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Analysis of Junior High School students' critical thinking ability on ecosystem materials

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Abstract. This research aims to determine junior high school students' critical thinking ability on ecosystem materials. This research is a quantitative descriptive research with number of sample 54 junior high school students in Sleman Regency selected by purposive sampling technique. The instrument used was essay test of critical thinking ability on ecosystems materials. Data analysis was performed in quantitative percentages. Based on analysis of the results, the critical thinking ability for material ecosystems indicator is analyze the facts/problems (47.22%), identify problem (38.70%), clarify/ evaluate logical ideas (33.89%) and make conclusions (27.59%). Based on these results, the average critical thinking ability in the ecosystem material is 36.85%. This percentage showed that junior high school students' critical thinking ability on ecosystem material were in the low category. Therefore, critical thinking ability must become serious concern and appropriate learning innovations need to be developed so that students' critical thinking ability in learning science can be better.

Keywords: *critical thinking ability, junior high school, ecosystem*

1. Introduction

Natural science is part of scientific knowledge, so as scientific knowledge have the characteristic tentative, subjective, empirical based, is the result of human imagination and creativity, and is embedded socially and culturally [1]. In addition, science is also a scientific discipline that includes knowledge, activities, and methods to understand natural phenomena and can solve problems in life [2]. Science learning emphasizes direct experience to develop competencies so that students are able to understand the environment through a process of discovery and carrying out activities that will help them to gain a deeper understanding [3]. This competency is also expected to equip students to continue developing to be able to compete in The Industrial Revolution Era 4.0.

Industrial Revolution 4.0 is defined as a revolutionary change based on a variety of the latest technology [4]. In The Industrial Revolution Era 4.0, there were indirectly demands to improve the capabilities and skills of human resources through education [5]. The Industrial Revolution Era 4.0 has also changed the landscape of educational innovation to focus on preparing graduates for the future life and work achieved by The Industrial Revolution Era 4.0, where more intelligent robots will replace humans in certain activities [6]. In response to these needs, Education 4.0 aligns people with technology to deal with new possibilities [7]. Technology in the world of education provides an opportunity for students to find and analyze information, solve problems, communicate and collaborate, because it provides provision of competencies to be able to compete in The Industrial



Revolution Era 4.0 [8]. One of the competencies is related to problem solving skills/ critical thinking ability.

The ability to think critically is an important ability in the world of education that needs to be developed by everyone including students at school so they can make decisions wisely in everyday life [9]-[11]. Therefore this ability becomes an indispensable ability. The ability or skills to think critically have been trained early on in school because of the demands of the curriculum that students must have Higher Order Thinking Skills (HOTS). However, in reality these abilities, especially the critical thinking of junior high school students are in the low category in some natural science material that is studied and tested in the National Examination [12]-[14]. Data from Kementerian Pendidikan dan Kebudayaan [15] shows that the achievement of the mean value of the ecosystem concept that is very close to the daily lives of students in UNBK (National Exam) has not yet been classified in either category. This shows that gaining expertise in critical thinking is difficult [16]. Though contextual learning material such as ecosystem material should be more easily understood by students. Because in accordance with its objectives, contextual learning will encourage students to be able to apply knowledge and skills that have been learned into their lives. Based on this and related to the final project research that will be carried out, this study aims to find out how students' critical thinking ability on ecosystem materials as a preliminary study.

2. Research method

This research is a quantitative descriptive study. This research was conducted in September 2019. The research sample was 54 8th grade students selected using purposive sampling technique. The instrument used was a test of critical thinking ability on ecosystem materials. The test instrument consists of 8 essay test items that have been developed by researchers and have been validated by experts. The test instrument used included four indicators of critical thinking ability with 8 question indicators listed in table 1.

Table 1. Grids of critical thinking ability instrument.

Critical Thinking Ability Indicators	Question Indicators
Analyze Facts/ Problems	1. Students are able to analyze facts based on the phenomenon of interaction in the form of webs and food chains in an environment 2. Students are able to analyze facts based on the constituent components of the environment in an ecosystem
Identify Problems	3. Students are able to identify problems regarding the constituent components of the environment, food chains and energy flow in an ecosystem 4. Students are able to identify a problem regarding symbiotic phenomena and changing patterns of ecosystem that occur in an environment
Clarify/ Evaluate Logical Ideas	5. Students are able to clarify concepts about symbiotic problems that exist in an environment and provide logical ideas about that 6. Students are able to clarify concepts about food chain problems and changing patterns of ecosystem and provide logical ideas about that
Make Conclusions	7. Students are able to make conclusions based on the phenomenon of changing patterns of ecosystem presented 8. Students are able to make conclusions based on the phenomenon of energy flow and the material cycles presented

Data analysis results of students' answers in the form of scores were obtained by assessment according to the rubric. Scores obtained by students are then converted to percentage form and then categorized. Percentage of critical thinking ability calculated by the equation:

$$\bar{X} = \frac{\Sigma X}{n} \times 100\%$$

Where $\bar{X}$ = expected percentage value, ΣX = raw value obtained, dan n = maximum score. The percentage of students' critical thinking ability analysis results are converted into categories according to Widoyoko [17] in table 2.

