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Profile of Critical Thinking Skills of Students in High School on Climate Change and Waste Recycling Materials

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ARTICLE INFO	ABSTRACT
	Critical thinking, which involves higher order thinking activities (HOTS), is an important skill that has been widely discussed in the last two decades. This study aims to determine the profile of high school students' critical thinking skills on climate change and waste recycling. It is a quantitative descriptive study using an instrument developed based on indicators of critical thinking skills developed by Ennis in 1985, namely providing simple explanations, building basic skills, concluding, providing further explanations, and setting strategies and tactics. The study participants were 102 senior high school students in Pontianak Indonesia who were selected through the purposive sampling technique. The results show that the critical thinking abilities related to each indicator had highest scores of two aspects that is basic skills and drawing conclusions. The simple explanation indicator scored 59.42%; that of building basic skills 71.37%; that related to drawing conclusions 67.62%; the explanation indicator 42.44%; and the setting strategy and tactics indicators 66.87%. The conclusion is that students' critical thinking skills are only sufficient to poor category.

1. INTRODUCTION

In the last two decades, discussion of critical thinking skills as an educational goal has increased (Ayub, Afifah, Verawati & Hikmayanti, 2021; Indah, 2014; Lieung, 2019). Critical thinking is vital when people are faced with the rapid flow of information resulting from the explosion of technology and information, from which everyone must be able to choose what is relevant and valid (Cahyono, 2017; Prasetyo, 2018).

Critical thinking is a part of high-order thinking, which is reasoned and reflective, and helps decide what to believe or do (Ennis, 2013; Widhy, Nurohman, & Wibowo, 2013). It involves thinking carefully and is one of the most satisfying aspects of being an adult (Chaffe, 2010). Education experts agree that critical thinking cannot be separated from education itself (Utami, Saputro, Ashadi, Masykuri & Widoretno, 2017).

It is the first line of defense when receiving information that is not always reliable. Fundamentally, an important characteristic of critical thinking is the search for basic evidence to justify a point of view (Ku, Kong, Song, Deng, Kang & Hu, 2019). It refers to a person's ability to take responsibility for their thoughts and to develop appropriate criteria and standards to analyze (Shirkhani & Fahim, 2011).

Critical thinking is easy for those characterized as being critical thinkers (Amin & Adiansyah, 2018). Many different factors can affect related skills, one of which is the type of assessment used in the classroom (Shirkhani & Fahim, 2011). Someone who thinks critically can ask appropriate questions, collect relevant information, sort the information efficiently and creatively, find logical reasons from the information obtained, and can make reliable conclusions (Schafersman, 1991). A critical thinker not only has cognitive skills, but also must have the thoughts and initiative to make good judgments (Birjandi & Bagherkazemi, 2010).

Individuals who think critically also tend to be skilled to think and have the tendency to believe and act in line with their own reasons (Kholidah, 2019; Mabruroh & Suhandi, 2017). The level of a person's critical thinking skills is influenced by learning experiences; if during the learning process they are often stimulated to undertake critical thinking activities, they will develop good critical thinking skills (Stephani, 2017; Suraya, Setiadi, & Muldayanti, 2019; Utami, Saputro, Ashadi, Masykuri, Probosari, & Sutanto, 2018).

Indications of critical thinking skills include analytical thinking, focus, depth, and taking multidisciplinary approaches to solving problems so that alternative solutions can be found (Mabruroh & Suhandi, 2017; Yulianti, 2015). The abilities that appear as subscales in the critical thinking ability indicators are analysis, synthesis, problem recognition, evaluation, drawing conclusions, and assessing the validity and reliability of assumptions and data sources (Ashar, Nurpadilah, & Jamilah, 2018; Birjandi & Bagherkazemi, 2010; Chan, 2013)

The purpose of critical thinking is to achieve in-depth understanding (Ashar, Nurpadilah, & Jamilah, 2018). This generally needs to be improved because it affects students' ability to find the truth about events and information in everyday life (Ashar, Nurpadilah, & Jamilah, 2018; Sabekti & Khoirunnisa, 2018). Critical thinking skills are very useful for students either in the present or future, and can be used in the classroom, the workplace and even in daily life (Birjandi & Bagherkazemi 2010; Kris, 2015).

The critical thinking skills of individual students differ depending on how often exercises are conducted to develop them (Fakhriyah, 2014). In general, students have critical thinking skills in learning, for example asking questions, proposing hypotheses, classifying, observing, and interpreting (Yustyan, Widodo, & Pantiwati, 2015). Such skills can be developed in learning that activates students, motivating them to be free to think (Istinah, 2013). Developing children's critical thinking skills can be achieved by constantly giving them the opportunity to think in more depth at every grade level (Kurniawati, Wartono, & Diantoro, 2014).

