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The Analysis Critical-Thinking Skills of Junior High School Students on Geoscience

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ABSTRACT

This research aims to analyze the critical-thinking skill of the junior high school student in Mojokerto. This research describes students geoscience conception by using question instruments related to students' critical-thinking skills. The method that used in this research was pre-experimental design with one-shot case study design and descriptive quantitative approach. The test is done online via google form. The question instrument contains 20 questions related to geoscience concept, disasters, and mitigation materials that have been validated by a validator. This research involved 107 students who were on the 7th grade of junior high school in Mojokerto. The results showed that the analysis related to geoscience knowledge of students got an average of 48.79% which was included as very low category, while the critical-thinking skills got 43% on the interpretation indicator, 52% analysis, 79% evaluation, 40% inferential, explanation. 54%, and self regulation 40% with an average critical-thinking skills of 51% which concluded in the very low category. These critical-thinking skills must be built, especially in geoscience conceptl. The accuracy of the analysis of critical-thinking skills in this research only shows the results in the Mojokerto area.

INTRODUCTION

The 21st century is an open flow of globalization that allows information and technology to develop very rapidly which will give an impact to the changing of life aspects (Wijaya *et al*, 2016). Critical-thinking is an ability or a skill to making concept, applying, analyzing, synthesizing, and evaluating the information that has been collected from the observation process (Abdullah, 2013). *Partnership for 21st Century Skill* identifies that critical-thinking skills are one that is needed to prepare the student and working world (Zubaidah, et al., 2015). Critical-thinking includes the individuals skills to make a reason effectively, ask a question and solve the problems, analyze and evaluate, critically describe the decision and the process (Guo, 2016).

In this research, an analyze of the critical-thinking skills of student about geoscience will be carried out. Knowledge of earth science is needed so that people can significantly avoid and cut the damage caused by extreme incident to became the main life disaster (Hariyono, *et al*, 2016). This is due to the geographic location of Indonesia which is prone to disasters, raise the victims, environmental damage, the losses of properties and impact the psychology (Permenkes, 2014). Some supporting factors in advancing geoscience education in science learning at the level of junior high school according to Anggrayni, *et al* (2020) among others (1) global sources of profit or income depend on energy source the involved nature were depent on geosciences knowledge; (2) air, soil, minerals, and other resources are a step towards the increasing human population and the global world of global domination today; and (3) recent climate

change has caused concerns related to sea level rise, drought, forest fires, storm intensity and so on.

The results of research at MTs Al Hidayah Karanggupito show low critical-thinking skills with a percentage of 16,75% explanation indicators; 33,33% self-regulation; 41,18% evaluation; 50,20% interpretation; 33,33% inferential, and 62,75% analysis (Nikmah, *et al*, 2019). In line with research at junior high school 6 Mojokerto it is categorized as very poor by getting a value interval of less than 62 out of 30 students on earth layer material (Nurdyanto, *et al,* 2017). Critical-thinking also not only about the skill to think in accordance with the rules of logic and probability, but also the ability to apply the things that already known to real life occasion, which do not depend on the availability of content (Karakoc, 2016).

This research aims to analyze the critical-thinking about geosciences and the ability to contribute in the form of thinking in an effort to minimize disasters. Another function of this analysis is as input for educators in designing appropriate learning to gain critical-thinking skills (Nuryanti, *et al,* 2018), in the geoscience field on junior high school level.

RESEARCH METHOD

General Background

This research used a pre-experimental design with a one-shot case study design and a descriptive quantitative approach. Descriptive research was a research that aims to describe a state or phenomenon as it is without manipulating the object of research (Sukmadinata, 2015). This research analyzed the reliability of some items based the results of Anates V4 program. The test instrument uses a *google form* created by researchers which consists of 20 questions about geoscience and opinions on disaster mitigation in a multiple choice form. Multiple choice questions will increase the variety of items that can be used in the assessment, so that the assessment instruments obtained can accommodate broad thinking skills (Hartini &Sukardjo, 2015).

The basic competencies that support the tools are structured research mastering of the dynamics and earth role as a system in our living, the aspects of understanding of the inter-dependences between the human and the earth, understanding the concept of the layers of the earth, understanding the potential of various natural disasters such as volcanoes and earthquakes in Indonesia, understanding the role of vigilance response against disasters. The research was focused on understanding 3 sub-materials, namely geoscience, natural disasters and their mitigation. In this case, students' knowledge will be measured critical-thinking skills.

