The analysis of students metacognitive in science with different learning environments on junior high school

N N Musyafaah[1], Suratno[2] and Nuriman[3]

[1,2,3] Magister Science Education Faculty of Teacher Training and Education, University of Jember, Jalan Kalimantan No. 37, Krajan Timur, Sumbersari, Sumbersari District, Jember Regency, East Java 68121.

Email: suratno.fkip@unej.ac.id

Abstract. The essential nature of science includes the process of observing, discussing, analyzing and representing. Science must be supported by metacognitive abilities that refer to prediction, planning, monitroring, and evaluation skills and can make students become independent learners. This research was to analyze the metacognitive of students in science with different learning environments. This research place was in Junior High School, Boarding school and Islamic Junior High School in Bondowoso. This research has qualitative descriptive study with mix method (qualitative and quantitative). Qualitative data were descriptive based on the results of observations with teachers and students. Quantitative data were from the MAI test (Metacognitive Awarness Inventory). MAI test has two indicators, namely knowledge about conditions includes declarative knowledge, procedural knowledge, and conditional knowledge, and regulations of cognition including planning, information management strategies, and monitoring comprehension. The results of this research showed a difference in metacognitive 20% in the Junior High School and Islamic Junior High School in science.

1. Introduction
Science learning is one of the sciences that studies about nature and its surroundings. The nature of science involves students in several important activities in science, namely the process of observing, discussing, analyzing data and representing the results of observations[1]. Science learning consists of 3 scientific fields, namely biology, physics and chemistry. In the nature of learning Biology in science, there are two fundamental dimensions, namely the process dimension that can be seen from the skills, values and attitudes that must be possessed in the development of knowledge that will later relate to students' metacognition abilities that are in accordance with aspects of science. One of the biology science materials is the human digestive system. The human digestive system is material that studies the entry process of food and processes in each organ which is passed by the digestive organs, both digestion mechanically and chemically. On the material of the human digestive system, students have difficulty connecting the process of entry of food from the mouth to out of the human body, this is due to the lack of media in the implementation of learning[10]. In addition, students also cannot memorize and understand how enzymes work in the digestive organs. This causes misconceptions and their value in the material of the digestive system is below the minimum standard value[2].

Science learning must make students to enjoy the knowledge they get by understanding and enjoying with activities, so that the acquisition of science knowledge can make students to construct their own knowledge and can access knowledge anywhere and anytime[9]. Therefore, to be able to go through the process of constructing, one's own knowledge by students requires one ability, namely

metacognitive. This metacognitive ability is a process that involves students to reflect, understand, remember and analyze the knowledge they learn so that metacognition occurs when individuals monitor and evaluate their own cognitive behavior in the learning environment[1]. Research conducted proves that metacognitive abilities significantly influence their learning outcomes, so they can perceive and organize new information to achieve results in learning[3]. Another research says that metacognitive can also make students to have the ability to identify their knowledge independently and express their level of understanding textually, visually and procedural knowledge for students[4]. In addition, the emergence of metacognitive abilities is also influenced by the learning environment that supports learning activities. The learning environment in question is anything that exists around students that can affect student motivation and learning activities.

2. Methodology

This research has a mixed method research. Mix method were research that combines qualitative data and quantitative data. Qualitative data were descriptive based on the results of observations, and quantitative data from the MAI (Metacognitive Awareness Inventory) test. This research place was based on 3 schools with different environments, namely Junior High School, Islamic Junior High School, and Junior High School based on Islamic boarding school in Bondowoso, East Java.

This research subjects were students of class VIII 2019-2020 school year on the material digestive system in humans. The total number of students were undertaken in the study were 173 students with 33% students in junior high schools, 33% students in Islamic Junior High School and 33% students in junior high schools based on Islamic boarding schools.

The metacognitive questionnaire data collection technique used the Metacognitive Awareness of Inventory (MAI) test, as well as observations of teachers and students. The MAI used consists of 27 points with two indicators namely knowledge about conditions including declarative knowledge, procedural knowledge, and conditional knowledge, and regulation of cognition including planning, information management strategies, and comprehension monitoring.