There are 13 indicators for measuring critical thinking skills according by Ennis (1985) and grouped them into five major activities: 1) providing simple explanations with sub-indicators, focusing on detailed questions formulating problems and criteria to determine answers; 2) building basic support with considering credibility of source and observing the result of observations; 3) making interference with considering the result, induction, and values of decision; 4) providing further clarification by sub-defining terms and considering premises and details of the operational form; and 5) developing strategies and tactics with deciding on an action and interacting with other people.

In Indonesia, critical thinking is an important component of the 2013 curriculum, considered as one of the higher order thinking skills (HOTS) (Azizah, Sulianto, & Cintang, 2018). The 2013 curriculum demands that the learning materials provided to students go up to the metacognitive stage, which requires students to be able to predict, design, and estimate. This is explained in the attachment to the regulation of the Indonesian minister of education and culture number 21 of 2016. Based on this explanation, the application of critical thinking skills in learning is very relevant to the 2013 curriculum. The learning of such skills lies in Core Competency in Indonesian education standards number 4, namely skill competence. Skill competence is related to the application of knowledge gained by students in everyday life; it can be through observing, asking, trying, reasoning, presenting, and creating activities.

Based on the results of interviews using open-ended question with teachers at senior high school number 10 Pontianak, critical thinking is an important theme that is encouraged. However, such thinking is difficult to understand both in terms of components and indicators, so it becomes a separate part of learning. Based on the discussion above, this study aims to determine the profile of the critical thinking skills of students at senior high school in relation to climate change and waste recycling.

2.   RESEARCH METHOD

To establish the profile of students' critical thinking skills related to climate change and waste recycling, a quantitative descriptive study was conducted. The study sample were 102 students at senior high school in Pontianak Indonesia of the 2019/2020 academic year, who were selected purposively. The data collection employed a test instrument with six description statements representing five aspects of critical thinking skills, with reference to Ennis (1985), namely providing simple explanations, building basic skills, concluding, providing further explanations, and managing strategies and tactics. Before the data collection was made, the test instrument was tested using validity and reliability tests. The results of the validity test show that out of the 12 questions tested, only six were declared valid. The reliability test was performed using the Alpha formula (Riduwan, 2004), which scored 0.908, meaning it has very high reliability (ST). Before the test was performed, a critical thinking skill grid was first constructed, as shown in Table 1.

Table 1. Critical Thinking Skills Test Grid

Critical thinking indicator	Critical thinking sub-indicator	Sub-indicator details	No question
	Focusing the question	Identifying or formulating a problem	1

Elementary clarification		Identifying or formulating criteria to determine answers	2
Basic support	Adapting to the source	Ability to give reasons	3
Inference	Considering the results of the induction	Generalising	4
Advanced clarification	Defining and considering the terms	Operational form	5
Strategy and tactics	Interacting with other people	Labeling	6

The descriptive data analysis was conducted by analyzing students' answers according to the scoring rubric that had been determined and adjusted to the category of critical thinking skills levels, using a score range of 0-3. Table 3 shows the scoring rubric used to calculate the percentage of critical thinking skills.

After the test results were obtained, they were processed in the form of values within a range of 0-100. The formula for processing the scores into values was as follows:

$$= \frac{the\ number\ of\ students\ who\ answered}{total\ number\ of\ students} \times 100 = Score$$

The values obtained were then interpreted to determine the level of students' critical thinking skills, referring to the value interpretation intervals used by Purwanto (2013), as presented in Table 2.

Table 2. Classification of Percentage Index of Critical Thinking Skills

Skill Level	Category
86-100%	Very good
76-85%	Good
60-75%	Sufficient
55-59%	Insufficient
<54%	Poor

Source: Purwanto (2013)

Table 3. Critical Thinking Skills Scoring Rubric

No.	Critical Thinking Skills Indicator	Answer Criteria	Score
1.	Elementary clarification	Gives correct and understandable answers and reasons	32
		Gives the right answer but the reason cannot be understood	
		Gives the right answer but does not give a reason	1
		Giving wrong answers or does not give answers	0
2.	Basic support	Answers according to theory and in a complete way	3
		Answer according to theory but not in a complete way	2
		Answers, but not related to theory	1
		Answers wrongly or gives no answer	0
3.	Inference	Answers based on facts and concludes correctly	3
		Answers based on facts but the conclusion is incorrect	2
		Answer is not based on facts and a wrong conclusion is given	1
		Answers wrongly or gives no answer	0
4.	Advanced clarification	Answers based on the information in the question correctly	3
		Answers based on the information in the question but incorrectly	
		Answer is not based on the information in the question	
		Answers wrongly or not at all	
5.	Strategy and tactics	Provides the right explanation and uses the correct and complete strategies and tactics	
		Provides accurate explanations but inaccurate or incomplete strategies and tactics	
		Gives an explanation but this cannot be understood	
		Answers wrongly or gives no answer	

