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Profile of Students' Critical Thinking Skills in the Sub-Concept of Environmentally Friendly Technology in the Energy Sector

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Abstract. This research aims to determine the critical thinking skills of class IX students of SMP Negeri 2 Selopampang, Temanggung Regency on the sub-concept of environmentally friendly technology in the energy sector. Sampling for this research used a convenience sampling technique where the sample was chosen freely according to the wishes of the researcher. The research subjects were 24 students in class IX C of SMP Negeri 2 Selopampang for the 2022/2023 academic year. The instrument used in the form of a written test refers to the critical thinking indicators developed by Ennis. The indicators of critical thinking skills measured are: 1) providing a simple explanation (elementary clarification); 2) build basic skills (basic support); 3) drawing conclusions (inference); and 4) provide further explanation (advanced clarification); and 5) organize strategies and tactics (strategies and tactics). The results of the research show that the overall profile of students' critical thinking skills in the environmentally friendly technology sub-concept in the energy sector is in the low category. The implications of this research can provide information about critical thinking skills.

Keywords: critical thinking skills, environmentally friendly technology, energy sector

1. Introduction

The development of the 21st century is characterized by the use of technology and communication in all aspects of life, including the learning process. The world of work demands changes in competencies. Critical thinking, problem-solving, and collaboration skills are essential competencies for entering 21st-century life [1]. One of the life skills required to face the 21st century is critical thinking skills. Critical thinking is a form of higher-order thinking skills needed in the development of 21st-century skills. Individuals require critical thinking skills to successfully solve problems in complex situations. Everyone needs to analyze and evaluate their life conditions to make important decisions [2].

Critical thinking skills represent reflective thinking when deciding to take action, solve problems, or accept information based on appropriate, logical, non-subjective, and careful reasoning [3]. These skills are essential for problem-solving activities and seeking solutions [4]. Critical thinking is the process of actively and skillfully formulating orderly reasoning through constructing concepts, applying, analyzing, integrating (synthesizing), or evaluating information obtained through observation, experience, reflection, reasoning, or communication as the basis for determining actions [5]. Students' critical thinking skills are crucial because they affect their daily lives [6].

There are several opinions about indicators of critical thinking skills. One indicator of critical thinking skills, according to Ennis (1985), consists of 5, namely: (a) elementary clarification or providing explanations that include focusing on questions, analyzing opinions or arguments, asking and answering questions to find information to solve problems; (b) basic support or building students' basic skills that include source credibility and observation considerations; (c) inference or drawing conclusions that include compiling deductions and inductions, considering deductions, inductions and

the results of solutions; (d) advanced clarification or providing arguments and explanations that include identifying and considering definitions and assumptions; (e) strategies and tactics or arranging tactics and strategies that include determining actions. There are five basic things in critical thinking: practical, reflective, reasonable, belief, and action. Critical thinking focuses on understanding something that is done consciously and leads to a goal (Ennis, 2011) in [7].

Science learning is oriented towards preparing students to face changing circumstances in everyday life and in an ever-evolving world, based on logical, rational, critical, careful, honest, and efficient thinking. However, in reality, students' higher-order thinking skills are underdeveloped in learning activities [8]. Critical thinking skills are closely related to the ability to think in science, which contains concepts, theories, or formulas that must be understood in depth through the process of exploring and understanding the surrounding environment [9]. Furthermore, through science learning, knowledge, concepts, process and scientific skills, and critical thinking skills can be built in solving problems [10].

Education for Sustainable Development (ESD) is one solution that can be used to improve critical thinking skills and efforts to raise sustainability awareness [11]. Sustainability awareness is an element that supports the implementation of the concept of sustainable development, which is one of the new innovations in education, starting with [12]. The priority goals of ESD are to promote critical and systemic thinking, analytical problem-solving, creativity, collaboration and decision-making in the face of uncertainty, as well as an understanding of the interconnectedness of global challenges and the responsibilities that arise from this awareness [13]. Teachers' attitudes regarding ESD not only influence the types of critical thinking skills students learn but also the critical thinking attitudes they acquire [14]. The use of ESD-based e-modules can also be used to support efforts to improve critical thinking skills, such as research findings [15].

