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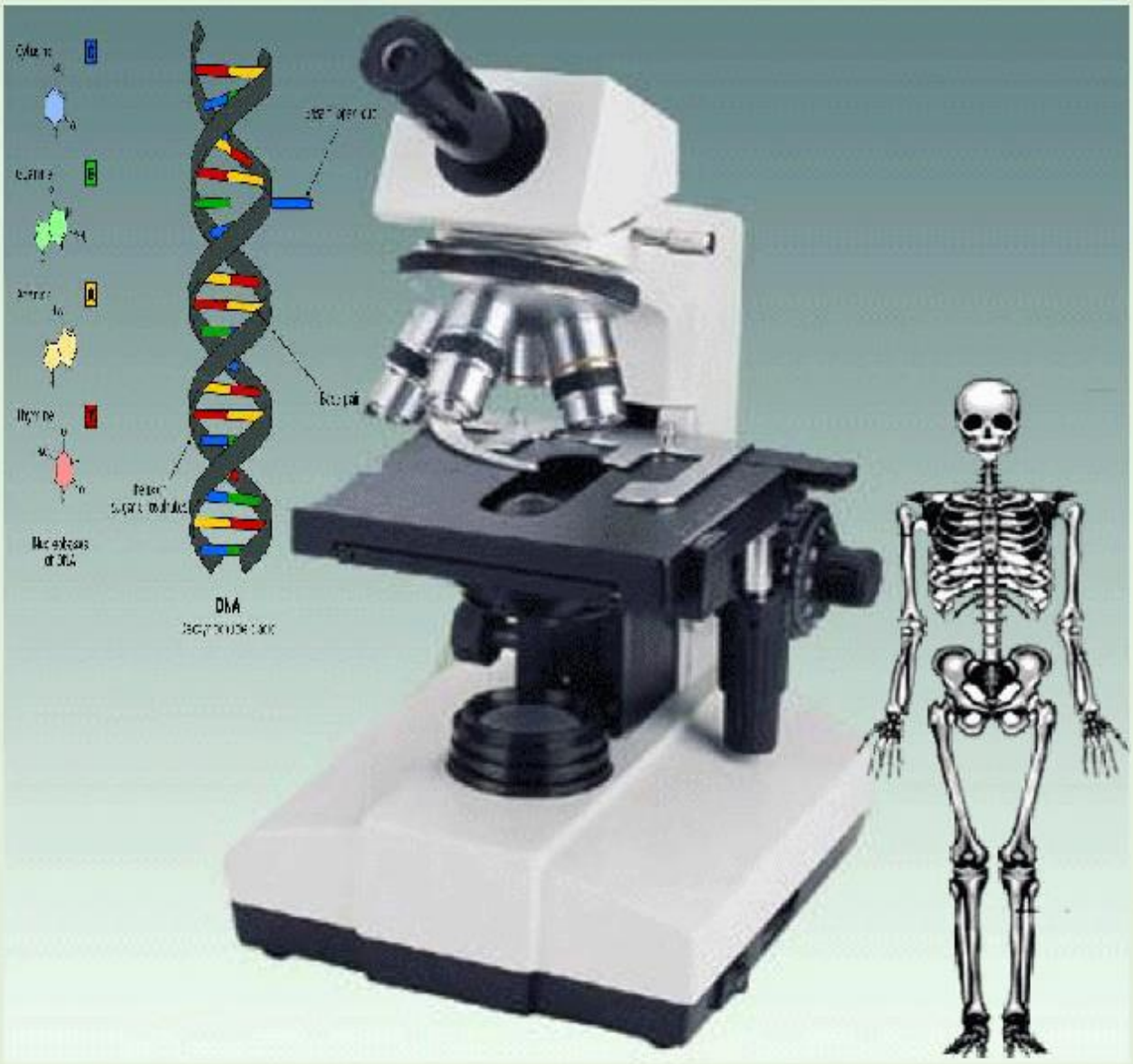

