STUDENTS' CONCEPT MASTERY: REASONING ABILITY AND CONCEPT MASTERY OF EVOLUTION

Helmi[1], N Y Rustaman[2], F S Tapilouw[3], T Hidayat[4]

[1]*Faculty of Teacher Training and Education, Djuanda university, Jl. Tol Ciawi No.1 Bogor,Jawa Barat, Indonesia*
[234]*Biology Education Department, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia*

Corresponding Author E-mail address: helmia.suwarjono@gmail.com

Abstract. Now a days, students tend to learn the concept of evolution through various sources independently through memorizing or reading on their own and unaware of the mutual relations among them in everyday life. The tendency leads makes learning the concept of evolution becomes meaningless and not profound, even though there are many studies that states that scientific reasoning will make the knowledge gained more meaningful and profound. This study aims to test the hypothesis, is there whether any correlation between students' concept mastery levelwith students' scientific reasoning skills in the evolution learning process. A total of 33 students participated in this study. Students' reasoning skills are obtained through the use of Test of logical thinking (TOLT), while students' concept mastery of evolution was assessed using concept knowledge assessment. The results of this study indicate that there is a correlation between students' scientific reasoning skills and students' concept mastery, where the tendency is that students who think formally are more dominant in obtaining high scores or better concept mastery of the knowledge.

Keywords: Scientific Reasoning; Concept Mastery; Evolution

1. INTRODUCTION

Scientific reasoning is a way of thinking involved in learning activities so that whatever science students learn can be more meaningful and profound. Scientific reasoning refers to the mental processes used when reasoning about scientific content, engaging in scientific activities such as designing experiments, or typical types of thinking as reasons often used in science learning activities (Dunbar & Fugelsang, 2005). Scientific thinking involves many general-purpose cognitive operations that are applied by humans in non-scientific domains such as induction, deduction, analogy, problem solving, and causal reasoning. What distinguishes research about scientific thinking from general research is that research on scientific thought usually involves the investigation of thoughts that have scientific content. As the foundation for profound and directed of the concept, scientific reasoning has an important role in the effort to get the desired conceptual changes that occur in the respondents who take part in the lecture program implemented. Scientific reasoning is the basis that supports the entire logical structure that underlies scientific research (Shuttleworth, 2019).

The characteristics of formal level reasoning consist of five things, namely: identification and control of variables, which is the ability to be able to identify the most appropriate variables, especially in solving problems (i); combinatorial thinking ability, which is reasoning ability that combines several indicators, then concluded as a result of the combination to solve problems (ii); correlational thinking ability, which is the respondent's ability to analyze problems by looking for correlation or cause and effect of the problem (iii); probability thinking ability, which is the ability to think to solve

problems through opportunities or various tendencies (iv); and proportional thinking ability, which is the ability to solve problems in proportion and combine one proportion with another (v); (Hewson, et al, 1998). Students can be categorized at the level of formal thinking if they are able to understand problems that are purely abstract, able to make hypotheses, handle problems of combination permutations well, and are flexible regardless of procedural rules that have been learned (Nur & Rahman, 2013).

Scientific reasoning is needed in teaching subjects that require profound concept mastery, such as in the course of evolution. Not only that, it requires mastery and reasoning, this course also requires students to think scientifically and make decisions about a conception based on scientific evidence and not just merely assumptions.Theory of evolution is the center of biological science, and the critical aspects of everyday life, but most people reject the theory of evolution (Grossman, 2017). Evolution is the basis of biology and scientific literacy, but in the teaching process, high school students often have difficulty mastering concept of evolution. Teachers who teach evolution face several challenges including limited knowledge of content, personal conflict with evolution, hope for resistance, and concerns about student conflict with religion (Borgerding, 2016). In his research, Abdurrahman found that students' scientific reasoning skills were able to improve the ability of concept mastery particular material (Abdurrahman, 2016). Scientific reasoning skills that tend to increase during learning, significantly can have a positive impact on learning practices for students, so that learning process becomes better and more meaningful (Steinberg & Sebastian, 2013). Training in scientific reasoning for teachers is very much needed in biology learning because such training contributes so that teachers are better prepared when delivering learning in the classroom (Stammen, 2018).

