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Critical Thinking Skills of Junior High School Students in Science Learning

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a b s t r a c t

Critical thinking skills are part of the 21st-century skills that are important for students to have. Critical thinking skills as an asset for students to achieve success in life. The purpose of this study is to describe the critical thinking skills of a state junior high school student in Bogor in learning Science. This research is a qualitative descriptive study. The research sample was taken by purposive sampling on the seventh-grade students of a state junior high school in Bogor. The participants were 176 students consisting of 81 boys and 95 girls. The data were collected by giving a multiple-choice test with the open reason, which was developed based on the indicators of the critical thinking skills of Ennis and interviews with a science teacher. The data were processed using Microsoft Office Excel 2013, then analyzed descriptively and qualitatively. The data analysis resulted in as many as 1.70% of students being included in the critical category; 88.64% of students are in the less critical category, and 9.66% are in the far less critical category. It can be concluded that the critical thinking skills of seventh-grade junior high school students in Bogor are still low at an average of 53.07. This proves that students' critical thinking skills still need to be trained further so that they can be improved.

1. Introduction

Today's society is rich in information and knowledge-oriented (Wang, et al., 2017). This has promoted critical thinking skills as one of the skills needed in the 21st century (Alismail & McGuire, 2015; Brown, 2015; Erdogan, 2019; Pursitasari et al., 2020; Putra et al., 2018; Saputri et al., 2020). Critical thinking is associated with in-depth analysis efforts and non-subjective assessments to make the right decisions (D'Alessio et al., 2019). Critical thinking is related to thinking sensibly and reflectively in making decisions about what to believe or do (Asysyifa et al., 2019; Ennis, 1985, 1987, 1993, 2011). In addition, critical thinking is also associated with problem-solving skills (cognitive thinking), skills in providing good reasons to support ideas (intellectual autonomy), and skills in considering positive and negative aspects in the decision-making process (Chen, 2017). Thus, it can be concluded that critical thinking is a thinking skill that involves cognitive-intellectual activity by considering logical and objective aspects in making decisions.

In recent years, critical thinking has become one of the most important skills to develop (Butler et al., 2017). Critical thinking is the key to science education which aims to prepare students as responsible citizens in a world that is increasingly influenced by science and technology (Vieira & Tenreiro-Vieira, 2014). Critical thinking skills are needed in daily activities and affect students' future success both academically and professionally (Khasanah & Azizah, 2018; Quitadamo et al., 2008). Critical thinking skills are very influential in the decision-making process for real-world related problems compared to mere intelligence factors (Butler et al., 2017). For this reason, education stakeholders must be able to prepare the next generation that is ready and adaptive in responding to all demands (Fuad et al., 2017). Thus, critical thinking skills are an asset for students to be able to solve problems in life with various alternative solutions that are suitable and can be accounted for.

Teaching critical thinking is one of the main goals in science education (Radulović & Stančić, 2017). For this reason, critical thinking skills need to be developed in the school curriculum (Nilson et al., 2013; Rennie et al., 2001; Vieira & Tenreiro-Vieira, 2014). That is, schools provide services to students through teachers by presenting various learning activities that can stimulate students to carry out activities of thinking critically. Thus, a good profile of the development of students' critical thinking skills can be produced (Dahlia et al., 2018).

However, several studies reveal that the critical thinking skills of junior high school students are still at a low level (Adnyani et al., 2018; Anggraini et al., 2019; Fuad et al., 2017; Nuryanti et al., 2018; Haris et al., 2015). In addition, a fact from the test results of junior high school students in international assessment studies, known as PISA in Indonesia in 2015 and 2018 (Pratiwi, 2019; Schleicher, 2018) show a position at the same level. The low critical thinking skills of students is caused by the role of the teacher who still dominates the learning process (teacher centered) (Haris et al., 2015). The learning activities conducted have not stimulated students to take an active role in them. Therefore, teachers as educators must be able to design learning that can train students' critical thinking skills, so that students can actively develop their own thinking potential.

Science learning activities in schools have not been fully designed to develop the potential of students' critical thinking skills. Teachers and students are used to carry out teaching and learning activities contained in teacher and student textbooks which are more conceptual instead of designing their own learning activities that activate students in critical thinking processes. The learning process should be designed to employ activities that provide opportunities for students to be able to find on their own the various concepts they are studying through that learning process (Firdaus & Wilujeng, 2018). Thus, students can hone and practice their critical thinking skills to be able to build their own learning concepts through active activities in the learning process.

Various studies have been conducted in order to train or improve students' critical thinking skills in science learning, such as Research of Pursitasari et al. (2020) which aims to improve the critical thinking skills of seventh grade junior high school students through science context-based inquiry learning (SCOIL). The results of the application of the SCOIL model showed an increase in activity in the high category and N-gain critical thinking skills in the medium category. The significance test showed that the students' critical thinking skills with the SCOIL model were greater than the guided inquiry learning model. Next, the research of Putri et al. (2020) which applies the STEM integrated PBL learning model. The results showed that the application of PBL-STEM online could improve students' critical thinking skills. The results of the significance test showed that the improvement in students' critical thinking skills was greater through PBL-STEM learning than PBL learning. Student responses towards the application of PBL-STEM in learning in the Covid-19 era are also good.