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Students' critical thinking skills and academic achievements in basic biology course: correlation-based analysis

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ABSTRACT

Critical thinking has become an important discussion over the last few decades and it is required skills of the 21st century. Critical thinking is thought to play a role in determining student success in education related to their academic achievement. The purpose of this study is to explain the correlation between critical thinking skills and students' academic achievement in the natural science education department, Universitas Hasyim Asy'ari Tebuireng Jombang. This research is a quantitative research with a correlation method which was conducted in the even semester of 2018/2019. The research sample taken was 57 students who had taken a Basic Biology course. The instrument used in the research is in the form of descriptive questions. Data were analyzed descriptively quantitative with correlation product moment analysis and continued with the ANOVA test. The research results show that there is a correlation between critical thinking skills and students' academic achievement. The contribution of critical thinking to academic achievement is 66.8% with the regression line equation Y= -37,652 + 30,177 X.

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INTRODUCTION

Globalization and internationalization are the points of education in the 21st century highlighting (Boholano, 2017) which is characterized by rapid and fundamental changes in all fields, where these changes require new skills, new ways of learning, new approaches to new knowledge and pedagogies (Hirschman & Wood, 2018). To prepare 21st century skills, the education system must be directed not only to transfer knowledge but also to be able to form quality human resources and have the competencies needed in the 21st century. In recent decades,

critical thinking has become an important discussion (Aliakbari & Sadeghdaghighi, 2013; Enciso et al., 2017; Larsson, 2017) and is an important skill possessed by the students (Prayogi et al., 2018).

Ennis (2013) defines critical thinking as rational thinking to determine what to believe and do. According to Ulger (2018), critical thinking involves thinking reflectively based on logic, focusing on determining what to believe and do. Halpern (1998) explains that critical thinking using strategies and cognitive skills that improve expected outcomes. Vijayaratnam (2009) explains critical thinking in a simple sense as the ability to think for oneself reliably and responsibly in making decisions that affect the lives of others. In this regard, Mitrevski & Zajkov (2012) states that critical thinking uses holistic thinking activities and involves higher order thinking to solve problems, make decisions and make conclusions. Furthermore, Chukwuyenum (2013) explains that critical thinking also includes logical reasoning and the ability to distinguish fact from opinion, critically checking information with various evidence before ignoring or accepting ideas regarding the problems experienced. Critical thinking skills are related to decision making, strategic planning, scientific processes and problem solving to find solutions (Bustami et al., 2019; Zulfaneti et al., 2018).

Facione (2013) explains that the cores of critical thinking are interpreting, analyzing, evaluating, inferring, explaining, and self-regulating. Interpreting means understanding the meaning of various situations, decisions, data, experiences, events, conventions, procedures, beliefs, criteria or rules. Interpretation includes skills in categorizing, decoding, and clarifying meaning. Analysis includes the skills of checking ideas, sorting and processing arguments. Evaluating means accessing accuracy of a statement or other representation that describes a person's responses, experiences, conditions, decisions, or opinions. Furthermore, inference means identifying the various elements used to draw conclusions, formulate hypotheses, take into account relevant information, and decide the impact of evidence, data and principles. Explanation relates to the skill of presenting one's thoughts in a convincing and coherent manner. The last component is self-regulation, which means self-awareness to regulate one's own cognitive activities, the components involved in these activities, and evaluation of decisions taken.

Critical thinking skills need to be empowered in the learning process at every level of education because critical thinking is the intellectual capital needed and a fundamental part of human maturity (H. Fitriani et al., 2018). Abbasi & Izadpanah (2018) explain that critical thinking as one of the 21st century skills and one of the goals of the education system that can support students to achieve success in education and get higher scores. In the same source, it is stated that students who have good abilities in critical thinking are not easily accept information from the environment, they will think about the methods they use and learn different perspectives on the problem and at the end of the problem, make the best decision and follow up. They are able to acquire knowledge on their own, evaluate various solutions and finally choose the best one. In addition, by applying and strengthening critical thinking, it allows students to improve their progress and get higher scores.