Table 2. Assessment category.

Percentage (%)	Category
$80 \leq x \leq 100$	Very Good
$60 \leq x < 80$	Good
$40 \leq x < 60$	Fair
$20 \leq x < 40$	Low
$0 \leq x < 20$	Very Low

3. Results and Discussion

The measurement results and analysis of the data obtained can be seen in figure 1. Figure 1 shows a graph of the results of measurements of critical thinking abilities of junior high school students on each ecosystem concept in the form of percent.

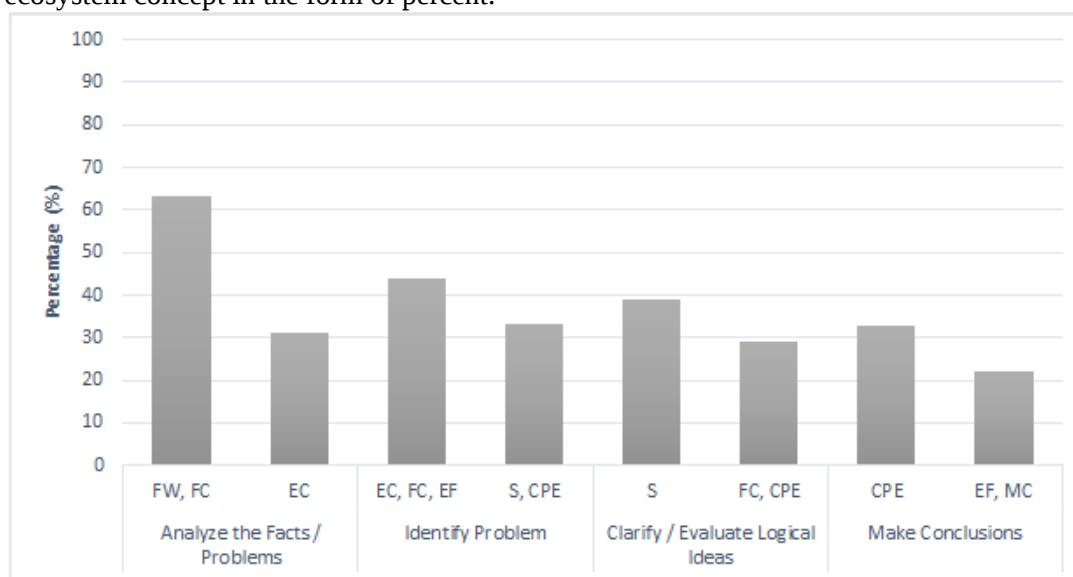


Figure 1. Percentage graph of critical thinking ability for each concept.

The critical thinking ability tested in this study include 4 indicators, namely analyze the facts/problems, identify problems, clarify/ evaluate logical ideas, and make conclusions. Each indicator is used to measure the ability to think critically on certain concepts or concepts combined with needs. The concepts can be seen in figure 1 marked by the acronym under the histogram including food webs (FW), food chains (FC), environmental constituent components (EC), energy flow (EF), symbiosis (S), changing patterns of ecosystem (CPE), and the material cycle (MC).

The ability to think critically analyze the facts/ problems in this study measures the concept of food webs, food chains and environmental constituent components that are tested with two different questions. The first question measures the ability to analyze the facts/ problems for the concept of food webs and food chains, the result is 63.33% which is included in good category. These results indicate that in the concept of webs and food chains, most students have no difficulty in analyze facts, so that the desired facts can be easily found. Whereas in the second question which measures the ability to analyze the facts/ problems for the concept of the constituent components of the environment obtained

results of 31.11% which fall into the low category. In contrast to the previous problem, the students' answers show that they did not really do the analysis in the pictures provided so that the desired facts were not fully explored. This happens because students are accustomed to solving problems without going through the analysis step first [18]. Low analytical ability can affect students' understanding of material that will complicate them in the problem solving process [19]. Therefore in learning especially science learning, students must be trained and given habituation to analyze a facts/problems.

