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Analysis of Critical Thinking Skills of High School Students

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Abstract *– Critical thinking skills are one of the essential 21st-century competencies that students must possess, as outlined by the Indonesian Ministry of Education's competency standards for graduation. The Minister of Education and Culture Decree No. 56 of 2022, which mandates the implementation of the independent curriculum, has prompted schools to change their existing curricula. This necessitates research to provide an overview of students' critical thinking skills as developed by schools. This study aims to describe the critical thinking skills of public high school students in Makassar City in the subject of Physics. The research is a quantitative descriptive survey, with the main variable being critical thinking skills, which are measured through three indicators: analysis, interpretation, and inference. The research instrument used was a six-item essay test. The population for this study consisted of all public high school students in Makassar City studying Newton's laws of motion, specifically students from SMAN 2 Makassar, SMAN 4 Makassar, SMAN 5 Makassar, SMAN 8 Makassar, and SMAN 16 Makassar. Using purposive sampling, the sample included all students from one class at each of the five schools in the population. The results indicate that 75.50% of the students' critical thinking skills in solving physics problems fall into the low category. The specific skills in analysis, interpretation, and inference are also categorized as low. Additionally, female students demonstrated a higher ratio of critical thinking skills compared to male students. In conclusion, the critical thinking skills of high school students in Makassar City remain at a low level.*

Keywords: *analysi; critical thinking; inference; interpretation; physics*

I. INTRODUCTION

At the beginning of the 21st century, the world entered the era of Industrial Revolution 4.0 or Industrial Revolution 4.0 (Rohida, 2018; Wahono et al., 2022). The era of industrial revolution 4.0 is marked by the development of science and technology which is very advanced so that it requires the world of education and science to carry out reforms in order to keep up with the times. According to World Economic USA Forum the competencies needed in the 21st century are (1) critical thinking/problem solving (2) creativity (3) communication and (4) collaboration (World Economic Forum, 2015).

This indicates that critical thinking skills are skills that students must have in order to be competitive in the 21st century (Rahmawati et al., 2021; Putri & Syafriani, 2020; Hikmah et al., 2023). In the Regulation of the (Permendikbud, 2016) concerning Competency Standards for Middle School Graduates, it is hoped that students can have critical thinking skills through a scientific approach as a development of what they learn at school.

Based on the regulation of (Permendikbudristek, 2022) which contains the implementation of the independent curriculum in the context of Learning Recovery as a complement to the previous curriculum. Through this decision, by 2023, many schools will have implemented the independent curriculum, including state high schools in Makassaar City. This is a factor to pay attention to and measure the extent of its impact on student development, especially in the aspect of critical thinking skills which are 21st century skills.

Overall PISA measurement results show that men's cognitive abilities are greater than women's, however, PISA measurement results in 2015 in Indonesia show that women's cognitive abilities are greater than men (OECD, 2016). The difference between Indonesia and other countries is something important to ascertain in more specific areas such as at the district/city level so that the data obtained is more accurate.

Many studies have discussed the analysis of critical thinking skills of State High School students in Makassar City, one of which is research conducted by Asniar et al. (2022) which examined the critical thinking skills of students at SMAN 11 Makassar. Based on research (Worachak et al., 2023; Khoiri et al., 2023; Marfu'i et al., 2019) that research cannot yet provide an overview of the critical thinking skills of public high school students in Makassar City because the population used was only in one school. Research results do not provide an overview of students' critical thinking skills based on gender.

Based on the description above, the researcher aims to find out a description of the critical thinking skills of high school students in the city of Makassar in physics subjects. So the researcher formulated the problem, namely, how do the critical thinking skills of high school students in the city of Makassar describe the physics subject?.

II. METHODS

This research is survey research with a quantitative descriptive approach. The variable in this research is critical thinking skills which consist of three indicators, namely analysis, interpretation and inference. The variables in this research were not treated, this research only collected data according to conditions in the field. The population of this study were all state high school students in Makassar City who were studying physics on Newton's laws

of motion. The population in this research is students from SMAN 2 Makassar, SMAN 4 Makassar, SMAN 5 Makassar, SMAN 8 Makassar, and SMAN 16 Makassar. Determining the research sample class was carried out using purposive sampling with the aim of obtaining a homogeneous class. The sample in this study was all students in one class in the five schools that formed the population.

This research procedure consists of three stages, including:

Figure 1. Research procedure

In the preparation stage, the researcher made observations at the school, then reviewed literature related to critical thinking skills, then prepared a research proposal, created a research instrument, and obtained a research permit at the education office.

Implementation stage, research data collection was carried out for approximately one week. Researchers gave tests in the form of essay questions to students who were the research samples. Then the results of the critical thinking skills test are obtained.