According to Thomas (2011), critical thinking can prepare students to be better able to explain reasons, make appropriate judgments and find solutions to problems, so it is very necessary. Students who have the ability to think critically mean that students have the provision to face problems in everyday life (Facione, 2013). Irwan et al. (2019) adds that students who are able to think critically tend to be confident and able to think logically and systematically to solve the problems they face. Then, a similar statement was also presented by Verawati et al. (2010) that critical thinking is very important in every action and decision because by having good critical thinking, a person will be able to solve problems. Furthermore, Wulandari et al. (2020) say that increasing the ability to solve problems logically and reflectively is very beneficial for the students when facing problems. So, when the students find various problems, they will be required to use

their thinking skills to provide solutions to these problems, so that they are accustomed to solving various problems that exist in everyday life.

Academic achievement describes the success of students in attending lectures. Thus, academic achievement describes a student's ability to understand lecture material (Rasmawan, 2017). However, the same source also stated that there is no guarantee that students who have good academic achievement will have high critical thinking skills, and vice versa. In studying lecture material, students are faced with calling for information that has been obtained during the learning process, as well as the problem solving process following standard procedures or rules that have been obtained in the learning process. When faced with problems in real life, students are required to find solutions using skills that are not trained in learning, so that it causes critical thinking to have a low relationship with academic achievement.

Basic Biology course is a course that examines the basic concepts of biology. In the natural science education department, faculty of education, Universitas Hasyim Asy'ari (UNHASY) Tebuireng Jombang, the Basic Biology course is taught in the even semester (second semester) with a point of 2 credits. It is very important for early semester students to have mastery of the basic concepts of biology as a guide to be able to understand the whole concept of biology. According to Suarniati et al. (2018), critical thinking skills must be trained on the students and cannot be obtained naturally. Through basic biology courses, students are trained to have critical thinking about biological concepts and are able to apply these concepts to solve various problems related to biology in everyday life.

Various studies have been conducted to describe the correlation between students' critical thinking skills and academic achievements. The results of research by Abbasi & Izadpanah (2018) show that critical thinking and academic achievement have a positive and significant relationship. Another study conducted by Dehghani et al. (2011) on postgraduate students also showed that academic achievement and critical thinking skills are significantly related. Furthermore, based on the research results of Permana et al. (2019), it is known that academic ability effectively contributes to students' critical thinking ability. Research by Kanbay et al. (2017) showed different results that critical thinking skills did not have a relationship with academic achievement. The results of a similar study were carried out by Shirazi & Heidari (2019) with the results that critical thinking ability does not show a significant relationship with academic achievement

Based on that explanation, the researchers were encouraged to conduct the research to identify whether critical thinking skills are related to academic achievement of natural science education department students of UNHASY in the course of basic biology. This study is different from previous research because it takes a sample of natural science department students who are in the environment of an Islamic boarding school-based university.

RESEARCH METHODS

Research Design

This research includes survey research through a quantitative approach (Sugiyono, 2019). The method used in this research is the correlation method. This research aimed to determine the relationship between students' critical thinking skills and academic achievement.

Population and Samples

The research sample was 57 students of natural science education department of UNHASY who had taken a Basic Biology course. The sampling of this research was carried out using a non-probability sampling technique, through a saturated sampling technique, in which the entire population was used as the research sample (Riduwan, 2018). This study was conducted in the even semester of 2018/2019.