2. METHODS

This study aims to determine the correlation between the level of scientific reasoning and students' concept mastery in evolution course for students majoring in biology in the 6 th semester, the research design used in this study is correlation. According to Sukardi (2009), Correlation research is a type of research that involves all data collection activities to see whether there is a correlation or not, and see the level of correlation between two or more variables. The subjects in this study were 33 sixth semester students majoring in biology. The research was conducted at one public university in Bandung, West Java, Indonesia. Data obtained based on the value of the results of student scientific reasoning tests through the Lawson's test of logical thinking, which then compared with the data obtained from the students' concept mastery in evolution course (Lawson, 1978).
Product Moment Correlation Coefficient (PMCC) / Pearson Correlation formula:

$$r_{xy} = \frac{N\Sigma xy_{-(\sum x)}(\sum y)}{\sqrt{(N\Sigma x^2 - (\sum x)^2(N\Sigma y^2 - (\Sigma y)^{2)}}}$$

The basis of decision making, data can be said to be correlated if:
H1: if < 0.05
H0: if> 0.05

While the correlation coefficient criteria that form the basis of determining how strong the level of correlation that occur between students' scientific reasoning skills towards their evolution concept mastery can be seen in **Table 2.1**

Table 2.1 Correlation Coefficient Criteria

Interval	Correlation
00-0.19	Very Weak
0.20-0.39	Weak
0.40-0.59	Intermediate
0.60-0.79	Strong
0.80-0.100	Very Strong

3. RESULTS AND DISCUSSION

3.1. Result

The data obtained in this study follows the objectives set at the beginning. Among them is to find out how the scientific reasoning profile of students of biology study programs, then what is the level of mastery of the concept of student evolution. The most core data is how to position the relationship between scientific reasoning abilities and mastery of student concepts. In detail the findings of this study are described as follows:

3.1.1. Profile of Students' Scientific Reasoning

Data information on the level of students' scientific reasoning were obtained from the test of logical thinking conducted on 33 respondents based on the test of logical thinking from Lawson. Tests conducted indicate the level of scientific reasoning and the percentage of types of scientific reasoning that students have. The following figure shows the results of the data on measuring the level of scientific reasoning of students. We can look the level of student scientific reasoning in Figure 3.1

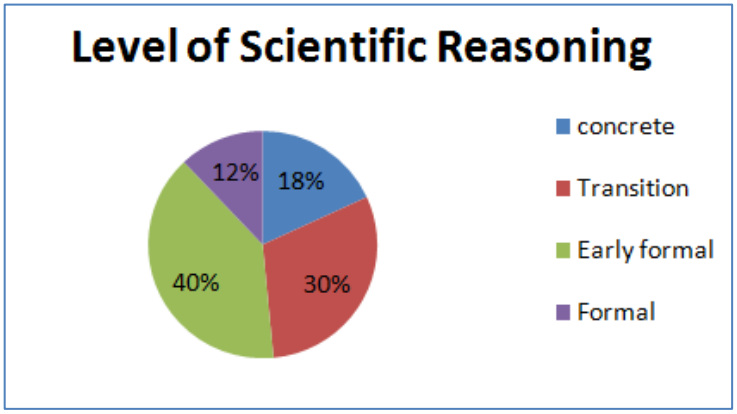

Figure 3.1 Levels of Students' Scientific Reasoning.

Figure 3.1 illustrates the mapping of the level of scientific reasoning of students. These results certainly oppose the theory of cognitive development that determines the level of scientific reasoning, where children aged over 11 years, at least 12 years, should have been at the formal operational level, with the level of formal and early formal reasoning only 52%. This study will calculate whether the level of students' scientific reasoning skills will influence the students' concept mastery in evolution learning. In this study, the comparison of values to determine the correlation between the two variables

is to give a score on the results of the scientific reasoning test and then compare it with the scores on the students' concept mastery test results on evolution concept.

3.1.2. Profile of Students' Concept Mastery on Evolution

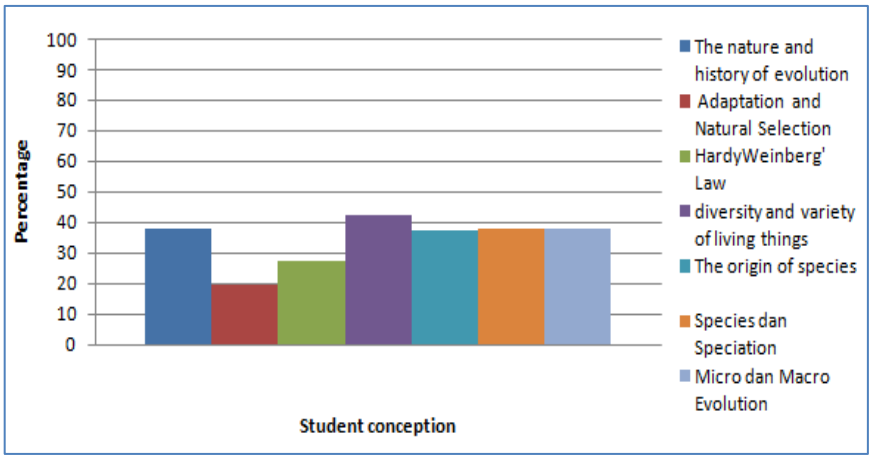

Figure 3.4. Students' Concept Mastery.

