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Analysis of critical thinking skills of junior high school students based on gender differences

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Abstract
The data collection technique is conducted by giving critical thinking skills tests based on indicators of critical thinking in plant structure and functions material. Data collection techniques in this study were to test critical thinking skills on the structure and function of plants. The research instrument used was validated by a team of learning evaluation experts as well as the item's validity test using the Karl Person product moment correlation coefficient formula. The item reliability test has been carried out with the Alpha formula. Critical thinking ability as the dependent variable and the independent variable is gender. The sample consisting of 31 male students and 31 female VIII grade students of SMP Negeri 6 Surakarta. The sampling technique was carried out by random sampling. The results showed that the average percentage of female students' critical thinking skills in lant structure and functions material was higher than male students.

Keywords: critical thinking skills; gender; plant structure and function

Introduction

The 21st century national education paradigm requires students to have competencies and expertise in the form of critical thinking, creative, collaborative, and communicative. According Dicerbo (2014) [2] the skills that students must have in 21st-century learning is critical thinking skills. According to Zare & Othman (2015) [18] abilities that are important for the success of education in the 21st century is the critical thinking skills. According to Shubina, *et al*. (2019) [15] critical thinking skills is influenced by external factors which include the educational paradigm, classroom teaching approaches and methods, and internal factors including intelligence, emotional state, and personality. According to Ennis (2011) [4], critical thinking is a person's ability to think rationally and reflectively to solve problems. Critical Thinking skills according Liberna (2013) [10] is one's skills to solve problems in daily life through active, serious, thorough analysis and rational thinking.

According to Facione (2015) [5], indicators of critical thinking skills consist of interpretation, evaluation, analysis, explanation, inference, and self-regulation. According to Santos (2017) [14] critical thinking skills is inseparable from science learning at schools because it is very important for the responsible application of science in society. Kalelioglu, *et al*. (2013) [8] explained that the critical thinking skills are very influential in daily life because it can help students to solve the problems. The importance of critical thinking skills according to Leach (2011) [9] is to prepare individuals to perform optimally in an ever-changing world.

The results of interviews with teachers and observations at SMP Negeri 6 Surakarta stated that the teacher had not trained their students to think critically because it was considered that it will be difficult to apply to students who had various characters. Teachers have not conducted critical thinking assessments because of limited time in teaching science in the class. They use the lecture method so that learning is teacher-centered on science subject. Learning method that does not accustom students to think actively will affect students' low critical thinking skills. This is in accordance with the research conducted by Ridho, *et al*. (2020) [13] explained that students' low critical thinking skills were due to the ongoing learning process that did not empower students to think actively.

In addition to teacher learning method at schools, students' critical thinking skills are also influenced by gender. According to Mahanal (2012) [11], gender in a narrow sense is the same as the difference in sex between women and men. In fact, teacher has never designed learning method that can empower the equality of learning outcomes for male and female students at school. Research conducted by Crawford, *et al*. (2005) [1] stated that female students have higher critical thinking skills than male students because female students have more credible and precise questioning skills. Relevant to research Suarsini (2017) [17] explains the critical thinking skills of female students are different from male students in biology learning. Harso and Jumilah's research (2018) [7], states that research conducted at one of the state junior high schools in Ende City showed that female students' critical thinking skills were 68.56 (high category) and male students were 62.03 (moderate /sufficient) so that it can be seen that the average critical thinking ability of female students is higher than male students.

Based on the background, it is known that the critical thinking skills of male and female students have fundamental differences in learning at school. Therefore, this study was conducted to analyze students' critical thinking skills in terms of gender in science learning.

2. Materials and methods

This type of research is descriptive quantitative. The method used in this research is the test method used to describe the average percentage of students' critical thinking skills in grade VIII at SMP Negeri 6 Surakarta, Central Java. In this study, critical thinking skills as the dependent variable, and gender (male and female) as the independent variable. The sample used in this study were 62 students of class VIII SMP Negeri 6 Surakarta, with 31 female students and 31 male students. The sampling technique used was purposive sampling, and it was divided into two groups: female students and male students. Test questions are given to students to analyze their critical thinking skills in science learning. Critical thinking skills test questions are prepared based on 6 indicators of critical thinking according to Facione (2015) which consists of: interpretation, evaluation, analysis, explanation, inference, and self-regulation. The test items used were validated by a team of learning evaluation experts and item validity test using the Karl Person product moment correlation coefficient formula, discrimination power test, difficulty level test, and reliability test using the Alpha formula. The science material used in critical thinking skills test item is the structure and function of plants. The data from the critical thinking ability test were analyzed descriptively by precentage to produce the percentage of each critical thinking indicator of each gender with the formula:

$$\text{Percentage (\%)} = \frac{\text{Score of Each Indicator}}{\text{Total Score of Each Indicator}} \text{ x } 100\%$$

The data obtained were then processed by calculating the percentage of the score for each indicator of critical thinking skills, then the results of the average percentage of critical thinking skills of each gender are compared between the acquisition of critical thinking skills of female students and male students.

3. Results

Regarding the results of the research of the analysis of the percentage of critical thinking skills in 62 VIII grade junior high SMP in science learning, especially in plant structure and functions material that shown in Table 1 and Figure 1.