The concept of environmentally friendly technology includes its definition and principles, environmentally friendly technology in energy, transportation, environmental management, industry, environmentally friendly behavior, and non-environmentally friendly technology. This study focuses on the sub-concept of environmentally friendly technology in the energy sector. The goal of environmentally friendly technology is to create environmental sustainability and reduce negative human impacts on the Earth, thus ensuring a healthier environment for future generations. Teachers are expected to enhance students' critical thinking skills through appropriate learning models and supporting media [16]. Teachers play a vital role in educational innovation to improve students' critical thinking abilities [17].

Based on this background, this study aims to describe students' critical thinking skills in each Ennis indicator within the sub-concept of environmentally friendly technology in the energy sector [11]. The results are intended for instructional reflection and improvement to enhance students' critical thinking skills. This study aims to provide information on the categories of students' critical thinking skills based on the indicators presented. Teachers should train students' critical thinking skills by using ESD-oriented teaching materials or learning.

2. Method

This study employed a descriptive quantitative research design conducted in May 2023. Convenience sampling was used, allowing the researcher to freely select samples. Convenience sampling was used, allowing the researcher to freely select samples [18]. The research subjects were 24 students of class IX-C at SMP Negeri 2 Selopampang in the 2022–2023 academic year, consisting of 11 female and 13 male students.

The research instrument consisted of five essay questions corresponding to five critical thinking aspects: providing simple explanations, building basic skills, drawing conclusions, providing advanced explanations, and organizing strategies and tactics. Data were analyzed qualitatively using descriptive statistics. Scores ranged from 0–4 and were converted to a 0–100 scale using the following formula.

$$Score = \frac{Obtained\ score}{Total\ score}\ x\ 100 \quad (1)$$

Interpretation of scores followed Setyowati's criteria [19] shown in Table 1.

Table 1. Criteria for critical thinking skills.

Criteria	Interval
Very High	$81.25 < x \leq 100$
High	$71.5 < x \leq 81.25$
Moderate	$62.5 < x \leq 71.5$
Low	$43.75 < x \leq 62.5$
Very Low	$0 < x \leq 43.75$

Obtaining the interpretation of the value is done by processing the final value into the formula used by Siregar in [19] as follows.

$$P = \frac{f}{N} x\ 100\% \quad (2)$$

This formula is used to determine the percentage interpretation value (P). The P value is obtained by comparing the frequency (F), which is the number of events or data that meet certain criteria, to the total frequency (N). Thus, the percentage interpretation value indicates the proportion of a certain frequency compared to the total frequency of the existing data.

The processed data was then interpreted as the average obtained in the research class using the Siregar formula in [19].

$$X = \frac{\sum x_i}{N} \quad (3)$$

This formula is used to calculate the average value (X) of a data set. The average value is obtained by adding up all the existing data values, which is expressed as Σxi as the total of each individual value, then the result of the addition is divided by N, which is the total number of data or the number of observations. Thus, the average value reflects the general trend of the set of data being analyzed.

3. Results and Discussion

Based on the research conducted, the critical thinking skills of students at SMP Negeri 2 Selopampang in the sub-concept of environmentally friendly technology in the energy sector are in the low category. Data on the interpretation of the final critical thinking skill scores can be seen in Table 2.

Table 2. Interpretation of final critical thinking test scores.