Instruments

Academic achievement in this study was obtained from students' cognitive learning outcomes at the end of Basic Biology course. To measure student learning outcomes, 15 descriptive questions are used. This instrument has been tested for validation on 19 non-samples. The critical thinking instrument consists of 6 descriptive questions. The instrument has been empirically validated by the validator, a biology lecturer at the State University of Malang. The number of questions and the question topics were based on the suggestions from the validator. The questions used cover several topics. Each topic is represented by one question, which is as follows: 1) number 1 regarding smoking (respiratory system), 2) number 2 related to waste management (environmental pollution), 3) number 3 was about the use of additives in food, 4) number 4 regarding administration of vaccines in infants (immune system), 5) number 5 was related to correct sitting position (bone system), and 6) number 6 was related to eye health (sensory system).

Tabel 1. Assessment rubric of critical thinking skills

Score	Descriptors
5	• The whole concepts are precise, clear and specific • All descriptions of answers are precise, clear, and specific, accompanied by proper and true reasons, clear arguments • The flow of thinking is good, all concepts are interrelated and integrated • Grammar is precise and correct • The overall aspects are visible and accompanied by appropriate and balanced evidence
4	• Almost all concepts are precise, clear but not specific • Almost all descriptions of answers are precise and clear, accompanied by reasons and arguments but not specific • The flow of thinking is quite good, almost all concepts are interrelated and integrated • Grammar is precise and correct, there are minor errors • Most aspects are visible, but not yet balanced
3	• Some of the concepts are precise and clear • Some of the descriptions of the answers are precise and clear, accompanied by reasons and arguments but not specific • The line of thinking is not good, some concepts are interrelated • Grammar is quite good, there are spelling errors • Most aspects that seem correct
2	• The concepts are not focused or exaggerated or dubious • The answer description does not support • The flow of thinking is not good, there is no interrelated between concepts • Incorrect grammar, incomplete sentences • Few aspects that seem right
1	• All concepts wrong • The answers to the questions are not correct • The line of thinking is not good • Very bad grammar and sentences • Overall components are not sufficient
0	No answer or wrong answer

Source: S. Zubaidah et al. (2015) adapted from M. Finken & Ennis, (1993)

Critical thinking skills are measured by referring to the rubric of S. Zubaidah et al., (2015) developed by M. Finken & Ennis, (1993), as described in Table 1. The descriptors of this critical thinking skill instrument include the correctness of the concept, the relationship between concepts, the reasons that support or reject, clarity in argument, flow of thought, evaluation of logical and balanced evidence, and the use of grammar.

Procedures

This study begins with the observation of students' thinking abilities and cognitive learning outcomes during the Basic Biology learning process. Furthermore, the preparation of instruments to measure critical thinking skills and academic achievement was carried out. The instruments that have been compiled are then tested for validity and reliability. The next stage is the implementation of tests to measure critical thinking skills and academic achievement of students. The data obtained from the test answers were, then analyzed to determine the correlation between the two variables. This research procedure is summarized in Figure 1.

