The analysis of metacognitive in biology lesson to senior high school students with different learning interest

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Abstract. Biology is a science with a broad scope and provides learning experiences that encourage students to become independent learners. Interest and development of thinking skills are needed in learning. Metacognitive is an important aspect of achieving learning competence and building a student's character as an independent learner. Metacognitive motivates the students to have awareness of something they know and about something they don't. This research aims to analyze the metacognitive of the science and the social students in biology lessons, and to compare the metacognitive of those different students. This research was conducted at high schools in Jember. This research was a qualitative descriptive research by using mix methods (combine the qualitative and quantitative approach). Qualitative data were descriptive and they were based on observations to students whereas the quantitative data were based on the results of the Metacognitive Awareness Inventory (MAI) test. There was two MAI indicators used in this research, knowledge about cognition and regulation of cognition. The result of this research showed that the metacognitive average of science students was 64.6785, meanwhile the social students reached 56,3533, which means the metacognitive of science students was 17% higher than social students.

1. Introduction

Biology is a science that has a very broad scope. Biology studies the diversity, origin, and evolution of living things [14]. The large scope of biology lesson causes biology to be easily learned if students have high awareness and interest in the biology lesson. Interest makes students more excited about reaching the success of the learning process [6]. Therefore, excavating interest and maximizing students' interest in learning must be done often so that learning becomes effective [8]. Biology is also known as a subject that provides learning experiences that encourage studentss to become independent learners [15]. The characteristics of the biology lesson will demand students develop their thinking skills. Thinking skills that can be developed to answer current learning challenges are thinking skills through experience [5]. One of these skills is metacognitive.

Metacognitive guides, teaches, and shapes students as independent learners [1] [15]. As independent learners students will be able to engage more effectively in their learning environment. Metacognitive also provides an opportunity for students to take appropriate steps for themselves to understand what has not been understood and determine how the learning process [7]. Metacognitive development in students will lead them to develop other thinking skills such as creative thinking skills [17]. Based on the description, it clearly illustrates that metacognitive is one of important aspects to

achieve the learning success. In fact, metacognition is still often overlooked. This is reinforced by the results of picking up biology teachers from several high schools spread in the city of Jember. The results of the research provided information that quite a number of teachers had known metacognitive but there had never been a teacher who measured students' metacognitive knowledge because of the teacher's ignorance of metacognitive measurement instruments known as MAI (Metacognitive Awareness of Inventory). There is also an opinion that said if the measurement of metacognitive achievement should be done, the measurement for science students is more important to do. In fact, biology subject is also learnt by social students. From the fact above, the researcher thought that it is also important to measure the metacognitive achievement of social students too. Therefore, more research is needed to analyze the metacognitive aspect of science and social students. Thus, it can be known how much the metacognitive achievement of science and social students, and the comparison of result between both of them.

2. Research Method

This research is a qualitative descriptive study that used data analysis mix methods (combining qualitative and quantitative approaches). Qualitative data were descriptive and were based on observations to students, while quantitative data were based on metacognitive test results. Observation was in the form of distributing questionnaires to students who became the research samples. The questionnaire distributed to students contained the choice of specialization (learning interest), the choice of cross-interest subjects, and the reasons for their choices. Metacognitive tests were tests that used the MAI (Metacognitive Awareness of Inventory). The MAI used was the MAI developed by Schraw, G. & Dennison, R.S. (1994) which contained 41 items and they were divided into two indicators namely *Knowledge About Cognition* with 17 items including 8 items *declarative knowledge*, 4 items *procedural knowledge*, 5 items *conditional knowledge* with 5 items, and *Regulation of Cognition* with 24 items including 7 items *planning*, 10 items *information management strategies*, and 7 items *comprehension monitoring* [12]. The assessment instrument used a Likert scale from 1 to 4, from disagreeing to strongly agreeing. The maximum score on the MAI test is 164. The score was then changed to a scale of 100 using the formula:

$$Metacognitif\ score = \frac{MAI\ score}{MAI\ maximum\ score}\ x\ 100$$

After changing to a scale of 100, students' metacognitive scores were categorized using the *rating scale* presented in the following table:

Table 1. Metacognitive categories. [17]

No.	Categories	Score
1	*Super*	$85 \leq x \leq 100$
2	*Good*	$68 \leq x \leq 85$
3	*Developing*	$51 \leq x \leq 68$
4	*Less capable*	$34 \leq x \leq 51$
5	*Risk*	$17 \leq x \leq 34$
6	*Not yet developed*	$0 \leq x \leq 17$

The population in this study was 263 students from high schools in the Jember city. The sampling technique used random sampling from students with different learning interests (science and social).