Final stage, At this stage the researcher collects all test result data that has been carried out by the research sample, in this case students at SMAN 2 Makassar, SMAN 4 Makassar, SMAN 5 Makassar, SMAN 8 Makassar, and SMAN 16 Makassar. The data was then analyzed descriptively, presented in the form of highest score, average score, standard deviation and variance. Then write down the research results, discussion and conclusions.

The data obtained was analyzed descriptively to obtain the highest score, lowest score, average score, standard deviation and variance. The average score of students' critical thinking skills obtained will be given a critical thinking skills level category based on the following table.

Table 1. Category of students' critical thinking skills

Interval Skor	Category
12 – 18	Height
7 – 12	Currently
0 – 6	Low

III. RESULTS AND DISCUSSION

An overview of the critical thinking skills scores of male and female students in public high schools throughout the city of Makassar is as follows.

Table 2. Critical thinking skills of public high school students in Makassar city on interference indicators

Statistics	Interpretation Score	
	M	F
Sample Size	49	102
Ideal Score	3	3
Lowest Score	0	0
Highest score obtained	2	2
Lowest score obtained	0	0
Average Score	0,37	0,4
Standard Deviation	0,76	0,65
Variance	0,57	0,42

Table 3. Critical thinking skills of public high school students in Makassar city on analysis indicators

Statistics	Analysis Score	
	M	F
Sample Size	49	102
Ideal Score	9	9
Lowest Score	0	0
Highest score obtained	8	7
Lowest score obtained	0	0
Average Score	2,51	3,19
Standard Deviation	2,46	1,7
Variance	6,05	2,89

Table 4. Critical thinking skills of public high school students in Makassar city on inference indicators

Statistics	Inference Score	
	M	F
Sample Size	49	102
Ideal Score	9	9
Lowest Score	0	0
Highest score obtained	8	7
Lowest score obtained	0	0
Average Score	2,51	3,19
Standard Deviation	2,46	1,7
Variance	6,05	2,89

Based on the results of the analysis, it shows that the critical thinking skills of female students are higher than male students for indicators of interpretation and analysis in the city of Makassar. Meanwhile, for inference indicators, male students are higher than female students, but all indicators are in the low category.

Table 5. Frequency distribution of categorization of critical thinking skills scores for class XI MIPA students

Interval Score	Category	Frequency	Percentage (%)
13 – 18	Height	1	0,66
7 – 12	Currently	36	23,84
0 – 6	Low	114	75,50
Amount		**151**	**100**

Based on Table 5. It was found that students' critical thinking skills were dominated by the low category with a percentage of 75.50%. This calculation was based on students' critical thinking skills scores. An overview of the percentage of critical thinking skills scores of students in class.

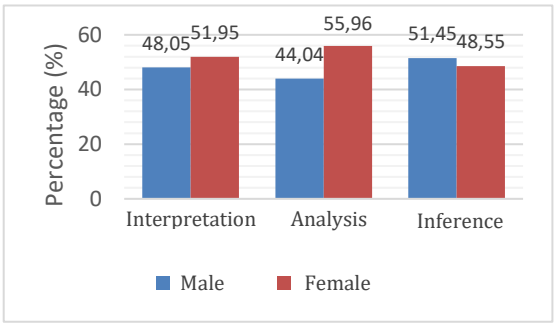

Figure 2. Bar chart of average percentage score of critical thinking skills of public high school students in makassar city

An overview of the critical thinking skills scores of male and female students at SMA Negeri 2 Makassar based on gender can be seen in the results of data analysis in the form of the following diagram.

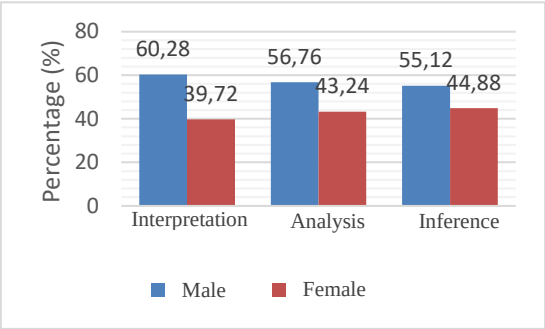

Figure 3. Bar chart of average percentage score for critical thinking skills of class XI MIPA students at SMA Negeri 2 Makassar

Figure 3 shows that the critical thinking skills of male students and female students get almost the same average score for the interpretation and inference indicators but are in the medium category. Meanwhile, for analysis indicators, the average scores obtained tend to be different, where male students are higher than female students and are in the medium category.

An overview of the critical thinking skills scores of male and female students at SMA Negeri 4 Makassar based on gender can be seen in the results of data analysis in the form of the following diagram.