MAI test results has analyzed and converted into a scale of 0-100 and then categorized rating scale in table 1. Analysis of students' answers in metacognitive abilities according to 4 choices namely "always" with 5 points, "very often" with 4 points, "often" with 3 points, "rarely" with 2 points, and "never" with 1 point. The points obtained are converted to a scale of 0-100 in table 1. Data on metacognitive skills are then analyzed using the T-Test analysis program SPSS 22.0 for windows to analyze metacognitive abilities in different learning environments. The score obtained in the MAI is calculated using the following formula:
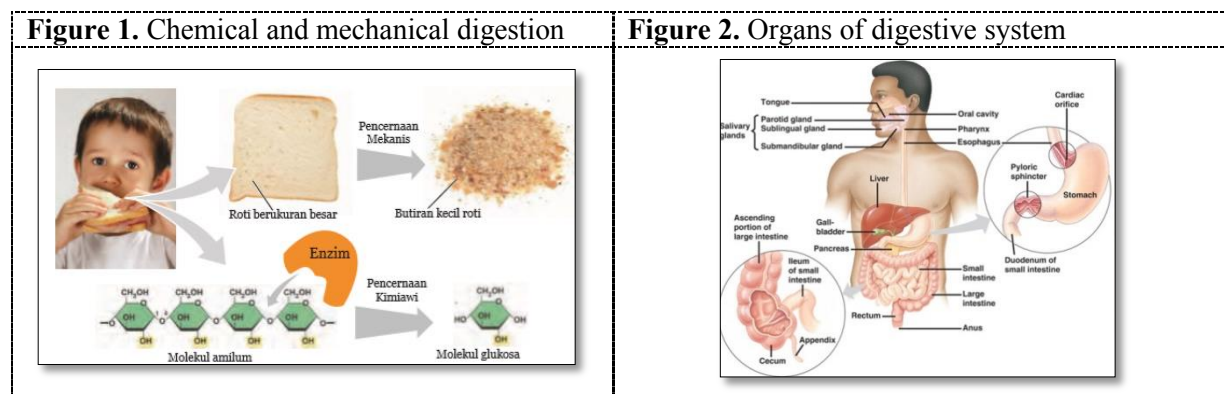
The description of this research could be comparative or narrative to several case study works or life-long research projects. It could also be an experimental works. The methods must be consisted of all research step-by-step works to be done.

$$\text{Final score} = (\textstyle\sum \text{score obtained}) / (\textstyle\sum \text{maximum score}) \times 100$$

Table 1. Criteria for evaluating metacognition

Kategori	Kriteria
$85 \leq x < 100$	Super
$68 \leq x < 85$	Good
$51 \leq x < 68$	Developing
$34 \leq x < 51$	Less capable
$17 \leq x < 34$	At risk
$0 \leq x < 17$	Not yet developed

This research uses human digestive system material with the following basic material in Figure 1 and Figure 2:

Figure 1. Chemical and mechanical digestion	**Figure 2.** Organs of digestive system

In this research, the material was used the human digestive system. Things discussed were the process of food entry and the order of the food as shown in Figure 1 through the mouth, until the exit. Based on Figure 2, students can analyze food that has been processed mechanically or chemically in the digestive organs. In this material students are expected to face many problems, and if students can solve them, then they will have learning experience and foster metacognitive abilities.

3. Results

This study aims to analyze students' metacognitive learning in different learning environments. The results of this study were on average in 3 different learning environments, namely in junior high schools, Islamic Junior High School and junior high schools based on Islamic boarding schools. The average table of metacognitive abilities in Table 2.

Table 2. Average metacognitive abilities in different learning environments

	N	Mean	Std. Deviation
Junior High School	58	75,0590	6,95783
Islamic Junior High School	56	73,8439	9,72229
Junior High School based Islamic Boarding School	59	72,4695	6,07525

Based on Table 2, the results obtained in Junior High School with 58 students, had a mean of 75.0590 and a standard deviation of 6.975. In Islamic Junior High School with 56 students, it has a mean of 73.8439 and a standard deviation of 9.72229. Whereas in Islamic boarding school-based Junior High School with 59 students the average number is 72.4659 and the standard deviation is 6.07525. This shows that there is a mean selection of metacognitive abilities in three different learning environments, where the metacognitive abilities of junior high school students are greater than the average of Islamic Junior High School and Junior High School students based on Islamic boarding schools. The results of metacognitive abilities were also analyzed using the SPSS test of the T test statistic, the results of which can be seen in Table 3. Sensitive in different learning environments.

Table 3. T-Tests for metacognitive abilities with different learning environments

	Test Value = 0					
			Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
	T	df			Lower	Upper
Junior High School	82,157	57	,000	75,05897	73,2295	76,8884
Islamic Junior High School	56,838	55	,000	73,84393	71,2403	76,4476
Junior High School based Islamic Boarding School	91,626	58	,000	72,46949	70,8863	74,0527

Based on the T-Test in Table 3, it shows differences in metacognitive abilities in different learning environments. Data on metacognitive abilities in Junior High School, Islamic Junior High School and Junior High School based Islamic Boarding school showed that (P = 0,000 <0.05) then H_0 is accepted and H_1 is rejected. In other words, there are significant differences in metacognitive abilities with different learning environments.