3. Research Finding / Result

The metacognitive scores data between science and social student were obtained from tests using MAI after the learning process. The following table illustrates the average metacognitive scores using the MAI:

Table 2. Metacognitive averages of students with different learning interest.

	N	Minimum	Maximum	Mean
The metacognitive score of the science students	136	50.61	78.05	64.6785
The metacognitive score of social students	127	39.63	71.95	56.3533
Valid N (listwise)	127			

Based on the table, the metacognitive average of science students was 64.68, while the social students were 56.35, which meant that the metacognitive average of science students was 17% higher than social students. The average also showed that science students and social students were in the same category that is in the *Developing* category

To find out the difference in average metacognitive scores between science students and social students, then the difference testing was conducted using the Independent sample T-test. A summary of the students' metacognitive T-test is presented in the following table:

Table 3. Metacognitive score T-test results on science students and social students.

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	df	Sig. (2-tailed)
Metacognitive score	Equal variances assumed	1.196	0.275	11.674	261	.000
	Equal variances not assumed			11.698	260.975	.000

Note
Sig. : significance
Hypothesis
H_0 : there is no difference between the metacognitive scores of science students and social students
H_1 : there is a difference between the metacognitive scores of science students and social students

Based on the results of the analysis in the table, it can be concluded that there was a significant difference between the metacognitive scores of science and social students. This can be seen from the significance value of 0.00 (sig. = 0.00 <0.05), which means that H_0 is rejected and H_1 is accepted, so based on *Equal variances assumed* the two learning interests have significant metacognitive score differences.

3.1 Metacognitive of science students

The metacognitive test results of science students using MAI in each class after being changed on a scale of 100 and categorized using a *rating scale* are as follows:

Table 4. The metacognitive categories of science students in each classes.

Class	Category		
	Ok	Developing	Less capable
A	2	33	
B		33	1
C	13	21	
D	25	8	

Table 4 shows that the metacognitive categories obtained from the MAI test results of science students consisted of 3 categories which are *Less capable*, *Developing*, and *Good*. After the data has been averaged and re-categorized, a summary of the metacognitive criteria for science students from all classes tested was presented in the following diagram:

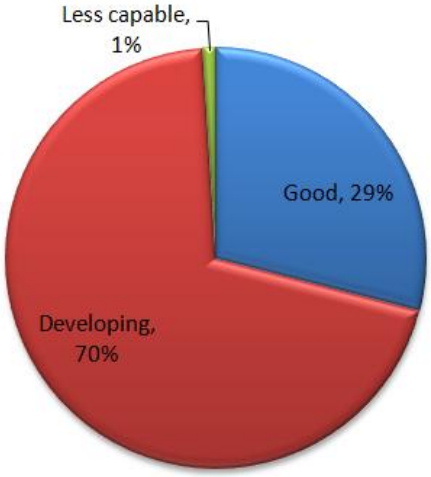

Figure 1. Percentage of metacognitive categories of science students.

Figure 1 shows that there is 1% of science students included in the *Less capable* category which can also be interpreted that the student has a low metacognitive achievement, 70% included in the *Developing* category which can be interpreted also that the student has a moderate metacognitive achievement, and 29% included in the *Good* category which it can also mean that the student has high metacognitive achievements. Achievement of metacognitive can be caused by a high interest in learning [4]. The high learning interest of science students is supported by the results of the distribution of questionnaires presented in the following diagram:

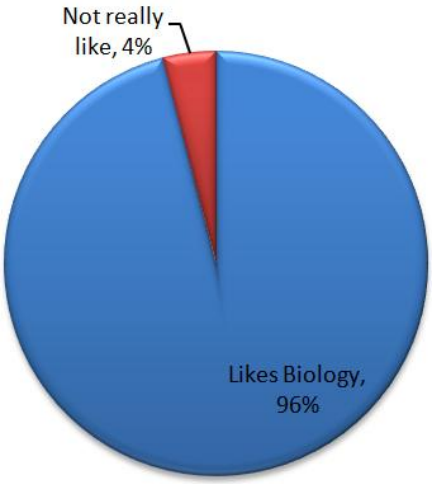

Figure 2. Percentage of interest in science students in biology lesson.