Sample / Participants / Group

Participants in this research involved 107 students who were on the 7th grade of junior high school in Mojokerto, East Java, Indonesia. Samples were taken heterogeneously from all schools in Mojokerto.

Instrument and Procedures

The criteria for the validation results are described in Table 1 and are calculated by the following formula

$$R = \frac{s}{N} \times 100\%$$

(Widoyoko, 2017)

Informations:
R = Average score
S = Number of scores obtained
N = Maximum number of scores

After knowing the validity value of each expert, then combining the results of expert validity and analyzing all expert validators using the following formula

$$M_R = \frac{\sum R}{N}$$

(Sudijono, 2017)

Informations:
M_R = Average combined score
$\sum R$ = Number of scores obtained
N = The number of validators

The instrument has validly categorized if the instrument measures the mastery abilities in measured domain (Arifin, 2017). Instrument in this research has valid category after reaching more than 50% and the instrument is suitable for use (Riduwan, 2014).

Table 1. Criteria of validity coefficient.

Validity coefficient	Criteria
75 ≤ VC ≤ 100	Very valid
50 ≤ VC < 75	Valid
25 ≤ VC < 50	Enough Valid
0 ≤ VC < 25	Less Valid

(Riduwan, 2014)

Critical-thinking indicators used in this research are according to Facione (2015). Here is a table to present the relevance of critical-thinking skills indicators to question test indicators.

Table 2. The linkage indicators question and critical-thinking skills.

Indicators Critical-Thinking	Indicator Question
Interpretation	Identifies use the earth's core
	Categorizing mitigation efforts before the earthquake
	Interpreting disaster prone locations volcanoes based on the image
	Categorizing ideas to solve the problem of flooding
Analysis	Solve the relationship of air pressure in the atmosphere
	Trobleshooting tsunami mitigation
Evaluation	Declare benefits of volcano
Inferential	Inferring the atmospheric layer
	Making generalizations of the water cycle
	Summarizing information relevant to the flood problem
Explanation	Identifying the stratosphere layer
	Identifying the ozone layer
	Identifying flood issues or flood problems
	Applying earthquake mitigation solutions

Indicators Critical-Thinking	Indicator Question
Self Regulation	Deciding flood prevention strategies
	Evaluating self explanatory answers
	Evaluate yourself for inferential answers about the water cycle

Data Analysis

Data analysis using descriptive analysis through techniques percentage for each indicator according to Purwanto (2013). The result of the score will be interpreted with the criteria according to the following table.

$$\% \text{ score} = \frac{\textit{average student score}}{\textit{maximum student score}} \text{ x } 100\%$$

Table 3. The Criteria of critical-thinking skills.

Interval Score	Criteria
86 % < N < 100%	Very High
76 % < N < 85%	High
60 % < N < 75%	Enough
55 % < N < 59%	Low
N < 54%	Very Low

(Purwanto, 2013)

RESULTS AND DISCUSSION

The following are the results of the validation of the question instruments used

Table 4. Expert validation results of instrument test.

Validation Aspects	Validation Result
Question items according to achievement indicators	97%
The question material being asked is relevant	92%
The subject matter is clearly formulated	86%
The working instructions are clear	89%
Communicative	95%
Standard common verb	88%

The validation of the test for critical-thinking was carried out by three junior high school science teachers. The validation aspect shows that each aspect has a very valid level of validity. A good quality test must meet the test requirements, namely validity, reliability, objectivity, practicality, and economics (Arikunto, 2013). Limitations in this research only use validity and reliability requirements. The test is said to be valid if the test can provide appropriate information and can be used to achieve certain goals (Oktanin, 2015). The validity of the items needs to be sought to find out which questions are not feasible and cause low validity (Utomo, 2018). Rationally, the instrument validity can be seen in terms of the suitability of the contents of the questions with the material and indicators (Oktanin, 2015)