Table 1: Analysis of Students' Critical Thinking Skills in SMP Negeri 6 Surakarta

No.	Indicator of Critical Thinking Skills	Percentage (%)	
		Male	Female
1	Interpretation	13	48
2	Analysis	29	32
3	Evaluation	39	39
4	Inference	26	31
5	Explanation	35	35
6	Self-regulation	44	45
Mean		31	38

Based on Table 1 above, we can see that the average percentage of male students' critical thinking skills is 31% and female students' critical thinking skills is 38%. Based on the results it can be concluded that the average percentage of male students' critical thinking skills is lower than female students.

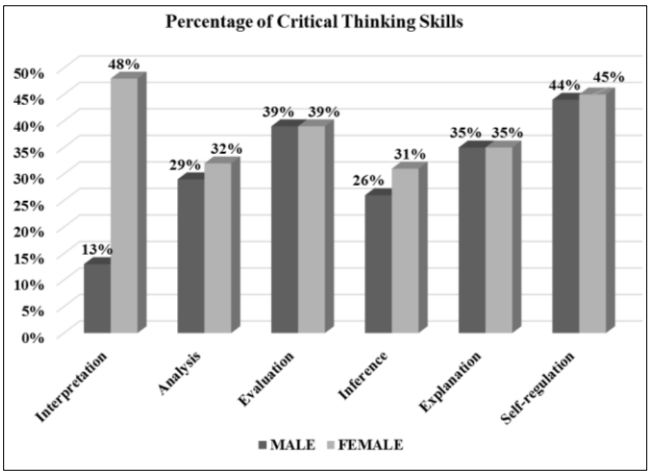

Fig 1: The Average Percentage of Students' Critical Thinking Skills in SMPN 6 Surakarta

Based on Figure 1 regarding the percentage chart for each indicator of female and male students' critical thinking skills, we can see that the percentage average acquisition for each male students' critical thinking indicators are the interpretation indicator of 13%, the analysis indicator of 29%, the evaluation indicator of 39%, the inference indicator of 26%, the explanation indicator of 35%, and the self-regulation indicator of 44%. The percentage average acquisition for each female students's critical thinking indicators are the interpretation indicator of 48%, the analysis indicator of 32%, the evaluation indicator of 39%, the inference indicator of 31%, the explanation indicator of 35%, and the self-regulation indicator of 45%.

4. Discussion

Based on Table 1 and Figure 1, the lowest percentage of male students' critical thinking skills indicator is interpretation indicators of 13% and the highest indicator is self-regulation of 44%. The interpretation indicator is to understand and express the meaning of various experiences. In this indicator, male students are less able to understand and express the meaning of the phenomena or problems presented by the teacher in science learning, especially in plant structure and functions material. The indicator of self-regulation is to make conclusions based on self-evaluation in the form of statements, confirmations, and corrections of the results of the reasoning that has been done. Male students are able to make self-correction and draw conclusions from self-evaluation in the form of statements based on observations made in learning activities. The indicator of the lowest percentage of female students' critical thinking skills is the inference indicator of 31% and the highest indicator is interpretation of 48%. The inference indicator is identifying and selecting the elements needed to make conclusions. Female students are less able to conclude observational data with rational reasons. The interpretation indicator is to understand and express

The meaning of the phenomenon or problem presented. Female students are able to understand and identify problems or phenomena related to the plant structure and function that occur in daily life. Based on the results, it can be seen that female students' critical thinking skills have higher average percentage than male students' critical thinking skills on plant structure and function material. Relevant to research conducted by Zeng *et al*. (2019) [19] stated that the difference in scores obtained was due to female students' answers on the interpretation, analysis, explanation, evaluation, inference, and self-regulation indicator on critical thinking skills test that were better than male students. Relevant with the research of Suardana *et al*. (2018) [16] stated that the values of critical thinking on interpretation, inference, analysis, and self-regulation indicator of female students were higher than male students.

According to Harish (2015) [6] the difference between male and female students is different in perspective to describe ideas. Research conducted by Mahanal (2012) [11] shows that female students have more abilities to explore critical thinking skills and setting their way of thinking in solving problems than male students. Relevant to research conducted by Perdana, *et al*. (2019) [12] stated that in chemistry learning female students have better critical thinking skills than male students in chemistry learning. According to Eliasson *et al*. (2016) [3] students' critical thinking skills based on gender differences can be seen from students' ability to solve problems, where female students are more able to think logically in solving problems than male students. In Harish's (2013) [6] research regarding students 'critical thinking skills based on gender, it was explained that gender affects students' thinking abilities, especially critical thinking skills. One of the influencing factors is the difference in intelligence between female students and male students.

5. Conclusions

Conclusions based on the research results indicate that there is a difference in the percentage average acquisition female and male students' critical thinking skills in plant structure and functions material. The analysis of critical thinking skills shows that the critical thinking skills of female students have a higher average than male students, namely 38% for female students and 31% for male students. The acquisition of the percentage of each indicator of male students' critical thinking skills which has the lowest percentage, namely interpretation indicator of 13%, while the lowest percentage of female students' thinking skills indicators is inference of 26%.

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