Figure 2 shows the high percentage of science students in the biology lesson. 96% of science students like biology and only 4% do not like biology for several reasons. This interest in learning is directly proportional to the students' reason when determining theirself to enter the science class or social class. The following diagram illustrates the percentage of reasons students choose to enter science classes:

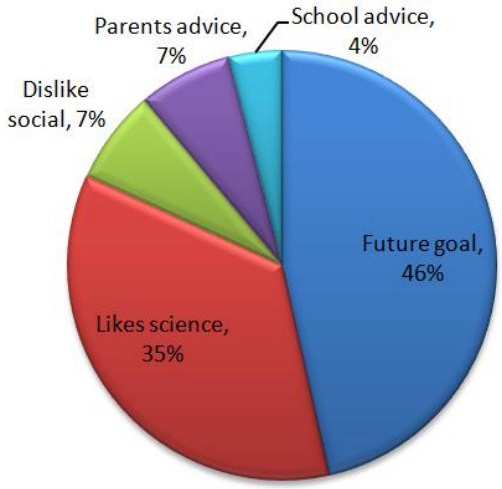

Figure 3. Percentage of student's reasons to choose science classes.

3.2 Metacognitive of social students

The metacognitive test results of social students using MAI in each class after being changed on a scale of 100 and categorized using a *rating scale* are as follows:

Table 5. The metacognitive categories of social students in each classes.

Class	Category		
	Ok	Developing	Less capable
A		31	1
B	2	25	7
C	1	22	7
D		27	4

Table 5 shows that the metacognitive categories obtained from the MAI test results of social students consisted of 3 categories which are *Less capable*, *Developing*, and *Good*. In the *rating scale*, the metacognitive categories achieved by social students have similarities with the metacognitive category of science students but different in the percentage of each category. A summary of metacognitive categories of social students is presented in the following diagram:

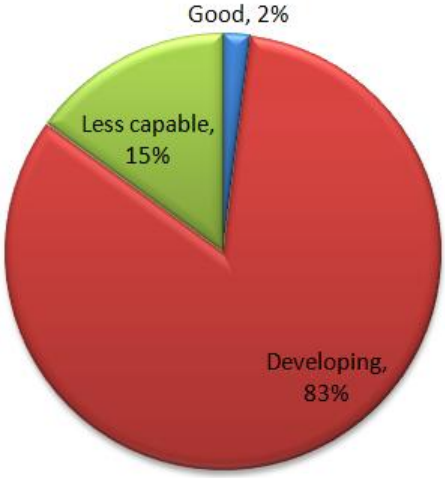

Figure 4. Percentage of metacognitive categories of social students.

Figure 4 shows that there are 15% of social students included in the *Less capable* category which can also be interpreted that the student has a low metacognitive achievement, 83% is included in the *Developing* category which can be interpreted also that the student has a moderate metacognitive achievement, and 2% is included in the *Good* category. It can also mean that the student has high metacognitive achievements. When it is viewed from the percentage of each category obtained by social students and then compared with the results of science students, it shows that there are differences in learning interest between these classes. Differences in interest in learning can also be seen in the results of the task as shown in the following figure:

