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Research Article

The quality of student critical thinking: A survey of high schools in Bengkulu, Indonesia

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ABSTRACT

Critical thinking skills are among the main skills in the 21st Century. However, many schools in Indonesia have not trained their students' critical thinking skills optimally. The purpose of this study was to identify the quality of high-school students' critical thinking skills. A survey was conducted to 175 tenth graders who were registered in the academic year of 2017/2018. The participants came from five different state senior high schools in Bengkulu, Indonesia. An essay test was used as an instrument to measure the students' critical thinking skills. The results showed that the students' average scores on providing simple explanations, presenting advanced delineation, and making assumptions and integration were in low category (48.15, 49.46, 50.25, respectively). On the other hand, the participants obtained medium scores on decision making (68.04) and conclusion drawing (65.24) and a good score on the management of strategies and tactics (70.00). It can be concluded that the overall rating of the students' CTS was weak, and therefore requires appropriate handling. These results indicate that it is necessary to apply learning strategies that can improve students' critical thinking skills in class.

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INTRODUCTION

Critical thinking is a life skill that needs to be developed and integrated into Biology learning. In addition to teaching biology concepts, facts, and principles to the students, biology teachers are also expected to help them construct knowledge through the exploration of the surrounding nature. In fact, many schools in several countries facilitate the empowerment of CTS in the science education they organize (Donald, 2012). The exploration activities in such learning should be designed to assist the students in solving everyday problems (Alghamdi & Hassan, 2016) and create individuals who can think critically and effectively (Arends, 2012).

Critical thinking consists of the process of analyzing, synthesizing, concluding, and evaluating information (Phan, 2010) as well as deductive and inductive reasoning (Duron et al., 2006). Learners who can think critically will be able to provide logical reasoning, analyze an argument, interpret information consistently and logically, formulate a conclusion, and make a decision based on evidence using appropriate concepts, methods, and contexts (Fitriani et al., 2018; Guo, 2017). Critical thinker could to discover the truth, think systematically and independently. Critical thinkers will be able to analyze, evaluate, and interpret the information received (Ali, 2016). They can understand the situation around them and are used to solving various problems that arise in their environment (Strauss, 2016; Živkovił-, 2016).

Due to its useful function in all aspects of life, critical thinking becomes an intellectual asset for every individual. One's success in solving problems highly depends on his/her thinking skills (Kabeel & Eisa, 2016). Critical thinking skills help students express their ideas smoothly (Bustami & Corebima, 2017), grow their confidence, make wise decisions and flexible and transparent problem formulation, and develop open-mindedness, persistence, and focus on investigations (Mahmoud, 2012). Critical thinking skills also play a crucial role in the development of student cognitive, scientific, social, mental, and moral growth. Critical thinkers will perform better academically compared to non-critical thinkers. Critical thinking skills have a significant correlation with student academic performance and can significantly affect student academic achievement (Mohamed & Mohammed, 2016).

Research has shown that Indonesian students' critical thinking has not been fully developed (Mahanal et al., 2017; Zubaidah et al., 2018). This happens because the students faced difficulties in dealing with everyday problems (Zubaidah et al., 2018). Another possible cause is that because daily tests provided for the students consist of multiple-choice and low-level cognitive questions.

Interviews conducted to five biology teachers from five State Senior High Schools (SSHS) in Bengkulu revealed that the critical thinking skills of Indonesian students were not entirely empowered. The majority of the students were mostly portrayed as passive receivers of information delivered by the teacher. Besides, questions raised by the teacher in the classroom were not intentionally designed to sharpen every aspect of the students' critical thinking. Information obtained from the interviews is indeed crucial; however, considering the insufficiency of the data, a more profound and systematic analysis of the students' critical thinking skills needs to be conducted.

The importance of critical thinking skills in determining the success of high-school students in learning have been underlined in the previous paragraphs. Also, based on the explanations provided, it is evident that the students' critical thinking skills need to be empowered. In line with this statement, several studies have analyzed the CTS level of students in Indonesia. A lot of research has been done at the university level (Amin et al., 2017; As'ari et al., 2017; Fitriani et al., 2018). The other study was conducted in senior high schools (Fauzi, 2019) and others were carried out in high schools (Elisanti et al., 2018; Santika et al., 2018; Suyamto et al., 2018; Utami et al., 2018). However, most of these studies involve students studying on the island of Java. Therefore, the aimed of this current study was to identify the quality of high-school students' critical thinking skills in Bengkulu, Indonesia.