4. Discussion

Important aspects of science learning are related to all activities of scientific thinking ranging from attitudes, processes, products produced as well as the application of science that is applied in everyday life. In addition, natural science learning places great emphasis on personal experience so that learning processes occur and associate with relevant science theories. Science learning is learning that requires student activities because students are directly involved in the problem solving process and make students trained to always think critically and also enthusiastically in learning theories related to the experiences and daily lives they go through. In the end students are required to have competence through what they go through in the process of learning, one of the important aspects of science learning that was closely related to student activities is scientific inquiry activities, all of which apply scientific activities [11].

Based on the results obtained from students' answers about the material of the human digestive system, students explain the answer by stating that:

In figure 1: chemical and mechanical digestion. Mechanical digestion is the process when food is chewed, mixed and kneaded. This mechanical digestion occurs in some digestive organs such as in the mouth when we eat bread and then destroyed by teeth. While chemical digestion, chemical processes occur that can destroy food into smaller parts and are assisted by digestive enzymes. For example in the mouth there is also the enzyme amylase or ptyalin which functions to break down the starch molecules into maltose molecules.

In figure 2: the constituent organs of the digestive system. Students can understand if the process of food entry starts from the mouth, where the process of digestion of food goes through 4 stages, namely ingestion (the process of putting meaning into the mouth), digestion (digestion), absorption (absorption) and defecation (expenditure).

Metacognitive abilities are inseparable from the influence of this learning model systematically in improving student learning outcomes. There are two main components of metacognition, namely knowledge about cognition and regulation of cognition that is valued from metacognition awareness[14]. The process in it can periodically build knowledge conceptually various real activities starting from declarative knowledge, procedural knowledge, conditional knowledge, planning, information management strategies, monitoring comprehension, strategies for correcting errors and evaluating. Both components describe self-knowledge to be able to help create and use effective

strategies in learning, monitor understanding in learning, help evaluate business results and correct errors in understanding learning in order to improve learning and remembering ease[6]. The process in it can periodically build knowledge conceptually various real activities starting from declarative knowledge, procedural knowledge, conditional knowledge, planning, information management strategies, monitoring comprehension, strategies for correcting errors and evaluating.

Students who have metacognitive skills that are in the good category have been aware of their own thinking and can manage and process information based on their knowledge [13]. In addition, researchers also analyzed quantitative data in the form of interviews. The following is an excerpt from the interview between researcher and teacher in junior high school:

Researcher   : What do you think about the importance of the learning environment for students?
Subject 1   : The learning environment influences the development of student knowledge, and can make students to always dig deeper into their knowledge.
Researcher   : Do you experience difficulties when you are building students' metacognitive abilities?
Subject 1   : No, if students can be motivated by learning styles carried out in class and always have a high curiosity when facing the learning they get in school and also in their learning environment, then students can become independent learners because of the easy internet access when this.
Researcher   : How can you find out students have metacognitive abilities that develop?
Subject 1   : Can be done by conducting discussions, as well as tasks related to learning material, then new questions will arise about the material.

The following are excerpts of interviews between researchers and Islamic Junior High School teachers:

Researcher   : What do you think about the importance of the learning environment for students?
Subject 2   : The learning environment includes everything that supports student learning activities, if at Islamic Junior High School, students besides learning about natural knowledge, also the religious environment.
Researcher   : Do you experience difficulties when you are building students' metacognitive abilities?
Subject 2   : No, if students can easily access learning resources from anywhere.
Researcher   : How can you find out students have metacognitive abilities that develop?
Subject 2   : By knowing affective and psychomotor attitudes which are assessed during the learning process.

The following are excerpts of interviews between researchers and Junior High School based Islamic boarding school teachers:

Researcher   : What do you think about the importance of the learning environment for students?
Subject 2   : The learning environment can influence student learning outcomes and learning styles.
Researcher   : Do you experience difficulties when you are building students' metacognitive abilities?
Subject 2   : No, what is difficult is that only students in Islamic boarding schools have busy activities and if the students cannot manage their time well there is no balance between general knowledge and religious knowledge. However, it does not rule out the possibility that students in Islamic boarding schools can also be superior to their metacognitive abilities than general junior high schools.
Researcher   : How can you find out students have metacognitive abilities that develop?
Subject 2   : Judging from their learning outcomes after getting learned.