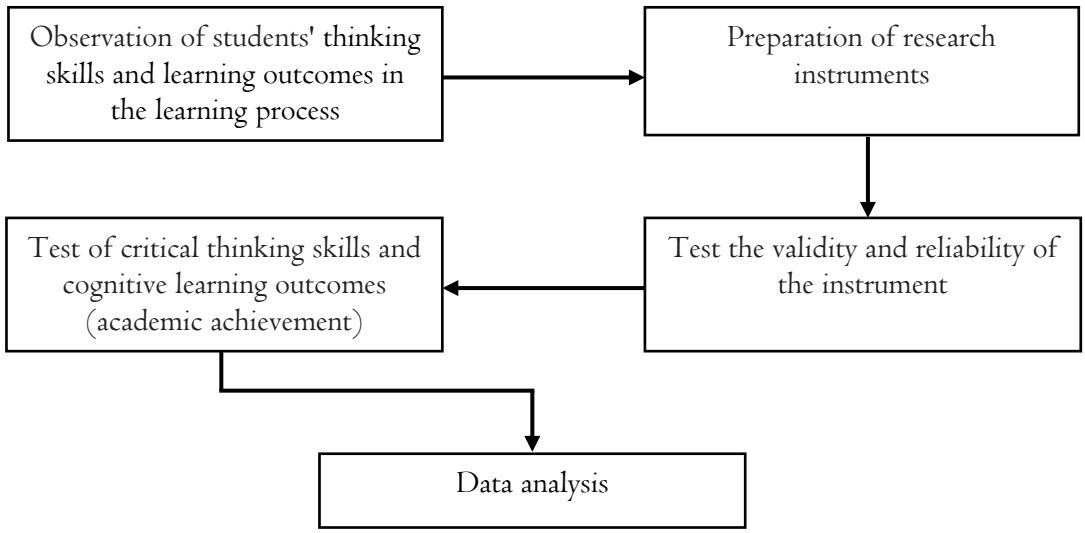

Figure 1. Research procedure.

Data Analysis

This research data were analyzed descriptively quantitative. After doing descriptive analysis, then continued with product moment correlation analysis. Furthermore, regression analysis was performed. The last step is the ANOVA test. The student's test answers are then assessed as data on students' critical thinking skills and academic achievement by referring to the following formula.

$$NA = \frac{\text{Total score obtained}}{\text{Total maximum score}} \text{ x } 100\%$$

Description:
NA = academic values or critical thinking scores
(Akbar, 2017)

The data on critical thinking skills and academic achievement obtained were then tested for normality first and then continued with descriptive analysis. The criteria for determining the normality of the data based on the following hypothesis.

H_0 = data distribution is not normal
Ha = data distribution is normal
Notes:
If the significance value is ≥ 0.05, then Ha is accepted and H_0 is rejected
If the significance value is ≤ 0.05, then H_0 is accepted and Ha is rejected

Descriptive analysis aims to explain the mean score of critical thinking skills and academic achievement data. Furthermore, quantitative analysis was carried out with product moment correlation analysis to determine the relationship between the two variables. After that, regression analysis was continued to determine the pattern of the correlation between the two variables. Next is the ANOVA test to determine the significance value of the regression between critical thinking skills and academic achievement. The criteria for determining whether there is a relationship between the two variables are based on the following hypothesis:

H_0 = there is no correlation between critical thinking skills and academic achievement
Ha = there is a correlation between critical thinking skills and academic achievement
Notes:
If the significance value is ≥ 0.05, then H_0 is accepted and Ha is rejected
If the significance value is ≤ 0.05, then Ha is accepted and H_0 is rejected

RESULTS

After obtaining the research data, then, the data analysis was carried out by starting with prerequisite tests in the form of normality tests to determine the normality of the data. The normality test results are shown in Table 2.

Table 2. Normality test results of the data

		Unstandardized Residual
N	Mean	57
Normal Parameters[a,b]	Std.	0E-7
Most Extreme	Deviation	7.61142262
Differences	Absolute	.064
Kolmogorov-Smirnov	Positive	.064
Z	Negative	-.047
Asymp. Sig. (2-tailed)		.484
		.973

a. Test distribution is Normal
b. Calculated from data

According normality test results in Table 2, it is known that the significance value is 0.973 or ≥ 0.05, so Ha is accepted. That indicates that the distribution data is normal. Furthermore, descriptive data analysis is carried out which is presented in Table 3.

Based on the results of the descriptive analysis in Table 3, it is known that the mean academic achievement score is 61.1754 and the critical thinking skills score is 3.2749. Furthermore, a correlation test was conducted to explain two variables as shown in Table 4.