Source: Larasati (2018)

3.   RESULT AND DISCUSSION

The results of the critical thinking skill profile that was conducted over the students were varied, as shown
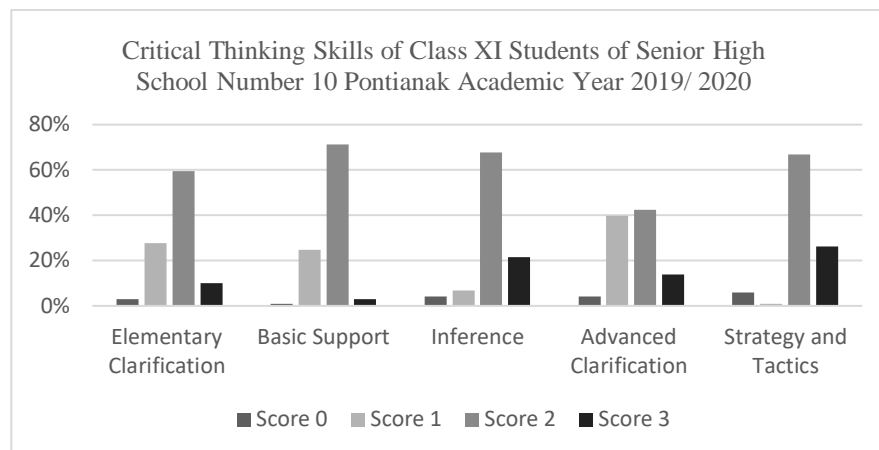
in Figure 1.

Fig 1. Critical thinking skill indicator percentages

The first image of each indicator has the highest percentage are in the score 2. On the indicator gives a simple explanation that consists of 2 questions with the form of questions to formulate the problem and formulate criteria to determine the answer has a percentage of 59.42 % with sufficient category according by Purwanto (2013). For this indicator, the students were given about the form of the case study about air pollution, especially that caused by fires resulting in smoke. The students were then asked to formulate two problems based on what they had read. Furthermore, question 2 was a continuation of question number one, which was to identify answers that were in accordance with the formulation of the problem that has been prepared by students. Students' skills in answering question number 1 were considered lacking because they were not able to formulate problems and or criteria to determine the answers. Students already gave the correct answer, but it cannot be understood, for example, it is correct to associate with forest fires and haze of smoke but do not use phrases such as 5W + 1H questions types. This is consistent with a statement indicating the formulation of the problem that is iterative, so students must review the formulation of the problem made until the problem that has been compiled can be completely solved (Jackman, Ryan, Ogilvie, & Niederhauser, 2008). The ability to recognize problems is also considered an important cognitive skill in problem solving. The following are examples of student answers which scored 2.

1. a. Forest and land fires in several districts in West Kalimantan
   b. The impact of smoke haze due to forest and land fires
2. The smog that occurs in several areas in West Kalimantan due to forest and land fires has a bad impact on residents living in areas affected by smog, because it can cause shortness of breath and headaches.

Fig 2. Example answers providing a simple explanation

Indicator 2 was aimed at building basic skills with the ability to justify forms of matter has a percentage of 71.37 % to the sufficient category. In this indicator, the students were given questions in the form of pieces of case study about 2018 WHO data, and were asked to give reasons based on the answers they gave. This indicator had the highest percentage. Students' skills in answering question 2 were sufficient because they were able to answer according to theory but the answers were incomplete; for example, giving reasons for children dying of respiratory diseases related to air pollution, but not giving complete data. The answers submitted by these students show an inability to provide logical arguments based on available data. Students only present facts without giving reasons for the causal coherence of why these facts occur. This is also related to student communication; if students have good communication they will provide answers with strong reasons (Rofiah, 2010; Fitasari, 2020). The following is an example of student answers given a score of 2.

Menurut saya data WHO tersebut dapat dipercaya, karena didalam data tersebut terdapat jumlah anak-anak yang meninggal karena penyakit tersebut. Solusinya:
- Sebaiknya untuk wanita yang sedang hamil sebaiknya tidak diperkenankan untuk keluar dari rumah.
- Orang tua seharusnya lebih memperhatikan dan menjaga anak-anak mereka agar tidak terlalu melakukan kegiatan diluar rumah.