Based on qualitative and quantitative data, knowledge of cognition refers to one's knowledge of cognition which involves three knowledge processes namely declarative knowledge, procedural knowledge and conditional knowledge. Declarative knowledge were a learning strategy. Procedural knowledge about how to use learning strategies. Conditional knowledge about when and why to use the strategy [8]. Declarative knowledge in this research were regarded knowledge of knowing as a student and the factors that influence learning achievement. Individual or group students are required to know their ability to solve problems encountered in learning, find other solutions that may be effective and repeat the important points they have learned. Procedural knowledge includes knowing how to use this strategy[12]. In this indicator, it can be seen that some students have a collection of learning strategies, such as writing notes, summarizing main ideas and testing their abilities periodically. Conditional knowledge includes knowing when, how and why to implement this strategy. This indicator is proven by each group maintaining a calm and conducive atmosphere. These three types of knowledge are believed to help the reflective aspects of metacognition [12]. This metacognitive ability is also supported by a learning environment.

The learning environment is everything that is around students in learning. The learning environment referred to here is the environment of junior high schools, Islamic Junior High School and junior high schools based on Islamic boarding schools. Based on the results of the study, obtained the average metacognitive ability of students in junior high schools based on boarding schools is lower than the junior high school or Islamic Junior High School. According to research shows that learning in Islamic boarding schools emphasizes more on religious values and students who are in Islamic boarding schools are less able to access the outside world more freely and there needs to be support for their learning abilities, especially metacognitive abilities[5].

5. Conclusion

The learning environment also influences the students' metacognitive abilities. This is proven based on research in junior high schools, Islamic junior high school and also junior high schools based on Islamic boarding schools. Based on the results of the MAI (Metacognitive Awarness Inventory) questionnaire analysis, there are average differences, dominated by Junior High School, this is because the Junior High School environment then Islamic Junior High School because it allows more students to access and focus learning being learned, and supported access to deepen learning material so that it will appear students' metacognitive abilities. It is also supported based on SPSS analysis through the T Test that there is a significant influence between metacognitive abilities and student learning environments.

References

[1]   Ajaja, O P 2017 Collection and Analysis of Students' Metacognitive Orientations for Science Learning A Survey of Science Classroom in Delta State Nigeria *Electronic Journal of Sciece Education* **21** pp 1-18

[2]   Cardak, O 2015 Student Science Teachers' Ideas of The Digestive System *Journal of Education and Training Studies* **3** pp 127-133

[3]   Choy S C, Yim, Joanne & Tan L P 2019 Mediating Effects of Quality Learning on Metacognitive Knowledge Metacognitive Experience and Outcomes *Issues in Educational Research* **29** pp 1-15

[4]   Dori Y J, Avargil S, Kohen Z & Saar L 2018 Context-based Learning and Metacognitive Prompts for Enhancing Scientific Text Comprehension *International Journal of Science*

Education pp 1464-5289

[5]   Heyeres M, et al. 2018 Strengthening the Capacity of Education Staff to Support the Wellbeing of Indigenous Students in Boarding Schools A participatory Action Research Study *The Australian Journal of Indigenous Education* pp 1-14

[6]   Hoseinzadeh D & Shoghi B 2013 The role of metacognition knowledge component in achievement of high school male students *Procedia - Social and Behavioral Science* **84**

[7]   Margunayasa I Gede, Dantes, Nyoman, Marhaeni, A A I N, & Suastra Wayan 2019 The Effect of Guided Inquiry Learning and Cognitive Style on Science Learning Achievement *International Journal of Instruction* **12** pp 737-750

[8]   Ning H K 2016 Examining Heterogeneity In Student Metacognition A Factor Mixture Analysis *Learning and Individual Differences Journal* **49**

[9]   Sawatdiruk B, Siphai S, Arawan, W & Saengprom, N 2018 The Development of Inspirational Test in Learning Science for Junior High School Students in Schools Under The Regional Education Office *Educational Research and Reviews* **13** pp 786-794

[10]   Schortland L R, Locke T 2017 The Tomato Pip's Story Creative Narratives as Bridging Cultural and Science Discourses for Indigenous Students *The Australian Journal of Indigenous Education* **11** pp 1-14

[11]   Schulze S, Lemmer E 2017 Family Experiences The Motivation For Science Learning And Science Achievement Of Different Learner Group *South African Journal of Education* **37** pp 1-9

[12]   Schraw G, Dennison R S 1994 Asseing Metacognitive Awareness *Contempory Educational Physiology* **19** pp 460-476

[13]   Suratno, Komaria, N, Yushardi, Dafik, Wicaksono, I 2019 The Effect of Using Synectics Model on Creative Thinking and Metacognition Skills of Junior High School Students *Internarional Journal of Intruction* **12** pp 133-150

[14]   Wilson E E, Moneta G B 2016 The Flow Metacognition Qustionnaire (FMQ) A Two Factor Model Of Flow Metacognitions *Personality and Individual Differences Journal* **90**