Table 3. The result of descriptive analysis

	N	Minimum	Maximum	Mean	Std. Deviation
Academic	57	28.00	86.00	61.1754	13.21407
Achievements	57	1.50	4.00	3.2749	.35795
Critical Thinking Skills	57				
Valid N (listwise)					

Table 4. Correlation test results between critical thinking skills and academic achievements

		Academic Achievements	Critical Thinking Skills
Academic Achievements	Pearson Correlation	I	.817**
	Sig. (2-tailed)		.000
	N	57	57
Critical Thinking Skills	Pearson Correlation	.817**	I
	Sig. (2-tailed)	.000	
	N	57	57

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4 show that the correlation result has a significance value of 0.000 or ≤ 0.05, then Ha is accepted and H_0 is rejected. It means that there is a significant correlation between critical thinking skills and academic achievement with correlation value of 0.817, so it is said that the two variables have a strong correlation. The results of the correlation analysis are continued with the regression analysis shown in Table 5.

Table 5. The analysis results based on regression test

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
I	.817[a]	.668	.662	7.68031

a. Predictors: (Constant), critical thinking skills
b. Dependent Variable: academic achievement

The results of the regression analysis in Table 5 show R value of 0.817 and R square value of 0.668. This value of 0.668 represents the relative contribution of critical thinking skills to academic achievement of 66.8%. Thus, students' academic achievement contributed by critical thinking skills of 66.8% while the remaining 33.2% (obtained from 100%-66.8%) is determined by other factors.

The significance of the regression between the two variables was carried out using the ANOVA test which is described in Table 6 below.

Table 6. The result of ANOVA test

Model		Sum of Squares	df	Mean Square	F	Sig.
I	Regression	6533.955	I	6533.955	110.769	.000[b]
	Residual	3244.290	55	58.987		
	Total	9778.246	56			

a. Dependent Variable: academic achievement
b. Predictors: (Constant), critical thinking skills

Based on Table 6, it is known that the significance value of the regression equation between critical thinking skills and academic achievement is 0.000 or ≤ 0.05, so it can be concluded that the regression equation between critical thinking skills and academic achievement is significant. Furthermore, an analysis of the regression line equations was carried out as shown in Table 7.

Table 7. Equation of regression line

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
I	(Constant)	-37.652	9.445		-3.986	.000
	Critical thinking skills	30.177	2.867	.817	10.525	.000

a. Dependent Variable: academic achievement

Based on Table 7, the results of the regression line equation have a constant value of -37,652 and a coefficient value of 30,177, so that the regression line equation is obtained in the form of Y = -37,652 + 30,177 X. Through this equation it can be seen that for each increase of I point in the critical thinking skill score, there is an increase of 7,475 on academic achievement.

DISCUSSION

The result of this study indicates a correlation between critical thinking skills and the students' academic achievement. Critical thinking skills contribute 66.8% to academic achievement, or in another sense it is concluded that 33.2% of academic achievement is determined by other factors. Other factors referred to are, for example, the students' learning motivation, the students' learning style, family background, learning resources owned by the students and economic factors. A. Fitriani et al. (2020) explain that in addition to critical thinking, other factors that also contribute to academic achievement are motivation, metacognitive skills, self-efficacy and creative thinking skills. According to Mushtaq & Khan (2012), academic achievement is influenced by communication, learning facilities, proper guidance and family pressure. Another factor that affects academic achievement mentioned by Mohamed et al. (2018) covers learning techniques, aspects related to family, availability of physical resources and study habits. Furthermore, Olufemi et al. (2018) state that the factors that influence academic achievement come from the students' factors, parental backgrounds, school factors and teachers' factors.

This research results are in line with the research results of Dehghani et al. (2011), Vierra (2014), Abbasi & Izadpanah (2018) and A. Fitriani et al. (2020) which explains the relationship between critical thinking skills and academic achievement. A significant and positive correlation between critical thinking skills and academic achievement can be seen from academic achievement which has increased along with the increase of critical thinking. The research that has been done by Permana et al. (2019) also explains that academic ability contributes effectively to the students' critical thinking skills. Furthermore, this is reinforced by the research results of Husnah (2017) which shows that the students' critical thinking levels are significantly related to learning outcomes. The students' critical thinking contributes 82.7% to learning outcomes. The higher the level of critical thinking, the higher the learning outcomes achieved.