METHOD

The present study was designed as a descriptive survey that was conducted on July 2017. The research sample was selected through a school determination process which was carried out based on the value of the National Examination. Schools are categorized into schools that have graduated with high, medium and low national exam scores. The purpose of the sampling technique is used to select the subject. As a result, SSHS 2 and SSHS 5 were chosen to represent schools that scored in the high category of national exams. Meanwhile, SSHS 1 and SSHS 4 were selected to represent schools that received average national exam scores. SSHS 6 was selected as a school that obtained a low category national exam score. It involved 175 students from five SSHS, namely SSHS 1, SSHS 2, SSHS 4, SSHS 5, and SSHS 6. An essay test was designed as the primary research instrument. The test contained 10 questions on Ecosystem and Environmental Pollution. Ten questions were considered valid, with a significance value of 0.000 < 0.05 and reliable with a coefficient of 0.949.The students' critical thinking skills were assessed from six aspects: 1) providing simple explanations, 2) establishing bases for decision making, 3) drawing a conclusion, 4) presenting advanced delineation, 5) making assumptions and integration, and 6) managing strategies and tactics (Ennis, 2011).

Statistical analysis was run to analyze the data. Each of the students' answers was scored 0-4. The students' average scores were then categorized into poor (<60), medium (60-69), good (70-79), and very good (80-100) (Sudjana, 2017). The descriptive qualitative formula used to calculate the students' scores is presented as follows: score per indicator = (score obtained/maximum score) x 100

RESULTS AND DISCUSSION

The critical thinking skills of the students from SSHS 1, SSHS 2, SSHS 4, SSHS 5, and SSHS 6 Bengkulu, Indonesia are described in Table 1. In addition, recapitulation of the students' critical thinking scores is presented in Figure 1.

Table 1. Critical thinking scores of the students

No	Critical Thinking Indicators	Categories					$(\overline{X})$
		SSHS 1	SSHS 2	SSHS 4	SSHS 5	SSHS 6	
1	Provide simple explanations	Poor	Poor	Poor	Poor	Poor	Poor
2	Determine the bases for decision making	Good	Good	Medium	Good	Medium	Medium
3	Draw a conclusion	Good	Medium	Poor	Poor	Poor	Medium
4	Present advanced delineation	Good	Poor	Poor	Poor	Poor	Poor
5	Make assumptions and integration	Poor	Poor	Poor	Poor	Poor	Poor
6	Manage strategies and tactics	Good	Good	Good	Good	Good	Good