The reliability analysis of the instrument was obtained from the results of Anates V4 by getting a value of 0.82 and it was stated that the critical-thinking instrument test that used in the research was reliable with a very high category. The test is said to be reliable

if the test produces consistent data whenever the test is carried out (Kusairi, 2013). The test is said to be reliable if the test will always give the same results if the test is given to the same group at different times or occasions (Oktanin, 2015). The reliability of multiple choice questions is obtained from product moment correlation result of instrument analyze (Paskalin, 2020). The criteria for the correlation coefficient range from 0.00 to 0.19 are stated to have very low reliability, the r coefficient of the range 0.20 - 0.39 is stated to be low reliable, the range 0.40 - 0.59 is declared sufficient, the range 0.60 – 0.79 were declared high, and the range 0.80 - 1.00 was declared very high (Arikunto, 2013). The conclusion of the item reliability refers to the reliability coefficient criteria of the test with the standard formula r_{11} 0.70. If $r_{11} > 0.70$; then the questions being tested have high reliability. Conversely, if $r_{11} < 0.70$; then the questions tested have low or unreliable reliability (Wijaya, 2019).

The geoscience test score in critical-thinking obtained an average of 48.79% which is categorized as very low category. Here is a graph of the distribution of critical-thinking skills test scores of junior high school students in Mojokerto.

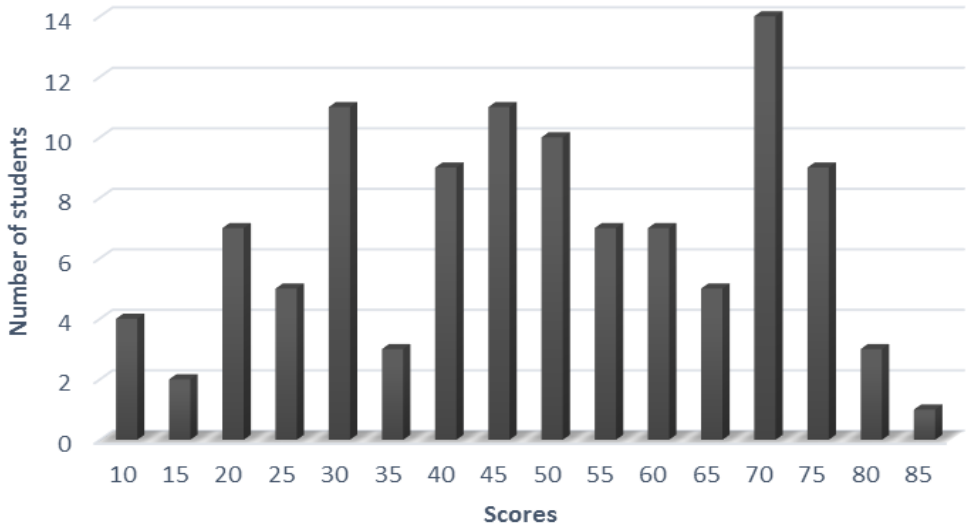

Figure 1. Distribution of geoscience test scores of junior high school students.

The results of the geoscience test score distribution for junior high school students in Mojokerto, the highest average score obtained by students was 70, but the score was not enough to meet the minimum criteria for junior high school science subjects. The minimum completeness criteria are set by the teacher board at a school (Permendikbud, 2016). Based on interviews with teachers in the field of science study, it would be better if the average student had a minimum achievement of 75 so that the geoscience conceptual ability of junior high school students in Mojokerto was included as the category of needing improvement. Hariyono (2016) states that earth science was dominated about theoretical studies and does not focus on the efforts for preparing student awareness about disasters. The learning process should be able to provide a stimulus to students so that they can develop thinking skills such as critical-thinking (Permendikbud, 2013). Education quality, it is necessary to habituate critical-thinking in students in every lesson (Sarjono, 2017). The skill to critically thinking is not only

needed in the educational process to get high scores, but is also used to help deal with problems in everyday life and careers (Gormley, 2017).

Other factors that can affect students 'scores in answering questions are the students' initial ability, the student's concentration when working on the questions, and the time to work on the questions. There are internal and external factors that affect material achievement (Kallesta, 2017). One of the external factors is that the teacher does not provide motivation and learning resources are less supportive.

Analysis per critical-thinking skills indicators is also presented in graphical form. The following graph is the acquisition of critical-thinking skills scores for junior high school students.

