The Contribution of Metacognitive Skills and Creative Thinking Skills in 21st Century Learning

Yusnaeni^{1,*}, Aloysius Duran Corebima², Herawati Susilo², Siti Zubaidah²

¹Faculty of Teacher Training and Science Education, State University of Nusa Cendana Kupang, Indonesia

²Biology Department, Faculty of Mathematics and Science, State University of Malang, Indonesia

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Abstract This is a correlational research related to the multiple correlation between metacognitive skills and creative thinking skills with students' cognitive learning results. This research aimed at investigating the contribution of metacognitive skills and creative thinking skills simultaneously on the cognitive learning results of 226 senior high school science students of Kupang, Indonesia. Metacognitive skills and creative thinking skills were measured integrated with cognitive test. The assessment of metacognitive skill, creative thinking skill, and cognitive learning results developed was validated before being used. The results of the research showed that metacognitive skills and creative thinking skill simultaneously had a high contribution on students' cognitive learning results as much as 62.78%. Metacognitive skills had a higher contribution to cognitive learning results as much as 50.26%, while the contribution of creative thinking skill was 12.52%. Based on this result, teachers need to empower students' metacognitive skills and creative thinking skills in learning because both thinking skills are required in 21st century.

Keywords Cognitive Learning Results, Creative Thinking, Metakognitive Skills, Thinking Skills

consisting of knowledge, disposition, cognitive operations and metacognitive. [3] also added that thinking skills need to be developed in order to help students to process information, plan learning activities, monitor attention and maintain motivation for learning.

Students' abilities to monitor, process and evaluate their learning activities are commonly known as metacognition. The term metacognition was first introduced by Flavell [4]. Metacognition is a person's consciousness about the process of monitoring, controlling and organizing thoughts and self-actions such as "what can I do differently, how will I do, what should I do if I don't understand?" Weiner and Kluwe [5] added that metacognition was a second order cognition having meaning as thinking about thinking, knowledge about knowledge or reflection about action. Metacognition has an important role in the success of student's learning. Metacognition can empower the students to become independent learners. To become independent learners required awareness to plan, control and evaluate their learning activities. Metacognition was an important element in the development of lifelong learning theory [6], important in learning and was a strong predictor of academic success [7]. [8,9] It is added that the application of metacognitive strategies in learning can improve learning outcomes, and creative thinking ability of low academic students.

Developing metacognition basically improves the process of thinking in order to control what is thought of and done. Students who have good metacognitive skills can change their learning habits such as making regular study time schedules or summaries that make learning easier depending on the demands of the environment. [10] The process of metacognition and self regulation is expressed in tasks such as checking, planning and stirring. Therefore it is clear that an important component of metacognition is students' ability to reflect on their own learning. The correlation between metacognitive skills and students' learning results has been reported by [11-13], but they do

1. Introduction

Biology is one part of science that emphasizes directly on the realization of the scientific method through a series of scientific work and scientific values and attitudes. Therefore, students' thinking ability in learning in class needs to be cultivated and empowered. [1] Thinking skills are tools that are needed for someone to take alternative actions or decisions both individually and collectively. Furthermore, [2] revealed that thinking skills are a collection of skills that regulate a person's mental processes

not report the correlation of both metacognitive skills and creative thinking skills on learning outcomes.

In addition to metacognitive skill, creative thinking ability is also believe play an important role in the success of students' learning. The definition of creative thinking has been expressed by [14], and [15] added that creative thinking is the ability to generate ideas that are new and unique by combining the ideas in other ways. Creative thinking ability is an important aspect that must be possessed so that students become more daring to try new things. Students' creative thinking skills can foster creativity [16].

According to Treffinger [17], students having a creative personality were usually more organized in action. Innovative plans and original products or designs are thought carefully in advance by considering the problems that may arise related to their implications. Harris [18] added that a creative student was child always curious of anything, having wide interests, independent and self-confident. Research on creative thinking in relation with learning results has been reported by [19-22]. They reported that there was a positive correlation between creative thinking and learning results. Hirs and Peterson [23] also revealed that academic gains could be predicted through creativity test.

Based on the theory and research result, metacognitive skills and creative thinking skill play an important role on students' learning results, it is necessary to pay attention on both two thinking skills to improve students' learning results. The multiple correlations between meta-cognitive skills and creative thinking skill see the contribution of both on students' learning results. The correlation needs to be revealed because both skills are required in learning in the 21st century. Greestein [16] revealed that one of the required skills in the 21st century was the thinking skill. Thinking skills include critical thinking, creative thinking, problem solving and metacognitive skills.