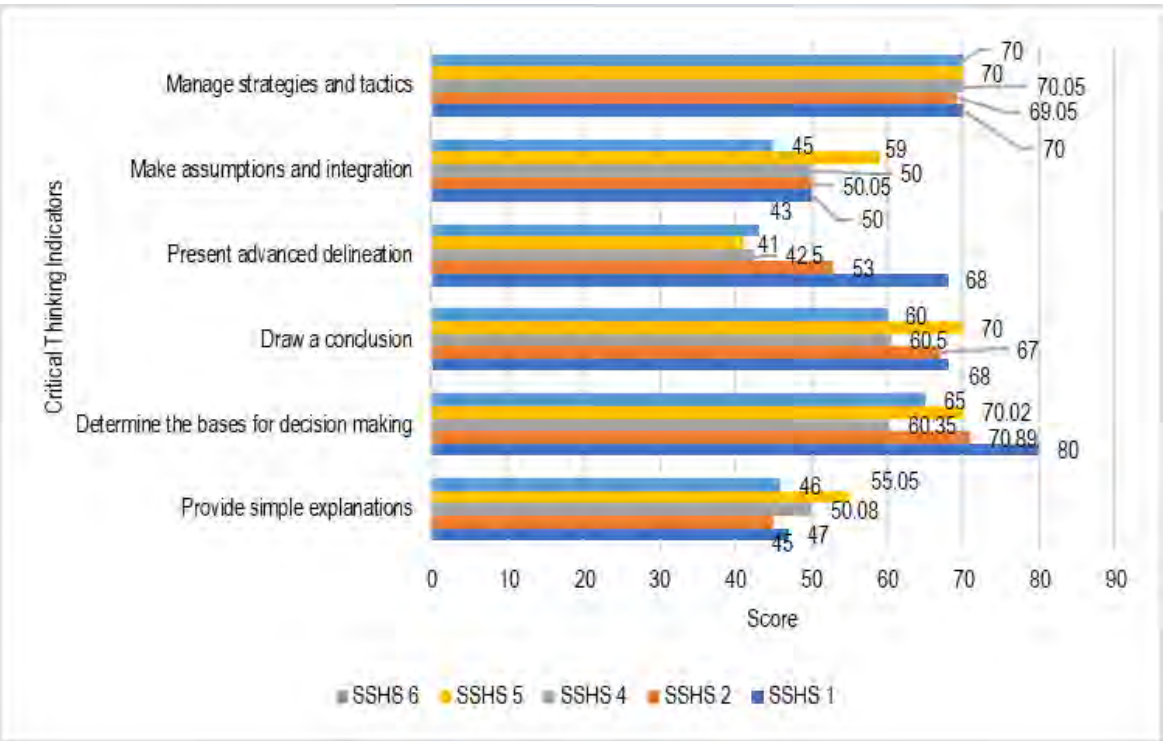

Figure 1. Students' critical thinking scores

According to the results of the statistical analysis, the students' critical thinking skills were categorized into poor category for providing simple explanations, presenting advanced delineation, and making assumptions and integration (48.15, 49.46, and 50.25 respectively), medium for determining bases for decision making and drawing a conclusion (68.04 and 65.24, respectively), and good for managing strategies and tactics (70.00).

All of the participants performed poorly in providing simple explanations. This is indicated by their inability to formulate problems or provide appropriate reasons to support their answers. An example of a weak answer given by student GN is presented below:
"*Illegal fishing is frequently performed by fishermen communities. What is illegal fishing?"*
The same pattern of the answer is also provided by student AB, such as follows:
"*Marine ecosystem is damaged by illegal fishing. What kind of activity is categorized as illegal fishing?*".

A right formulation of problems usually contains question words, such as how and why and is supported by logical reasons (Ennis, 2011). Students, as critical thinkers, should be able to provide consistent and comprehensible arguments (Fitriani et al., 2020; Wang, 2012). They, therefore, have to collect sufficient information to help them solve more complex problems. In addressing the issues, they also need to grow confidence in delivering their arguments and evaluating the evidence (Firdaus et al., 2015).

The majority of the students who came from SSHS 1, SSHS 2, and SSHS 5 obtained good scores on determining bases for decision making. On the other hand, the SSHS 4 and SSHS 6 students' scores on determining bases for decision making were categorized into medium category. In conclusion, all of the participants are quite proficient in selecting appropriate information to support their answers. An example of a good answer provided by student MN is presented below:

"*The threats to marine ecosystems in the Indonesian seas over time have become increasingly apparent and difficult to contain. These threats include microplastics in seawater. The number of microplastics in Indonesian seawater is between 30 and 960 particles/liter. Microplastic effects can threaten the existence of marine life, environment, and human health*". Student NP also prepared a similar formulation of the answer, such as follows:

"*Microplastics have become one of the important issues in Indonesia. Indonesian waters contain a large number of microplastics that threaten the existence of the country's marine ecosystems. One of the best solutions to reduce the effect is through water conservation projects".*

Critical thinking includes the ability to listen to and read the information carefully, investigate and discover an assumption, and predict a statement (Phan, 2010). Students equipped with adequate skills to think critically will possess an organized mental process that plays a significant role in decision making and problem-solving by analyzing and interpreting investigation data (Lin, 2014).

The SSHS 1 and SSHS 2 students' average scores on drawing a conclusion were categorized into good and medium categories, respectively. The following excerpt shows an excellent response provided by student AP:

"*Plastic is a type of waste that is difficult to decompose and can take up to 450 years to decay. The more plastic is produced, the higher the amount of plastic waste is accumulated in the soil, thereby reducing soil fertility. Plastic can block the circulation of air in the ground and limit the underground creatures' moving space*".

Similarly, student FK provided the following answer:

"*The constant use of plastic products will bring a negative impact on soil fertility. Besides, it is unwise to burn plastic waste because this can result in gases that can pollute the air. Air pollution is hazardous to the respiratory system organs".*

The SSHS 4, SSHS 5, and SSHS 6 students' skills to draw a conclusion were categorized into poor category. This is shown by the inability of the students to interpret terms and provide logical reasoning.

A poor answer provided by student MA is shown as follows: "*Plastic is a versatile material commonly used to package human daily needs products. Besides being lightweight, plastic is also easily shaped into various items*".

The findings of this study are in line with those by Amin et al. (2017) that underline students' struggle with analyzing and interpreting investigation results as well as connecting these results to the theories. Interpretation skills consist of the abilities to define experiences, phenomena, data, and decisions (Arends, 2012).

The SSHS 1 students' average score on presenting advanced delineation was categorized into good category. It means that the students were able to explain their answers using relevant concepts. The following shows an exemplary answer provided by student AK:
"*Germplasms, or genetic resources, are substantial part of living things serving as a source of inheritance that can be assembled to create new superior species*".