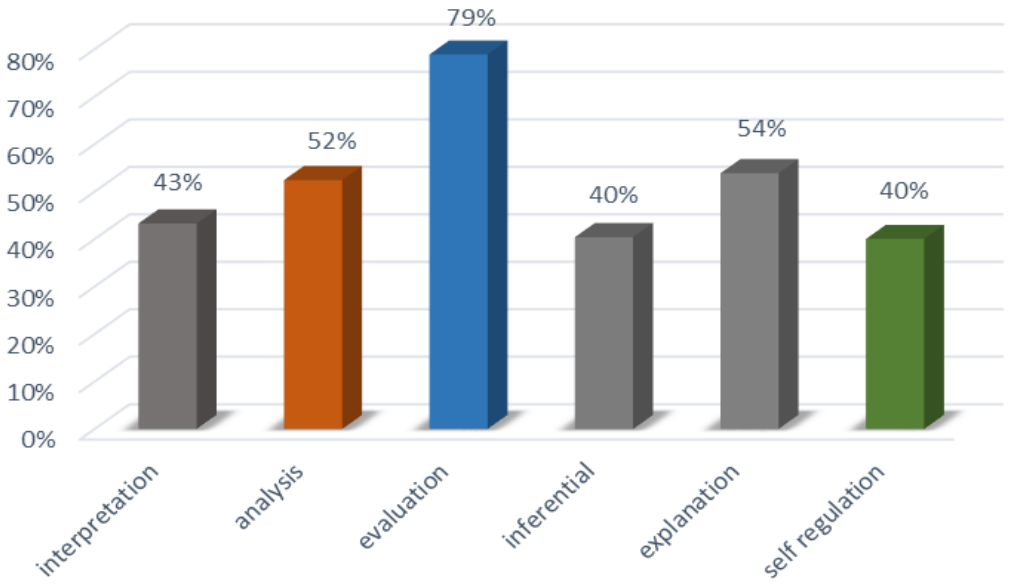

Figure 2. Percentage of critical-thinking indicators.

Displaying the results of critical-thinking skills on the concept of geoscience is categorized in the following explanations:

Table 5. Percentage critical-thinking skills indicator of junior high student.

Critical-Thinking Indicator	Percentage (%)	Criteria
Interpretation	43	Very Low
Analysis	52	Very Low
Evaluation	79	High
Inferential	40	Very Low
Explanation	54	Very Low
Self Regulation	40	Very Low
Average	**51**	**Very Low**

In the results gained from 107 junior high school students in Mojokerto, it is known that students still do not have good critical-thinking skills in the material of geoscience, disasters and their mitigation which obtained an average result of 51 as very low category. Critical-thinking skills are needed, especially in geoscience material for the future, to compete globally. Critical-thinking skills are part of 21st century skills that

emphasize a discovery-based learning process that focuses on real global problems (Puspita, *et al,* 2017).

The low ability of students to think critically can occur because the learning applied in schools is still dominated by teachers so that they do not give and prepare a material to train the students's critical-thinking (Nuryanti, *et al,* 2018). Agree with Mabruroh & Suhandi (2017) that the learning method applied has not stimulated and fostered students' critical-thinking skills. Yuliati (2013) which states that teaching critical-thinking requires practice to have it. Have a less ability to think critically because in learning they still prioritize the process of remembering and memorizing the concepts obtained only from books and teachers. Not accustomed to practicing critical-thinking indicators in learning and still not empowering critical-thinking skills (Agnafia, 2019).

In education, constructivist learning theory not only provides knowledge, but is also able to give the students some opportunities to find and apply their own ideas (Trianto, 2014). The low ability to think critically will adversely affect education. Critical-thinking skills are trained so that students can make a decisions in analyzing their thinking and drawing conclusions appropriately (Nikmah, 2019). Critical-thinking skills can guide the student to decide something and take action on the problems faced and equip them to face every problem encountered in everyday life (Hartini & Sukardjo, 2015).

The following are the indicators of critical-thinking skills for each geoscience test question that are answered correctly:

Table 6. Percentage of indicators of critical-thinking skills on each geoscience test question.

Critical-Thinking Indicator	Test Question Number	Percentage (%)	Criteria
Interpretation	3	40	Very Low
	6	34	Very Low
	9	30	Very Low
	11	42	Very Low
	15	70	Enough
Analysis	10	68	Enough
	12	29	Very Low
	14	54	Very Low
	17	58	Low
Evaluation	13	79	High
Inferential	1	30	Very Low
	8	53	Very Low
	18	37	Very Low
Explanation	4	50	Very Low
	7	60	Enough
	16	52	Very Low
	19	43	Very Low
	20	65	Enough
Self Regulation	2	31	Very Low
	5	50	Very Low