In Figure 3.4, it can be seen that the students' concept mastery is almost evenly distributed on each topic, where the percentage of students' concept mastery is in the range of 20 to 50 percent. The lowest level of concepts mastery is on the topic of adaptation and natural selection, while the highest is on the diversity and variety of living things.

3.1.1 Relation between Students' Scientific Reasoning and Concept Mastery

The correlation between the level of students' scientific reasoning and concept mastery is calculated through the PMCC formula where the aim is to find out whether there is a correlation between the level of students' scientific reasoning and concept mastery on the topic of evolution. The level of correlation can be seen in Table 3.2

Table 3.2

Correlations

		SR	PK
SR	Pearson Correlation	1	.651
	Sig. (2-tailed)		.000
	N	33	33
PK	Pearson Correlation	.651	1
	Sig. (2-tailed)	.000	

N	33	33

Based on the Table 3.2, it can be seen that the level of significance of the data is 0.000 where this significance value is expressed if the value of sig. <0.05. In this case it can be concluded that scientific reasoning has a correlation with students' concept mastery.While the level of correlation between the two variables can be seen in the value of Pearson Correlation which is equal to 0.651, so that the correlation is classified into "**strong**" category**.**

While the visualization of correlation between variables can be seen in **Figure 3.2**

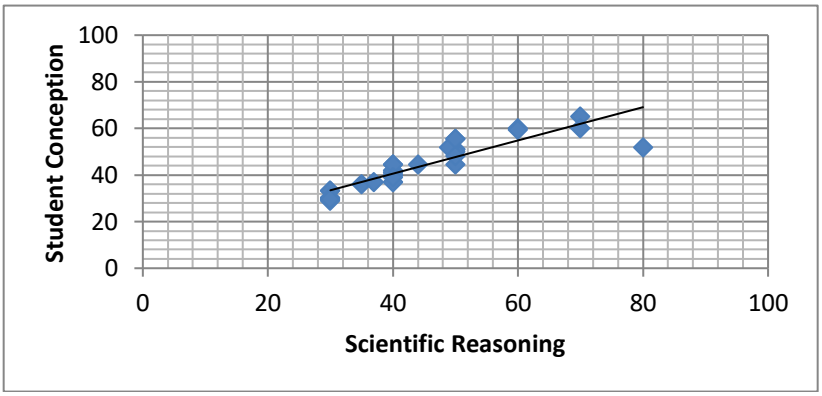

Figure 3.2. Scatter Plot of Scientific Reasoning danStudents' Concept Mastery

Figure 3.2 shows the Scatter Plot of the correlation between the two variables, namely scientific reasoning and students' concept mastery. Based on the scatter plot, it is we can see that the correlation [that occurs] is a correlation, which means that students 'scientific reasoning skills influence or positively correlate to the level of students' concept mastery in learning evolution material. These data indicate that if students have good scientific reasoning skills or are already at a formal level, students will be able to understand the concepts of evolution more easily. While if students' scientific reasoning ability is low, the ability to master the concept, or concept mastery, will also be low.

3.2. Discussion

According to the Indonesian Language Dictionary (KBBI), concepts are ideas or understandings extracted from concrete events, concepts are ideas or representations of elements or general attributes by which groups or classes can be distinguished. Knowledge that students have before learning is called prior knowledge. However, the knowledge that is possessed after learning is called concept mastery (Fraser et al, 2014). The misunderstanding of the theory of evolution occurring in the general public is quite alarming, but when misunderstandings occur in the academic field environment, this will be even more dangerous because educated people are examples or examples who should enlighten many people in this matter (Helmi et al, 2019). While conception is the ability of each individual (in this case, students) in understanding scientific concepts. Concept mastery to be measured in this study is the ability of each student to know and understand the concepts learned in

the course of evolution. As it is well known, evolution is a material which knowledge is quite controversial and may contain confusion or misunderstanding.

The findings obtained in this study were in the form of mastery of the concept of students in the course of evolution. Other data found is the level of scientific reasoning of students. The material with the highest level of misconception, the correlation between scientific reasoning and mastery of student concepts. The lowest concept of evolution possessed by students is a concept that is included in the topic of diversity and variety of living things. Based on the data seen in the scatter plot we can conclude that if scientific reasoning is located at a low level, then mastery of the concept of students is also low. this shows a strong correlation.

4. CONCLUSION

The results of this study indicate that the level of students' scientific reasoning is still at a fairly weak level. Some have reached their normal limits, which is at the operational level, but some of them in quite large percentages are at very low levels, namely transitions and operational level. However, this study has the main objective of knowing the correlation between the level of scientific reasoning and students' concept mastery, and based on the data obtained, it was found that the two variables has a strong level of correlation.

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