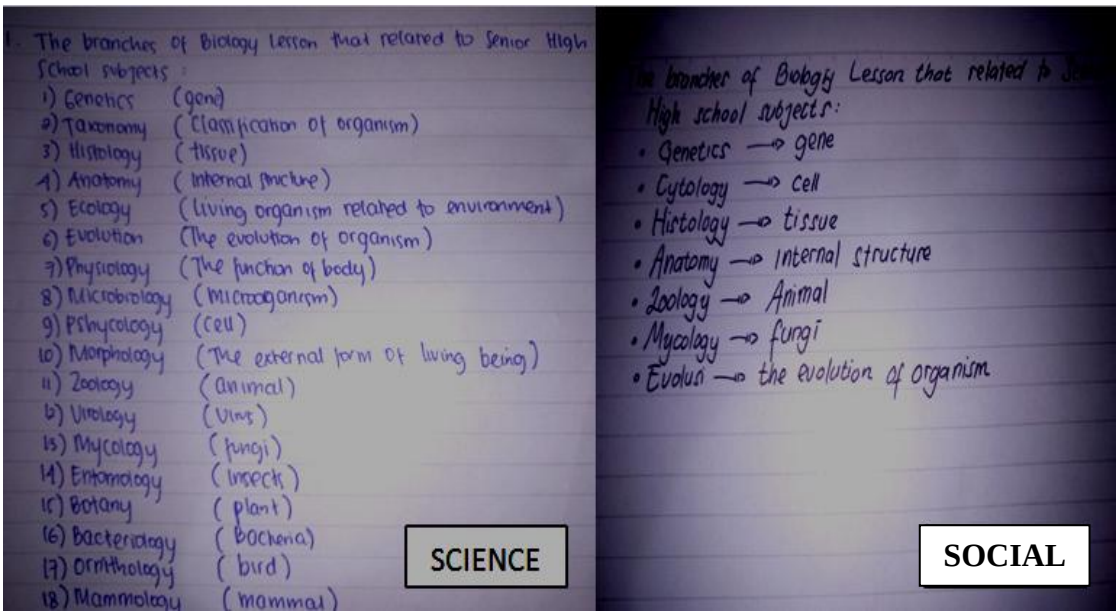

Figure 5. Different answers between science students and social students.

The low level of interest was also supported by the results of the questionnaire of social students' interest in biology lesson presented in the following diagram:

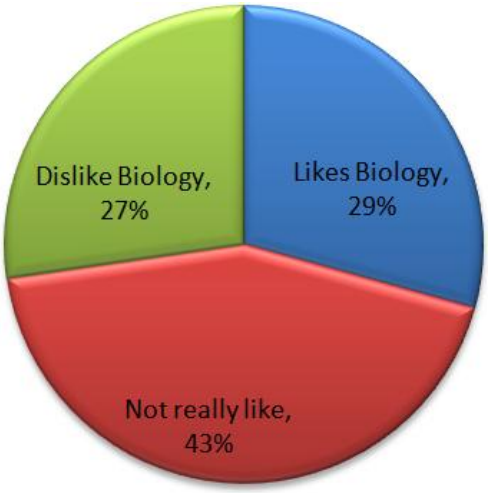

Figure 6. Percentage of interest of social students in biology lesson.

Figure 6 shows the lower percentage of students' interest in social studies in the biology lesson. Only 29% of social students like biology, 43% of social students do not really like biology, and 27% of social students did not like learning biology. The lower interest in the biology lesson in social

students can be influenced by the reason they chose biology as their cross-interest subject. There are only 23% of students who choose biology because they really like biology while 55% of students just want to take lessons that they think make it easier for them, while the remaining 15% only follow advice from school.

4. Discussion

Achievement of metacognitive in science students can be caused by a high interest in biology lesson. High learning interests will have a positive influence on metacognitive development and vice versa. This is due to the high interest in learning that can stimulate an increase in 3 important things from students which include feeling like, happy, and motivation to involve themselves in the learning phase to get the desired results [3] [18]. Another reason that can affect the achievement of metacognitive is the tendency of students who feel comfortable when learning lessons that are within the scope of their specialization. In addition, the large number of students who reach the *developing* and *Good* categories cannot be separated from a large number of students who have a high interest in the biology lesson. 96% of science students like biology and only 4% do not like biology for several reasons. This interest in learning is directly proportional to the students' reason when determining theirself to enter the science class or social class. Students who like to study biology generally consist of students who choose the science specialization class for reasons of pursuing their future goal, likes science studies, do not like social studies and some students are suggested by parents and suggested by schools. While students who do not really like the biology lesson consist of students who feel a little pressure into the science class because of suggestions from parents or from schools. Social students have lower average metacognitive achievements than science students. Social students tend to have a low interest in learning which results in a decrease in their joys, excitement, and motivation to study biology. Even when participating in learning, some social students tend to be less willing to explore their knowledge to answers a question given by the teacher.