This multiple correlation research will reveal the contribution of metacognitive skills, creative thinking skill, and the simultaneous contribution of both skills to the students' learning results. The results of this research also give information about the importance of empowering students' metacognitive skills and creative thinking skill in learning, and not only focusing on students' learning results. Empowering both of these thinking skills is so important that students can become competent and capable of addressing the challenges of education in the 21st century. This era gives a challenge for the students to be critical and creative. Therefore, the thinking skill developed in learning should already reach *high order thinking skills*, which include metacognitive skills and creative thinking skills.

2. Methods

This is a correlational research related to the correlation

between metacognitive skills and creative thinking skills with biology cognitive learning results.

The population of this research was 10th grade student's in 3rd Kupang Senior High School, 4th Kupang Senior High School, students of state senior high school 3 Kupang, state senior high school 4 Kupang and Catholic Giovanni High School Kupang. Schools are selected by purposive sampling. Each school is randomly sampled as many as 3 classes so that the total sample class is nine classes. Of the nine sample classes a total sample of 226 students were obtained.

The instruments of data collection were in the form of essay test measuring metacognitive skills, creative thinking skills, and cognitive learning results altogether. The metacognitive skills were assessed by referring to Corebima [24], the creative thinking skills were assessed by referring to Treffinger [17] that had been adapted based on five aspects of creative thinking namely flexibility, originality, elaboration, fluency, and metaphorical thinking, and the cognitive learning results were assessed by referring to Hart [25].

The used instruments were validated before by the expert and empirical validation. Expert validation consisted of content and construct validity. Empirical validity was carried out on 105 senior high school students. The results of expert and empirical validation showed that the instruments were valid and reliable to be used. The validity test used was the Pearson product-moment, meanwhile the reliability calculation used was alpha Cronbach. Analysis of the data used was the normality and homogeneity test then was proceeded with the multiple regression analysis using SPSS.

3. Result and Discussion

The summary of the regression analysis of the correlation between metacognitive skills and creative thinking skills on students learning results is presented in Table 1 to Table 4. Table 1 shows that the analysis of variance result is highly statistically significant (0,000).

Table 1. Results of ANOVA (b)

	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	5831.51	2	2915.76	188.04	.000a
	Residual	3457.78	223	15.51		
	Total	9289.29	225			

a Predictors: (Constant), Metacognitive skills, creative thinking skills

b Dependent Variable: Cognitive learning result

The results of ANOVA test presented in Table 1, if the

table is obtained showed that the significance value was 0.000 less than 0.05 ($p < 0.05$). This result indicated that there was a correlation between metacognitive skill and creative thinking skill on students' learning results. The results of the analysis of multiple regression between metacognitive skills and creative thinking skill on students' learning results. The B value of the metacognitive skills and creative thinking skills is given in Table 2.

Table 2. Analysis of Regression Equation Coefficient

Model	Unstandardized Coefficients	Standardized Coefficients	T	Sig.
	B	Beta		
1 Constant	17.42		14.86	.000
Metacog	.56	.645	11.42	.000
Creative	.15	.195	3.46	.001

a Dependent Variable: student's learning result

The regression equation of the correlation between metacognitive skills and creative thinking skill on students' learning results is shown in Table 2, the regression equation is $Y = 17.42 + 0.56X_1 + 0.15X_2$. The equation shows that an increase in the value of metacognitive skills will increase the value of learning outcomes by 56.0 with the assumption that creative thinking skills are constant. The same thing applies to creative thinking skills. Then, the summary of multiple regression between metacognitive and creative thinking on student's learning results is given in Table 3

Table 3. Multiple Regression between Metacognitive and Creative Thinking Skills on Students' Learning Results

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.792(a)	.628	.624	3.93773

a Predictors: (Constant), metacognitive skills, creative thinking skills

Based on table 3, the multiple correlation coefficient (R) is 0.792 with a contribution value (R^2) of 0.628. The correlation value of 0.792 indicates a strong correlation between metacognitive skill and creative thinking skills on students' learning results. It also indicates that both metacognitive skills and creative thinking skills give effective contribution as much as 62.8% in explaining the students' learning results, while the remaining 37.2% is explained by some other factors outside metacognitive skills and creative thinking skills.

Table 4. The Contribution of metacognitive and Creative Thinking Skill on Students' Learning Results

Predictors	Relative Contribution (%)	Effective Contribution (%)
Metacognitive skills	80.07	50.26
Creative thinking	19.93	12.52
Total	100.00	62.78

Based on Table 4, the effective contribution of metacognitive skills is 50.26%, and the creative thinking skills is 12.52% on students' learning results. Simultaneously metacognitive skills and creative thinking skills give contribution as much as 62.78%.

4. Discussion

Based on the results of the data analysis, it can be stated that a positive correlation between metacognitive skills and creative thinking skills on learning outcomes indicates both types of thinking skills in this case are very important to be empowered to students. Metacognition is important because it is a higher thought process that involves active control of cognitive processes such as planning, prediction, monitoring, testing, refinement, checking, and evaluation activities, in the sense that metacognitive reflects students' understanding of what is thought. Metacognition indicates that the internal processes in students are the center of their cognitive activities, because the essence of metacognition is thinking about thinking, as stated by Weinert & Kluwe, and Mesaros et al [5, 6].