Interval	Category	Number of Students	Percentage	Class Average
$81.25 < x \leq 100$	Very High	1	4.17%	
$71.5 < x \leq 81.25$	High	3	12.5%	
$62.5 < x \leq 71.5$	Moderate	6	25%	59.38%
$43.75 < x \leq 62.5$	Low	12	50%	
$0 < x \leq 43.75$	Very Low	2	8.33%	
	Total	24	100%	

The results of the data analysis of students' critical thinking skills in the very high category ($81.25 < x \leq 100$) were 1 out of 24 students or 4.17%. Students who had the high category ($71.5 < x \leq 81.25$) were 3 students or 12.5%. Students who had the medium category ($62.5 < x \leq 71.5$) were 6 students or 25%. Students with the low category ($43.75 < x \leq 62.5$) were 12 students or 50%. Meanwhile, students with the very low category ($0 < x \leq 43.75$) were 2 students or 8.33%. Data on the percentage of students' critical thinking can be seen in Figure 1.

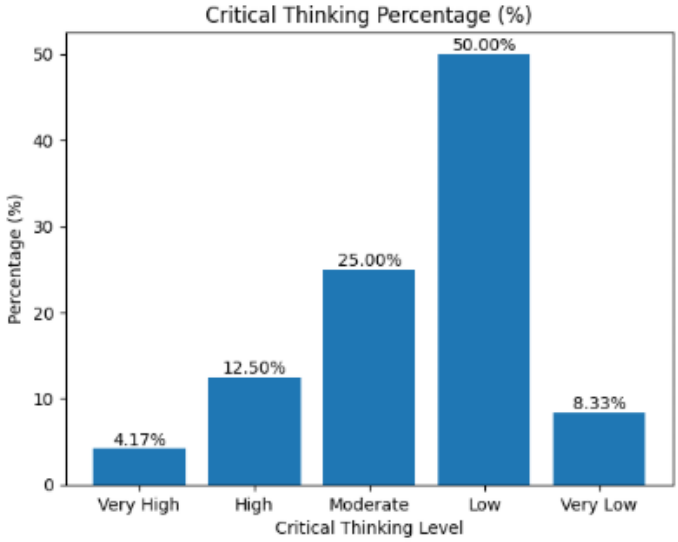

Figure 1. Bar chart of percentage of students' critical thinking skills.

Figure 1 shows that students' critical thinking skills still need to be improved. This low level of critical thinking skills aligns with previous research by [9] , which found that junior high school students' critical thinking skills are still low. Data on the percentage of students' critical thinking skills per indicator can be seen in Table 3.

Table 3. Percentage of students critical thinking skills by indicator.

Indicator	Percentage	Category
Providing Simple Explanations	64.58%	Moderate
Building Basic Skills	54.17%	Low
Drawing Conclusions	59.38%	Low
Providing Advanced Explanations	52.08%	Low
Organizing Strategies and Tactics	66.67%	Moderate

Table 3 shows the percentage of students' critical thinking skills per indicator. The first indicator, the skill of providing simple explanations, showed a figure of 64.58%, which is in the medium category. The second indicator, building basic skills, showed a figure of 54.17%, which is in the low category. The third indicator, summarizing, showed a figure of 59.38%, which is in the low category. The fourth indicator, creating advanced explanations, showed a figure of 52.08%, which is in the low category. The fifth indicator, organizing strategies and techniques, showed a figure of 66.67%, which is in the medium category.

These data indicate that students' critical thinking skills in the sub-concept of environmentally friendly technology in the energy sector still need to be improved. This is in line with research [20] which states that critical thinking skills can be improved. Students in the low critical thinking skill category do not yet have the ability to identify problems well. They can only cite information from their surroundings without a good understanding of the concepts behind the information obtained and are unable to provide ideas or solutions to solve a problem [21].

4. Conclusion

Based on the research results and data analysis, it can be concluded that ninth-grade students at SMP Negeri 2 Selopampang demonstrated low critical thinking skills in the subconcept of environmentally friendly technology in the energy sector. The average scores for each indicator included providing simple explanations (medium), building basic skills (low), summarizing (low), creating advanced explanations (low), and organizing strategies and tactics (medium).

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