three strategies. It means that the PBLJigsaw is better than the other three learning strategies to empower metacognitive skills, which further improves cognitive retention of students. Thus, the findings can be caused by the presence of syntax PBL in PBLJigsaw. According to Arends (2008), through the PBL, students could develop inquiry, high order thinking skills, independence and confidence. PBL improved self-regulation (Sungur & Tekkaya, 2006; Steck et al., 2012) and promoted metacognition (Ackay 2009; Downing, et al., (2009). Similarly, Corebima (2010) stated that PBL have proven potential to empower metacognitive skills. PBL developed essential skills e.g. critical thinking, problem solving strategies, and collaboration within the team (Steck et al., 2012).

According to Biggs (1999), PBL could be used to realize the goal of education at the undergraduate level. It was further mentioned that the purpose of education is to develop the graduate level functional knowledge base that integrates academic knowledge (declarative knowledge), skills needed for the job (procedural knowledge) and context to solve the problem (conditional knowledge). Thus, PBL empowered third metacognition because such knowledge is metacognition knowledge that occurred during the learning process. This is in line with Gassner (2009) who stated that PBL was a student-centered learning, one of its goals is to help students become lifelong learners, so as to achieve this goal, self-directed learning skills were important. Therefore, when students learn to become a self-directed learner, then they use the knowledge and metacognitive thinking.

PBL also been proven to improve student retention. Trianto (2009) suggested that one of the advantages of PBL was the retention of the concept to be strong. Correspondingly, Crosling (2009) stated that several important factors to improve students' retention in higher education, among others: (1) student-centered active learning that can conduct with PBL and project-based learning and (2) the orientation and induction course materials into the special curriculum materials to help students learn the context, and (3) the integration of learning skills during the lectures. PBL strategy will affect the students' retention because PBL strategy requires the ability to think towards solving problems so it can be stored in long-term memory.

In addition to the PBL, the presence of phase of jigsaw on PBLJigsaw became one factor that contributed to the high position of the regression line. Jigsaw has been proven to empower metacognitive skills. It was caused by the syntax of cooperative Jigsaw to train the student to help each other to learn, discuss, and argue to comprehend, understand and know the topic. Discussion and arguing with each other will bring expansion and cognitive conflict in students, as a result, students accustomed to think and to do metacognition (Lie, 2002; Slavin, 2010). According to Susilo (2005), Jigsaw as one part of a cooperative learning had a strong potential to empower learners to think because it provides an opportunity for learners to become "experts" so in self-learners are traits and thought process.

To support the statements mentioned above, Arends (2008) explained that the cooperative learning could be beneficial for underachieving students and high academic to finish the tasks together. High-achieving students would teach the lower-achievers and act as tutors who demanded to think more deeply among the various ideas. In Jigsaw, each member of group is responsible for the control of one part of the course material and then teaches it the other members in the team. It indicates that students should have the awareness to know and understand the course material with a lot of thinking so that students can be peer tutors. The burden of responsibility of each student in group is the strategy to empower metacognitive.

According to Sanjaya (2008), the cooperative learning strategies e.g. jigsaw could increase motivation and stimulate confidence in its ability to think, to find information, to empower each student to be responsible and improve academic achievement. Cooperative learning strategies could develop inter-group relations, acceptance of classmates who were lower academic, and increase self-esteem of students, thus encouraging the growth of mutual learning awareness among students (Slavin, 2010). According to Slavin (2010), giving groups award could make students aware themselves of the responsibilities assigned to them so that each group member is aware that the group of their friends wanted them to learn and also learning mutually. Thus, cooperative learning can empower metacognitive skills.

Related to the cognitive retention of students, if the teaching strategy can empower metacognitive skills (Suratno, 2009) then it will also affect learning outcomes. The same thing was stated by Kauchak & Eggen (2007) that metacognition, and content knowledge are related to each other. It is caused if the students have metacognition, it means that they are able to regulate and to control the cognitive processes that can also increase the knowledge. Furthermore, it will also be having an effect on the cognitive retention because the students who have a good learning outcome will have a good retention as well. It is caused that Jigsaw requires individual responsibility to master the course materials.

Conclusions

The results show that the correlation between metacognitive skills and cognitive retention of students in the four teaching strategies implemented (PBL, jigsaw, PBLJigsaw, and direct teaching) in biology classroom is significant, having the relatively high contribution value (30.1%, 36.5%, 63.9%, and 83.0%). The results of further analysis of variance on the four regression equations prove that the four regression lines are parallel. Moreover, the regression line of PBLJigsaw is proved being at the highest position. It is an important information that the PBL strategy integrated with jigsaw has the greatest potential in empowering metacognitive skills and simultaneously increases cognitive retention of students compared to the other three strategies. Based on the conclusion, the implication of this research is suggested that teachers use PBLJigsaw in biology classroom and also care about students' metacognition empowerment (metacognitive awareness and skills). Other finding of this research, there is no correlation between metacognitive awareness and cognitive retention of students. The limitation of this research was caused by metacognitive awareness of the students and was measured using MAI. It is suggested that further researches can consider about more accurate measuring instrument of metacognitive awareness.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14