Related to the result of this study, the relationship between critical thinking skills and academic abilities was conveyed by Setiawati & Corebima (2017) that students who have low academic abilities also have low critical thinking skills. This is supported by Vierra (2014) that based on the test results, it is known that the students with high critical thinking skills get higher scores. Further, Kurniahtunnisa et al. (2016) explain that low critical thinking skills lead to low learning outcomes. Karbalaei (2012) also states that high critical thinking triggers students' skills, knowledge and critical dispositions which in turn can increase academic success.

According to research conducted by Afshar et al. (2014), the students who have high academic abilities have better independence and cognitive abilities than the students with low academic abilities, so that the students with high academic abilities will more easily achieve their educational goals. In line with this, Dzulkifli & Alias (2012) explain that the emotional control of the students with low academic ability is not too good when compared to the students with high academic abilities so that their thinking skills are also low. A. Fitriani et al. (2020) also argue that the students who think critically will formulate critical, logical, and effective questions based on the data and the information. Critical thinking involves the students in accessing, synthesizing and analyzing relevant information to find various solutions to problems. Thus, the students will gain a lot of knowledge so that students are able to master the material more clearly. This makes the students more successful in learning so that they will improve their academic achievement.

The results of this study explain that critical thinking skills have a strong relationship with academic achievement which is indicated by correlation value of 0.817. The results of the regression analysis also show the equation of the regression line Y = -37,652 + 30,177 X, it can be concluded that for each increase of I point in the critical thinking skill score, there is an increase of 7,475 on academic achievement. Someone who has good academic ability tends to have good ability in analyzing and evaluating their abilities. This will encourage and motivate someone to analyze the information obtained critically, for example on certain problems. Thus, it can be said that someone with high academic ability shows high performance in solving problems. When someone analyzes information critically, he will use critical thinking skills that involve complex mental activities and higher order thinking skills in processing information, considering various possible solutions with supporting evidence, making decisions and drawing conclusions to overcome the problems at hand. So, it is clear that critical thinking skills are correlated with academic achievement. In this study, students' critical thinking skills and the academic achievement were revealed in the basic biology course. By thinking critically, the students will have a deep understanding of the basic concepts of biology so that it will have an effect on their learning outcomes which in turn affects the improvement of their academic abilities.

Knowing how important critical thinking skills is in improving the students' academic abilities, the learning in the classroom is expected to integrate observation, reasoning, analysis, consideration and decision-making skills to empower students' critical thinking skills (Hidayati et al., 2019). Critical thinking skills can be developed by applying constructivist learning, such as: problem solving (Pratama et al., 2017), problem based learning (Fatimah, 2015; Husnah, 2017; A. Fitriani et al., 2020; Wulandari et al., 2020; Ritonga et al., 2021), inquiry learning (Prayogi et al., 2018; Suarniati et al., 2018; Irwan et al., 2019; Andayani & Budijastuti, 2021), STEM education (Hidayati et al., 2019), project based learning (Wulandari et al., 2020).

According to Ritonga et al. (2021), learning by giving problems provides opportunities for the students to formulate problems, estimate plans, initial hypotheses and answers in an effort to solve problems given so as to empower critical thinking skills. Furthermore, problem based learning makes students trained to uncover problems, determine actions, use arguments, formulate solutions so that students' critical thinking skills can increase (Kurniahtunnisa et al., 2016). Handayani

(2016) states that students' ability to think critically can be empowered through the habits given by educators in building and conveying ideas on problems.

CONCLUSION

According to the results of the study, it is proven that there is a relationship between critical thinking skills and the students' academic achievement with a correlation value of 0.817 and regression line equation Y = -37,652 + 30,177 X. Critical thinking skills contribute 66.8% to the students' academic achievement. Meanwhile, the recommended suggestion is that the learning in the classroom needs to be directed at empowering critical thinking skills because it contributes to improving the students' academic achievement.

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