I think the WHO data can be trusted, because it contains the number of children who died from the disease. The solution:
1. pregnant women should not be allowed to leave the house
2. parents should pay attention and take care of their children so they don't do too much activities outside the home
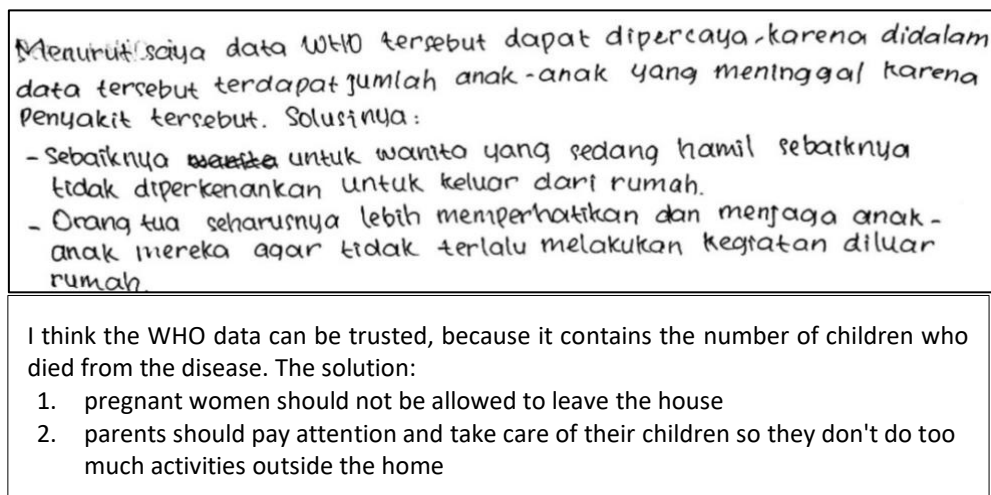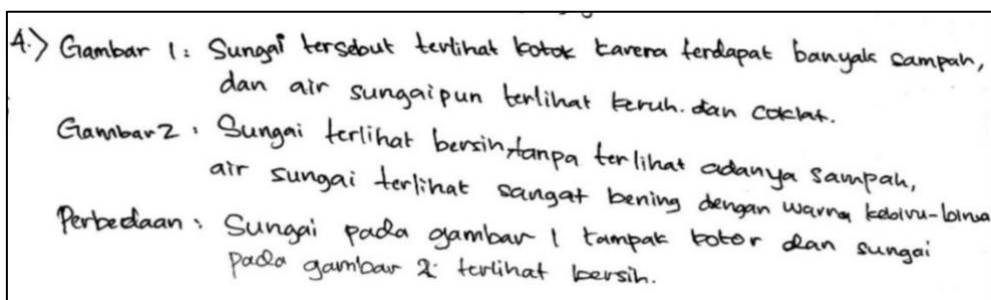
Fig 3. Answers to the building basic skills indicator

Indicator 3 that concludes with generalized form of matter has a percentage of 67.62 % to the sufficient category. In this indicator, students were asked a question on comparing two images, namely one of a river that had been polluted due to litter, and a clean one that was untouched by humans. From the two pictures, students could conclude the cause of the difference in the condition of the two rivers. Students' skills in answering question number 3 were sufficient because they were able to answer based on facts, but drew inaccurate conclusions; for example, explaining the conditions of the two rivers but not arriving at a conclusion on this. The skill of drawing conclusions is important for students to master because to identify different arguments it is necessary to draw logical conclusions, make hypotheses, and to consider relevant information (Saputri, Sajidan, & Rinanto, 2018). The following is an example of student answers given a score of 2.

4.> Gambar 1: Sungai tersebut terlihat kotor karena terdapat banyak sampah, dan air sungaipun terlihat keruh. dan coklat.
Gambar 2: Sungai terlihat bersih,tanpa terlihat adanya sampah, air sungai terlihat sangat bening dengan warna kebiru-biruan
Perbedaan: Sungai pada gambar 1 tampak kotor dan sungai pada gambar 2 terlihat bersih.

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4. Figure 1: The River looks dirty because there is a lot of garbage, and the river water looks cloudy and brown.
Figure 2: The River looks clean without visible trash; the river water looks very clear and bluish.
Difference: The River in picture 1 looks dirty, and the river in picture 2 looks clean.