In addition, the results of Fitriani and Setiawan (2017) using an ethnoscience-based science module show that an ethnoscience-based science module can effectively improve students' critical thinking skills by calculating N-Gain. The N-Gain calculation of critical thinking skills show results in the medium category and the student response questionnaire show results in the very good category. Based on the analysis of the three articles, there is no profile explanation regarding students' critical thinking skills as the subject under study. For this reason, it is necessary to analyze students' critical thinking skills holistically. Therefore, the writing of the article in this study aims to describe the critical thinking skills of seventh grade students of a state junior high school in Bogor, where the seventh grade students will be the subject of further research.

2. Method

This research is a qualitative descriptive research. This research was conducted in the seventh grade of state junior high school in Bogor, in the 2020/2021 school year. The population in this study amounted to 315 students. Determination of the number of samples was calculated using the Slovin formula with e = 5%, so the total sample size obtained was 176 students consisting of 81 boys and 95 girls.

Data collection was done using written tests and interviews with science teacher in the format of google form. The instruments used are science teacher interview sheets and critical thinking skills test developed by Ennis (1987). Ennis (1987). The multiple-choice test with open reason consists of five questions to measure five indicators of critical thinking skills, including: analyzing arguments, focusing questions, deciding an action, observing and considering the results of observations, as well as deducing and considering the results of deductions.

Testing of the validity of multiple choice items is using the product moment correlation formula (Arikunto, 2012). The reliability test for instrument in the form of multiple choice uses the Kuder Richardson 21 (KR-21) formula (Sugiyono, 2014). The instrument is said to be reliable, if the value of the reliability coefficient KR, namely r_i > 0.7 (Fraenkel et al., 2012). The research instrument is declared valid and reliable based on the validity and reliability test. Students' critical thinking skills test answers are corrected based on the multiple choice test scoring guidelines, if the correct choice gets a score of 1 and if the wrong choice does not get a score, while the answer in the form of reasons is adapted from Stiggins (1994) scoring guidelines with a score range of 1–3 shown in Table 1.

Table 1. Guidelines for scoring critical thinking skills according to Stiggins (1994)

Score Category	Score	Rating Indicator
High	3	When the answers given are accurate, focused and clear; expressing relevant points to support the answer; and the relationship between the answers to the questions is illustrated clearly.
Medium	2	If the answers given are clear and focused; the examples given are limited; and the relationship between the answers to the questions is not strong enough.
Low	1	If the answer given is not in accordance with what is intended in the question; points raised contain inaccurate and unclear information, and the examples provided are not supportive.

The scores obtained are then converted into values with a range of 0–100. The value obtained is then interpreted into the category of critical thinking skills adapted from Setyowati et al., (2011) which is shown in Table 2. The data obtained was then processed using Microsoft Office Excel 2013 and analyzed descriptively and qualitatively.

Table 2. Categories of critical thinking skills

Score	Category
$81{,}25 < X \leq 100$	Very critical
$62{,}50 < X \leq 81{,}25$	Critical
$43{,}75 < X \leq 62{,}50$	Less critical
$0{,}00 < X \leq 43{,}75$	Far less critical

3. Result and Discussion

The results and discussion are written in one unit; the author is not justified based on the results and prior discussion in the form of a new chapter. How to write in the results and discussion is done directly by reviewing directly one by one, the research results obtained with relevant references and prioritizing from primary sources. The results of the study can be equipped with tables, pictures, and graphics to clarify the presentation of the research results verbally.

At the stage of making a test to measure students' critical thinking skills, the results of the validity test of the questions obtained were r count > r table so that five questions of test instruments were valid and reliable. Based on the results of the validity and reliability tests, the test instrument can be used to measure students' critical thinking skills. The results of the validity and reliability tests can be explained in Table 3 and Table 4 below.

Table 3. The validity test results of the questions with pearson product moment

Question	t count	r table	Conclusion
1	0,659	0,235	Valid
2	0,748		Valid
3	0,638		Valid
4	0,683		Valid
5	0,564		Valid

Table 4. The reliability test results of the test instrument with KR-21

n	$\bar{x}_t$	s_t	s_t^2	r_i	r table
5	16,431	2,901	8,416	6,829	0,7

The results of the analysis on students' answers for the critical thinking skills test are shown in Table 5, that out of the five questions tested on students, it turned out that none of the students reached the high score category (three). Among them, there were 25.59% and 67.73% students who obtained the category of medium score (two) and low score (one), while 6.68% of students could not answer questions on aspect number one and number four. This is because most students have not been able to analyze arguments based on the information presented and also students have not been able to observe the data presented properly which resulted in students having difficulty in giving consideration to the results of their observations.