By knowing the metacognitive achievement of science and social students, teacher can decide the next step of learning process so that it can be developed into optimal limit (with a good category or even super). One of way that can be done is the choosing of a proper teaching strategy in learning process, for example the determination of approach and learning method. Additionally, the selection of learning strategies is also an important thing in improving the quality of learning process. The learning process in the classroom will undoubtly run optimally and well when the teacher can choose the right learning strategy for the students [16].

There are so many approaches, models, and methods that can be used in learning. Approaches, models or even the methods can be applied individually or combine with each other to get a proper and optimal learning strategy. With lots of approaches, models, and methods, teacher can have so many alternative teaching strategies. Yet, teacher should be still capable in choosing a compatible strategy for their class because if they are not careful, it will make the learning process do not run smoothly and ineffective especially in improving students' metacognitive achievement.

Basically, there are some things that needed more attention from teacher before choosing and deciding learning strategy which will be use in the class such as the learning material that will be taught, the goal of learning, the class condition, and of course teacher understanding about the use of strategy. The understanding of strategy by the teacher becomes so important because it will encourage the teacher to lead the class to become conducive in learning process [13]. The understanding of teaching strategy is not only knowing the strength and weakness, but also knowing the component that needs to be fulfilled in running the strategy like learning media, the score evaluation, and the steps of applying learning strategy.

Based on the presented data above, we also know that biology is not only taught to science students but also to social students. Therefore, teacher should know how to decide the proper strategy for each classes. Teacher must not have a thought like it is only the biology learning achievement of

science student that more important than social students so that teacher is only thinking about the proper teaching strategy for science students. teacher should have a thought that social students are important too and they need the same attention although they realize that biology is only and additional subject as their learning interest so that the metacognitive achievement of science and social students can be achieved according to the expectations.

The application of teaching strategy by the teacher in learning and the result of this research about the metacognitive of science and social students is so important to do because there some reasons that picture the essential of metacognitive in learning biology especially for students. metacognition is so related to students motivation in learning. Students who have metacognitive strategy in optimal criteria, having a possibility to become an independent people so that they can manage theirself, become more active in self-developing and setting goal, also they are able to motivate theirself to try reaching their goal with the planning strategy. Metacognition can be able to lead the students to a high thinking skill that including the active control to cognitve process in learning like a better critical thinking [2]. Metacognitive also makes the students are able to monitor their result in study, keep the information of learning, take the decision about the learning that they got from the teacher or the learning they do individually. Metacognitive also possible to make them analyze their own thinking to make sure that they already make their choice dan draw smart conclusions [9].

Metacognitive is able to lead the students becoming independent, smart, and critical, because metacognitive has important components to be taught. Those components consist of an evaluation for ourself, the knowledge about cognitive capability, and the cognitive setting. The knowledge about cognitive capability is referring to students' level of understanding of his own memory, the cognitive system, and the way they learn in certain subjects. The cognitive setting is referring to how good the students can set their own learning system that include their skill in setting goals, the choice, the application of strategy, and the monitor of action [10]. If it spelled out in more detail, metacognitive teaches some important skills in learning process of students that include prediction skills, planning skills, monitoring skills, and evaluation skills [11]. If metacognitive achievement of science and social students are increasing into optimal category because of mastering all of the skills, it will create a great possibility for students to have the skill of thinking to choose the most effective strategy and evaluating the process also the result of study independently. It is so clear that it can make the teacher easier in achieving the success of learning process.

5. Conclusion

Based on the results of research and discussion of metacognitive using MAI (Metacognitive Awareness Inventory), it can be concluded that the average metacognitive science students and social students were in the same category that is in the *Developing* category. Even though they were in the same category, the metacognitive average of science students was 17% higher than the metacognitive average of social students and based on the difference test (T-test), it was obtained a significance value of 0.00 (sig. = 0.00 <0.05) which showed a significant difference between the metacognitive averages of science and social students. This is due to differences in the level of interest in learning which affects their liking, pleasure, and motivation to involve themselves in the learning phase to get the desired results. Interest in learning science students in the biology lesson is relatively higher because they tend to think of biology learning as part of their interests while social students were more likely to think of the biology lesson as an addition to the cross-interest learning program. Referring to the result of this research, the researchers suggest and hope there is a next research related to the improvement of students metacognitive about learning interest like applying learning method especially to social students.