Fig 4. Answers to the building basic skills indicator

Indicator 4, which provides further explanation of case study in the form of structural and operational questions, had a percentage of 42.44 %, which is the poor category. The question related to this indicator asked the students to define a term based on the data presented in the case study reading materials. They were asked to define terms based on these data in accordance with their understanding. Students' skills in answering question number 4 can be said to be very lacking because the answers presented by students are not based on the data available in the reading material. Students tend to express their own arguments regardless of the data presented; for example, explaining the meaning of air pollution but not linking the data in the questions and reading materials. This was influenced by the lack of student understanding of the material being studied. Understanding itself is the result of the teaching and learning process that has indicators that explain or define information in their own perception (Astuti, Yusmin, & Suratman, 2015). It is often found that students do not understand questions; they can read them correctly, but do not fully understand the terms of the problem (Oktaviana, 2017; Kristianto, 2019; Murtiyasa & Wulandari, 2020). The following is an example of a student answer which scored 2.

Air pollution: a condition in which air pollution that caused by several aspects and is detrimental
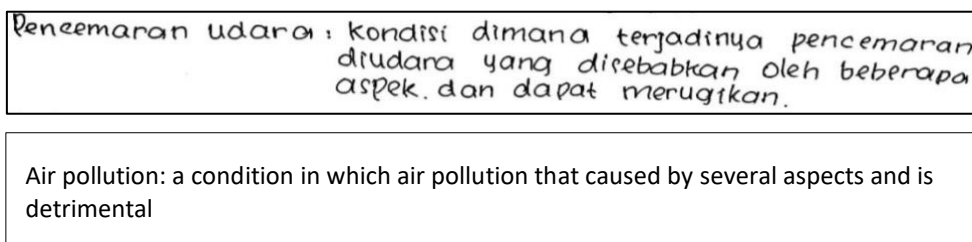
Fig 5. Conclusions made by students based on their understanding

Indicator 5, which concerns setting strategies and tactics in the form of labelling questions, had a percentage of 66.87 %, in the sufficient category. Students were asked questions based on categorizing the types of pollution and waste generated from activities that occur in the community. The students' skills in answering question 5 were sufficient, because they gave explanations correctly, but the strategies and tactics were not precise or complete; for example, giving the impact of daily activities, but not the name of the type of pollution. This was because the students were unable to draw conclusions from a given concept (Januari, 2017). The following are examples of student answers given scores of 2.
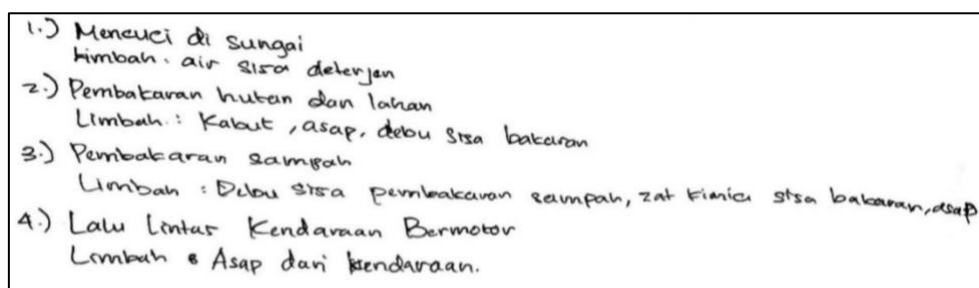
1. Washing in the river. Waste: detergent residual water
2. Forest and land burning. Waste: fog, smoke, combustion residue dust.
3. Garbage burning. Waste: dust from burning garbage, chemical residues from combustion, smoke.
4. Motorized vehicle traffic. Waste: Smoke from vehicles.

Fig 6. Answers to the setting strategy and tactics indicator

In general, the percentages of each indicator of critical thinking skills are in the sufficient category. This is because students are not used to facing questions that require them to think critically (Saputri, Sajidan & Rinanto, 2018). In addition, the results of which are taken into are also influenced by several factors, including the learning process in the classroom, who is not accustomed to exercises in critical thinking skills in accordance with the requirement of 21st century (Saputri, Sajidan, & Rinanto, 2018). What is needed in 21st century are ways of thinking such as critical, creative, research-based, initiative, informative, systematic, communicative, and reflective (OECD, 2018; Pratiwi, 2019).

4. CONCLUSION

Based on the results, it can be concluded that the students' critical thinking skills on each indicator have the highest percentage being at score 2 with a sufficient to poor category. From the results, it is expected that schools should provide motivation and training for teachers to develop innovative learning models and tools for developing students' critical thinking skills. Teachers should also apply critical thinking skills in the learning process, for example by employing HOTS questions, and students should continue to practice solving problems that measure critical thinking skills.

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