On the other hand, the SSHS 2, SSHS 4, SSHS 5, SSHS 6 students' scores on presenting advanced delineation were poor. This is indicated by the students' explanations that are irrelevant to the theories or

facts. Some of the students faced difficulties in understanding the test questions and were unable to analyze or evaluate the information, while the others were merely receiving information from the teacher. Another poor explanation is shown in student SP's answer, such as follows: "*Germplasm is biodiversity or a collection of various plant species*".

Thompson (2011) points out that students' critical thinking skills can be enhanced through connecting concepts or acquiring new information. Furthermore, research by Michalsky and Kramarski (2015) has proven that students who merely receive information from the teacher will have difficulties thinking by themselves.

This study has shown that it is hard for the students to make an assumption or integrate theories or facts into their answers. As a result, the students performed poorly in making assumption and integration. An example of a poor answer provided by student KN is presented below:

"I manage the waste by throwing them into the trash or burning them".

National Research Council (2011) states that many students are not accustomed to integrating theories or facts into their arguments because the teacher provides very few opportunities for the students to express their ideas or opinions. According to Rodzalana and Saat (2015), learning processes that are dominated by the teacher, where the students are required to take a note, may bring a negative impact to the students' critical thinking skills.

In addition, all of the participants had sufficient skills to manage strategies and tactics. The students' answers indicate that they can provide various alternative solutions to the problems and support their answers correctly.

The following excerpt contains an appropriate answer from student LP:

"*Plastic waste can be handled by the "Reuse, Recycle, & Recovery" strategy. Reuse is an effort to reuse plastic waste without performing any treatment, for example, to make embellishments. Reuse is cost-friendly. Recycle is an effort to recycle plastic waste by processing them using physical, chemical, and biological treatments into new or secondary materials for other plastic products. Recycled products are highly valuable. Recovery is an effort to select useful materials from waste without processing them using physical, chemical or biological treatments".*

The unsatisfactory level of students' critical thinking skills reported in this study could be caused by several conditions. First, they are not used to solving thinking skills-based questions. This reasoning is consistent with several studies that report that students in Indonesia are not used to answering questions based on higher order thinking skills (Fauzi & Sa'diyah, 2019; Hadi et al., 2018).

The second reason is that students still do not master the basic concepts of biology. Biology is often reported to have many difficult concepts (Çimer, 2012; Mavrikaki et al., 2012). Critical thinking is part of higher order thinking skills. Understanding the concept is the foundation of higher order thinking skills (Kamarulzaman et al., 2017).

Third, learning in schools still does not facilitate students to improve students' critical thinking skills. Most learning in schools still have not implemented a proven learning model that can empower critical thinking skills. Problem-based learning is a learning model that is often reported to be able to improve students' critical thinking skills (Birgili, 2015; Boleng & Maasawet, 2019; Masek & Yamin, 2012; Sada et al., 2016; Sulaiman & Elnetthra, 2014). Project-based learning is another cooperative learning that is also reported to have a positive impact on the development of students' thinking skills (Eldiva & Azizah, 2019; Issa & Khataibeh, 2021; Sasson et al., 2018). Unfortunately, these two learning models are still rarely implemented in various biology lessons in schools in Indonesia.

Learning needs to involve students in doing activities that empower their critical thinking skills. Students with critical thinking skills will have a thriving future. They will be able to implement their knowledge of problem-solving and become a contributing member of society. Because of that, it is necessary to design and create a conducive learning atmosphere. Furthermore, students with sufficient skills to think critically are able to make a decision based on careful considerations and thus solve problems effectively. In other words, one of the ways to evaluate one's critical thinking skills is by assessing his/her competency in drawing a wise conclusion.

Despite the interesting and important findings of this study, this study only focuses on the critical thinking skills of high school students on a particular topic in Biology that is Ecosystem and Environmental Pollution. There were only 172 students 175 tenth graders who were registered in the academic year of 2017/2018, and they were all coming from senior high schools. Further investigation can be carried out on other variables and different levels of education.

CONCLUSION

Based on the findings of the current study, the critical thinking skills of the high-school students from Bengkulu are categorized into poor category for providing simple explanations, presenting advanced delineation, and making an assumption and integration. On the other hand, the majority of the students obtained medium scores on determining bases for decision making and drawing a conclusion and good scores on managing strategies and tactics. Based on these findings, it can be concluded that the students' critical thinking skills in Biology need to be continuously developed.

Critical thinking skills are dominant skills that should be explicitly taught in 21st-century classrooms because they constitute one of the ultimate goals of education and demand of the century. The results of this study may provide insight for the researchers themselves and future researchers to improve students' critical thinking skills through, for example, implementing active and constructive learning models, strategies, or methods.

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