On the other hand, metacognitive also involved in creative thinking. When students can control and regulate their thinking activities, the other thinking skills will go along, including the creative thinking skill. This statement is in line with Al-Hayat [26] who argued that metacognitive skill was required to help people overcome their problems and it also played an important role in creative thinking. Creative thinking is correlated with metacognitive thinking, where the aspects and components of creative thinking are included in metacognitive skills such as planning and evaluation. Beyer [27] has also reported that metacognition approach in the classroom used five components, which were, preparing and using strategies, using a monitoring strategy, as well as using evaluation strategy. It was also the same as the creative thinking skill. Furthermore, Swartz & Perkins [28], Pesut [29] also revealed that the process of creative thinking was regarded as one of the cognitive mental processes, which was a day-to-day individual practice during his lifetime, similar to the case of metacognitive thinking. The individual practice is brainstorming, creating new and valuable ideas, describing, perfecting, analyzing, and evaluating.

Multiple correlations of metacognitive skills and creative thinking skills give high contribution in improving

students' learning outcomes. These results indicate a strong correlation of metacognitive skills and creative thinking skill in improving students' learning results. Both metacognitive skills and creative thinking skill are classified as high order thinking skills and have a strong correlation with students' learning outcomes. This was confirmed by Pesut [29] who argued that creative thinking was a metacognitive process, the process of thinking to regulate through planning, monitoring and evaluation. Feldhusen & Treffinger [30] added that creative thinking could develop the ability to solve problems and encourage independent learning. When both of these thinking skills are empowered, it will give good effect on students' learning results. This is in line with Al-Hayat [26] who stated that metacognitive thinking skills do not work solely in determining the learning success, but involve the other cognitive mental processes including creative thinking skills.

In addition to having contribution on improving the learning results, metacognitive skills and creative thinking skills are also part of the skills that are required in the learning in the 21st century [31-35]. On the other hand, metacognitive skills and creative thinking are classified as high level thinking skills. Higher-order thinking skills are skills for analyzing, evaluating, and creating [36-37].

The findings of the research also showed that the metacognitive and creative thinking skills are also interconnected, as stated by Pesut [29], who explained that the basic skills of creative thinking based on the idea were metacognitive guide serving to maintain and to enhance creative thinking.

Students can use their metacognitive skills to know and understand their thinking processes and how to organize the thinking process. Using the metacognitive skills, students can understand the tasks given by the teacher. According to Van Hook and Tegano [14], metacognitive skills enabled students to understand how the tasks should be performed.

Students who have metacognitive skills can understand their tasks and can adapt to existing learning situations that allow them to become independent learners. According to Eggen & Kauchak [38], metacognitive skills can motivate students to become self-regulated learners who are responsible for their own learning progress, and adapt their learning strategies to achieve the task demands. Razak and Hua [39] added that application of self-regulated learning could improve cognitive skills.

Metacognitive skills is one of the important aspects needed to be developed in learning because metacognitive skills can be used as a tool to empower students. With metacognitive skills, students can control, organize and reflect on their learning process. Various learning situations in the classroom can be adapted by students if they have metacognitive skills. Dweck [40] revealed that students having good metacognitive skills tended to be successful and fortunate, and the failure could be

reduced. In addition, the metacognitive skills can be used for students having learning difficulties, particularly those with low working memory as revealed by Whitebread [41], that the students having low capacity of working memory could use the knowledge and metacognitive skills to compensate for the shortfall. With metacognitive skills, students' behavior in learning can be controlled and monitored.

Metacognitive skills play an important role in improving students' learning results. Using metacognitive skill, students are aware about what they are thinking, so that they can monitor the actions. Metacognition can make the students aware of their own strengths and weaknesses in learning. [42] revealed that awareness in learning was necessary to become independent learners. The success of becoming independent learners depends on how students plan, control and evaluate their thinking skill. This is in line with [5] who said that metacognitive skills referred to specific mental operation in order to examine, plan, organize, monitor, predict and evaluate their own thinking processes. This illustrates that meta-cognitive skills are very important and need to be empowered on students, so that they can reflect on their own learning. Similarly, [43-45] revealed that metacognitive skills had a positive effect on academic achievement and learning success.

5. Conclusion

Based on the findings and discussions of this research, it can be concluded that metacognitive skill and creative thinking skill simultaneously give high contribution as much as 62.78% on students' learning results. Metacognitive skill has a higher contribution as much as 50.26% on students' learning results than the contribution of creative thinking skill as much as 12.52%. Based on this fact, teachers need to consider the empowerment of these thinking skills in the classroom, because these two thinking skills are required by the students to face the challenges of education in the 21st century.

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