The acquisition of interpretation indicators with the lowest percentage of students answering correctly, namely 30%, is indicated by test question number 9, where in this question students categorize mitigation efforts before the earthquake with a total of only 32 students who answered correctly. Almost the same answer resulted in the

students being wrong in giving their opinion. The difficulty level of the test is also caused by the complexity of the test subject and the condition of the answer choices because tests often present students who are confused and alternative answers that are also homogeneous or sentences that are too difficult to understand (Hanifah, 2014)

The analysis indicator obtained the lowest percentage, namely 29%, which was indicated by the test question number 12 with only 31 students who answered correctly on the question indicator solving the concept of the relationship between air pressure in the atmosphere. This maybe because of the lack of students understanding in terms of molecular relationships in the atmosphere, which so far have only been imagined by abstract thinking. Factors which determine student learning success is the ability to think abstractly (Suliman, *et al,* 2017). Abstract is a natural process of mind that focuses on some aspects of the state to make decisions and the process of making concrete situations by finding new meanings to build interconnections in various whole elements (Yusepa, *et al,* 2018)

The evaluation indicator obtained a good percentage, namely 79% with test question number 13 with the number of students who answered correctly as many as 85 of the total students on the question indicator stated the benefits of volcanoes. Therefore, it can be concluded that students are able to evaluate a question posed in the question. Evaluation ability is the activity of making an assessment with the value of an idea, creation, method or method (Yudhanegara, 2015). In line with the acquisition of critical indicators according to (Nikmah, *et al,* 2019) who get high scores with sufficient categories on the evaluation indicators.

The inferential indicator obtained the lowest percentage, namely 30%, indicated by the number 1 test question with the number of students who answered correctly as many as 31 on the question indicator to generalize the water cycle. In this case, students feel that they are unable to conclude correctly regarding the images presented. Basic competencies that sometimes become difficult for students are when summarizing news or text content, concluding ideas, finding information from tables or pictures (Wuryani, 2014)

The explanation indicator obtained by the lowest percentage was 43% which was indicated by the test question number 19 with the number of students who answered correctly as many as 46 of the total students on the indicators identifying the stratosphere layer. Students still do not understand the layers of the earth, resulting in poor learning outcomes in identifying the stratosphere. Atmospheric material is material that requires critical-thinking skills (Mukarromah, *et al,* 2020). The ability to think critically in earth topics, especially atmsofer, needs to direct students to think in solving environmental problems, provide solutions (Sholihah, *et al,* 2016)

In the self regulation indicator, the lowest percentage was 31% which was shown by the number 2 test question with the number of students who answered correctly as many as 33 on the indicator questions self-evaluating against inferential answers about the water cycle. This can happen because students do not understand the water cycle which is only presented in the form of pictures without any direction in answering the questions. The learning outcomes of class X senior high school 1 Mawansangka Tengah show an average value of 64 in the hydrosphere material (Fitriono &Ramli, 2017)

Based on the results, the analysis obtained by the students, there is a need for mitigation assistance by keeping an eye on the environment, the concept of geoscience is also trained so that it can be used as the basis of future life. Components in geoscience

that include geoscience knowledge, predictive skills, and decision -making skills will be indispensable to face present and future challenges (Hariyono, 2018).

One way to gain critical-thinking skills such as modifying learning strategies or methods (Nikmah, *et al,* 2019). Learning models, strategies, methods or learning techniques used must be interactive, inspirational, challenging, fun, motivating, and encouraging student interest in learning (Wijayanti, *et al,* 2015). The learning method will affect the results and enthusiasm for learning, especially in the ability to think critically, especially in expressing opinions. A learning model that has the potential to improve students' critical-thinking is a model that facilitates interaction between students, such as debates, group discussions, asking open-ended questions, solving problems, evaluating and applying concepts to solve problems in new situations (Agboeze &Ugwoke, 2013).

CONCLUSIONS

Based on the result, we can conclude that students are very low in critical-thinking on the concept of geoscience, disasters and their mitigation even though the evaluation indicators are categorized as sufficient. These critical-thinking skills must be trained continuously, especially in geoscience material. The accuracy of the analysis of critical-thinking skills in this research only shows the results in the Mojokerto area, so that further research can be carried out in disaster-prone areas such as coastal areas, mountains, and so on. Further research is also expected to solve the low thinking skills of students by using several efficient models to train or improve critical-thinking skills, especially in relation to global issues.

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