The ability to think critically identify problem in this study measures the concepts of the environmental constituent components, the food chain, energy flow, symbiosis, and changing patterns of ecosystem that are tested with two different questions. The first question measures the ability to identify problems for the concepts of the environmental constituent components, the food chain, and energy flow, the results of 44.07% are included in pair category. These results indicate that some students can identify the problem described in the question, in this case students can study the relationship between the data presented and also map the problem quite well. While the second question measures the ability to identify problems for the concept of symbiosis, and changing patterns of ecosystem, the result is 33.33% which is included in low category. Students' answers to this questions show that they are actually able to identify existing problems, but they don't and tend to focus on solutions to solve these problems. In fact, when students are able to identify existing problems, then they will have the attitude to find better solutions [20],[21]. Emphasis on what is really desired on the identification question here is needed, so that students do not neglect the identification steps that should be taken.

The ability to think critically clarify/ evaluate logical ideas in this study measures the concepts of symbiosis, food chains, and changing pattern of ecosystem that are tested with two different questions. The first question measures the ability to clarify/ evaluate logical ideas for the concept of symbiosis, the result is 38.89% which is included in low category. Whereas the second question measures the ability to identify problems for the concept of the food chain and changing pattern of ecosystem, the result is 28.89% which falls into the low category. These results indicate that the ability to clarify/ evaluate students possessed on ecosystem material is still low. Critical thinking ability that involve evaluating thinking through process-oriented classifications such as inquiry and the nature of science as well as the ability to make arguments are important abilities [22],[23] and need to be trained in science learning.

The ability to think critically make conclusions in this study measures the concept of changing patterns of ecosystems, energy flow, and the material cycle that is tested with two different questions. The first question measures the ability to make conclusions for the concept of changing pattern of ecosystem, the results is 32.96% which is included in low category. While the second question measures the ability to make conclusions for the concept of energy flow, and the material cycle, the result is 22.22% which falls into the low category too. Just like the ability to clarify/ evaluate, the ability to make conclusions that students have on ecosystem material is also low. This is supported by the answers written by students, they are only able to make basic conclusions and statements expressed by students in concluding are still low [24]. Making reasonable conclusions is closely related to relevant information regarding data, questions, principles, evidence, judgments, beliefs, opinions, concepts, descriptions, questions or other forms of representation [25]. Students must really understand the relevance of the problem presented before they can make a certain conclusion and then state it in oral or written form. So the ability to make conclusions of students, especially for ecosystem materials still needs to be trained and improved.

Overall based on the graph shown in figure 1, the average critical thinking ability can be calculated based on the number of indicators tested including the ability to analyze the facts/ problems, identify problems, clarify/ evaluate logical ideas, and make conclusions. The average ability to analyze the facts/ problems in the ecosystem materials obtained a percentage of 47.22% which is included in fair category. While the average ability to identify problem, clarify/ evaluate logical ideas, and make conclusions on ecosystem materials successively obtained percentages of 38.70%, 33.89%, and

27.59% which fall into the low category. It can be concluded from this acquisition that students generally have the ability to think critically in the low category with an average percentage achievement of 36.85%. This illustrates that students' critical thinking ability are still in separate parts that are not even relevant to the facts and are not comprehensive so that most students have not been able to develop logical and critical ideas or even conclude problems to solve a problem [25], [26]. Based on the analysis of the answers written on the answer sheet, students actually know that even most of them understand the concepts in the ecosystem materials being tested, but they still cannot apply it in more complex cases or problems. Students are still confused to apply the knowledge and concepts that they already have to solve ecosystem problems, which means students are not yet able to think critically on ecosystem materials. Learning innovations in the form of tools and media can be used as an alternative for teachers to improve and measure students' critical thinking ability [27], [28]. Therefore, it is necessary to develop learning innovations that can train and improve students' critical thinking ability, especially in science learning. In addition to the interests of learning and teaching activities, this critical thinking ability is important for students to be able to interact in society [29] and also compete in the Industrial Revolution Era 4.0.

4. Conclusion

Junior high school students' critical thinking ability in the ecosystem materials is classified into low category. This is indicated by the average percentage of the overall who gets the results of 36.85%. Therefore, the critical thinking ability of junior high school students on ecosystem materials must still be a serious concern due to the low achievements in almost all indicators and concepts tested. Educators need to develop appropriate learning innovations to improve students' critical thinking ability in learning science especially in ecosystem materials.

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