Table 5. Results of the analysis of student answers

No	Aspect	Score Category		
		Tall (%)	Medium (%)	Low (%)
1	Analyze argument		23,30	64,77
2	Focus on a question		32,95	67,05
3	Decide on an action		24,53	75,57
4	Observe and consider the results of observation		12,50	65,91
5	Deduce and consider the results of deduction		34,66	65,34

In addition, there is a very large difference in scores on aspect number three. Most students get low scores on the aspect of deciding an action. This shows that students are weak in expressing their own opinions. It is in accordance with the results of teacher interviews in which it is stated that during the learning process students tended to be passive and unable to express their opinions. For this reason, Patonah (2014) states that the weakness of students in expressing their opinions makes students dependent on other people instead of being responsible for their choices.

Based on the results of the data analysis, most of the students were only able to answer questions in the low score category in each aspect. Thus, it can be said that students on the average have not been able to provide clear, focused, and accurate answers, and the relationship between answers and questions is not clearly illustrated. This is because the questions presented are oriented to measure students' critical thinking skills. The questions are accompanied by stimulus that comes from real situation (Jamaluddin et al., 2020).

The form of stimulus given in this critical thinking skills test is in the form of relevant news or information and case descriptions regarding environmental pollution. The stimulus will be the source to be associated with the questions that must be answered by students. Not every answer to the questions can be found in the stimulus (Kemendikbud, 2017), but the data and information contained in the stimulus need to be analyzed so that students can formulate their own answers by utilizing the data contained in the stimulus. Therefore, processing skills such as analyzing, evaluating, or synthesizing relevant information to form arguments or reach conclusions that are supported by evidence are needed by students to be able to solve problems related to critical thinking skills (Reynders et al., 2020; Tiruneh et al., 2017).

In Table 6 it can be seen that the largest percentage is in the less critical category with scores between 45, 50, 55 and 60, the far less critical category with scores between 35 and 40, and the critical category with a score of 65. Thus, it can be concluded that the critical thinking skills of seventh graders of a state junior high school in Bogor are still low with the average grade score that does not meet the standards of the critical category. This is in line with research by Adnyani et al., (2018); Anggraini et al., (2019); Nuryanti et al., (2018) which states that the critical thinking skills of junior high school students are still relatively low.

Table 6. Interpretation of the final score of the critical thinking skills test

Score	Criteria	Total students	Percentage	Score Average
$81{,}25 < X \leq 100$	Very critical	0		53,07
$62{,}50 < X \leq 81{,}25$	Critical	3	1,70	
$43{,}75 < X \leq 62{,}50$	Less critical	156	88,64	
$0{,}00 < X \leq 43{,}75$	Far less critical	17	9,66	

Based on the results of interviews with science teacher, the low critical thinking skills of students, among others, is caused by science learning activities in junior high schools that are still oriented to mastery of concepts and are still very rarely designed to develop students' critical thinking skills. Jamaluddin et al., (2020) also stated that the assessment system implemented put more emphasis on the aspects of mastery of concepts. Most of the questions developed require answers that are rote in nature, not oriented to critical thinking skills. As a result, students become weak in reasoning, weak in analyzing, and weak in expressing opinions (Patonah, 2014; Widura et al., 2015).

In addition, there are obstacles faced by the science teacher in an effort to organize learning that can train students' critical thinking skills, namely the lack of training for science teachers, limitation of the human resources in utilizing ICT to find relevant sources, and limited time to create learning environment oriented to the development of students' critical thinking skills. In addition, learning activities carried out during the Covid-19 pandemic are still limited to online mode using the WhatsApp and Zoom applications.

Nevertheless, students' critical thinking skills can be improved through a learning process designed by the teacher. Teachers can improve students' critical thinking skills by using learning strategies that involve students actively in the learning process, focusing instruction on the learning process rather than just content, and using assessment techniques that provide intellectual challenges rather than just remembering or memorizing (Peter, 2012). Thus, students' critical thinking skills will develop if they are intentionally developed and trained by students through learning activities that are deliberately designed by the teachers to be able to improve students' critical thinking skills.

Basically, students' critical thinking skills can be trained and developed through the implementation of learning activities that are designed to improve critical thinking skills so that students can get used to using their critical thinking potential in everyday life. The writing of this research article is limited to describing the critical thinking skills of seventh graders of a state junior high school in Bogor, which is the result of preliminary research for the next research.

4. Conclusion

Based on the analysis and discussion results, it can be concluded that the critical thinking skills of seventh graders of a state junior high school in Bogor are still low. This is evidenced by the class's achievement of the average score, which is in the less critical category. Students' low critical thinking skills are due to not being used to being presented with learning activities that activate students' critical thinking potential to the fullest. This proves that students' critical thinking skills still need to be developed and trained further to be improved. One of the efforts that can be done to improve student's critical thinking skills is by designing science learning activities through the development of teaching materials in the form of e-modules based on socio-scientific issues (SSI).

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