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References

[1] Asy'ari M, Ikhsan M and Muhali 2019 The Effectiveness of Inquiry Learning Model in Improving Prospective Teachers' Metacognition Knowledge and Metacognition Awareness *International Journal of Instruction* **12**(2) pp 455-470
[2] Balim A G, Inel-Ekici D and Ozcan E 2016 Concept Cartoons Supported Problem Based Learning Method in Middle School Science Classrooms *Journal of Education and Learning* **5**(2) pp 272-284
[3] Crouch C H, Wisittanawat P, Cai M and Renninger K A 2018 Life science students' attitudes, interest, and performance in introductory physics for life sciences: An exploratory study *Physical Review Physics Education Research* **14**(01) pp 2469-9896
[4] Coymak A 2019 An Experimental Study of the Effect of Computer Assisted Learning on Metacognitive Performance Development in Psychology Teaching *Contemporary Educational Technology* **10**(1) pp 94-105
[5] Dinkel D M, Lee J M and Schaffer C 2016 Examining the Knowledge and Capacity of ElementaryTeachers to Implement Classroom Physical Activity Breaks *Int. Electronic Journal of Elementary Education* **9**(1) pp 182-196.
[6] Ellah B, Nworgu L and Achor E E 2018 Meta-Cognitive Awareness and Study Process of Senior Secondary School Science Students of Low Cognitive Ability Level *Journal of Research in Curriculum and Teaching* **10**(1) pp 161-180
[7] Stanton J D, Dye K M and Johnson M S 2019 Knowledge of Learning Makes a Difference: A Comparison of Metacognition in Introductory and Senior-Level Biology Students *CBE-Life Sciences Education* **18**(2) pp 1-13
[8] Kristiyani E 2018 Increasing Interest And Mathematical Learning Outcome In Mathematic Of Trigonometry Basic Competence (Kd) By Using Reciprocal Teaching Model For Students Of Class X Mipa 4 Sma Negeri 5 Magelang In The Even Semester Of Academic Year 2017/2018 *Indonesian Journal of Education and Learning* **2**(1) pp 142-149
[9] Kulak V, Newton G and Sharma R 2017 Does the Use of Case-based Learning Impact the Retention of Key Concepts in Undergraduate Biochemistry? *International Journal of Higher Education* **6**(2) pp 110-120
[10] Psycharis S, Botsari E, Mantas P and Loukeris D 2014 The impact of the computational inquiry based experiment on metacognitive experiences, modelling indicators and learning performance *Computers & Education* **72** pp 90-99
[11] Raes A, Schellens T, De Wever B and Benoit D F 2016 Promoting metacognitive regulation through collaborative problem solving on the web: When scripting does not work *Computers in Human Behavior* **58** pp 325-342
[12] Schraw G and Denisson RS 1994 Assessing Metacognitive Awareness *Contemporary Educational* **19**(4) pp 460-475
[13] Sieberer-Nagler K 2016 Effective Classroom-Management & Positive Teaching *Canadian Center of Science and Education* **49**(1) pp 163-172
[14] Silva P R, Andrade M A B S and Caldeira A M A 2014 Biology Teachers' Conceptions of the Diversity of Life and the Historical Development of Evolutionary Concepts *Journal of Biological Education* **9**(1) pp 1-19
[15] Suratno 2011 Metacognitive Ability with Metacognitive Awareness Inventory (MAI) on High School Biology Learning with Jigsaw Strategy, Reciprocal Teaching (RT) and Jigsaw-RT joint *Journal of Education and Learning* **18**(1) pp 11-18

[16] Suratno 2015 Empowering Students' Metacognition Skills with Learning Strategies Jigsaw Reciprocal Teaching (Jirat) *Education Journal* **17** (2) pp.151-155
[17] Suratno, Komaria N, Yushardi Dafik and Wicaksono I 2019 The Effect of Using Synectics Model on Creative Thinking and Metacognition Skills of Junior High School Students *International Journal of Instruction* **12**(3) pp 133-150.
[18] Tsai Y, Lin C, Hong J and Tai K 2018 The effects of metacognition on online learning interest and continuance to learn with MOOCs *Computers & Education* **121** pp 18-29