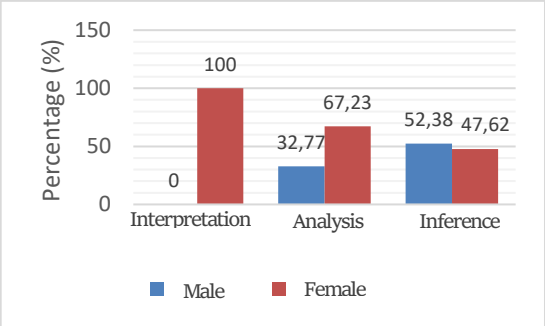

Figure 4. Bar chart of average percentage score for critical thinking skills of class XI MIPA students at SMA Negeri 4 Makassar

Figure 4 shows that the critical thinking skills of male students are lower than female students for the interpretation and analysis indicators with almost the same average score but in the low category. Meanwhile, for the inference indicator, male students are higher than female students, although only slightly, but are in the low category.

An overview of the critical thinking skills scores of male and female students at SMA Negeri 5 Makassar based on gender can be seen in the results of data analysis in the form of the following diagram

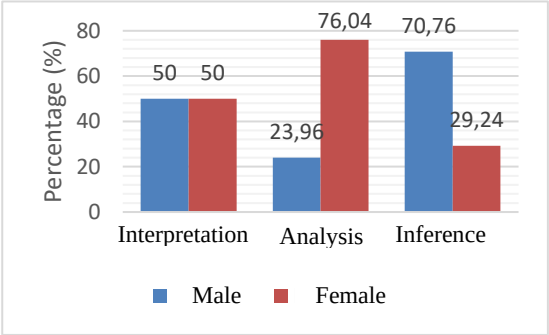

Figure 5. Bar chart of average percentage score of critical thinking skills of students at SMA Negeri 5 Makassar

Figure 5 shows that the critical thinking skills of male students are the same as female students for the interpretation indicator with the same average score but in the low category. Meanwhile, the analysis indicators for female students are higher than male students but are in the low category. Meanwhile, for the inference indicator, male students are higher than female students, although only slightly, but are still in the low category.

An overview of the critical thinking skills scores of male and female students at SMA

Negeri 6 Makassar based on gender can be seen in the results of data analysis in the form of the following diagram:

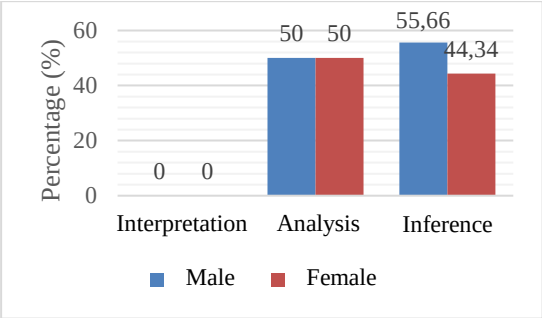

Figure 6. Bar chart of average percentage score for critical thinking skills of class XI MIPA students at SMA Negeri 8 Makassar

Figure 6 shows that the critical thinking skills of male students are the same as female students for analysis and interpretation indicators which are in the low category. Meanwhile, the inference indicator for male students is higher than female students but is in the low category.

An overview of the critical thinking skills scores of male and female students at SMA Negeri 6 Makassar based on gender can be seen in the results of data analysis in the form of the following diagram

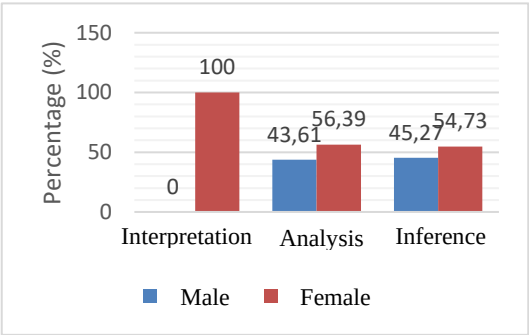

Figure 7. Bar chart of average percentage score of critical thinking skills of students at SMA Negeri 16 Makassar

Figure 7 shows that the critical thinking skills of female students are higher than male students for all three indicators and are in the low category.

The research results showed that the 151 class XI MIPA students from five state high schools in the city of Makassar were dominated by students who were in the low category. This indicates that the critical thinking skills of class XI MIPA students in the city of Makassar regarding Newton's laws of motion are still low.

Apart from describing students' critical thinking skills in general. This research also displays a comparison of students' critical thinking skills based on gender. Based on research in the book Human Intelligence, it shows that women's cognitive abilities are higher than men. Although the comparison is not significant (Aliakbari & Sadeghdaghighi, 2010; Bagheri & Ghanizadeh, 2016; Hunt, 2010; Zetriuslita et al., 2016; Ariani, 2020). In line with this statement, this research shows that the critical thinking skills of female students are higher than male students for the interpretation and analysis indicators, while the inference indicators are not much different. This shows that the critical thinking domain of female students is more dominant than male students.

There is a lot of speculation and studies regarding the comparison of critical thinking skills based on gender are nothing new. One of the things that always serves as a benchmark for the national picture is the PISA

measurement results. The results of the last measurement in (OECD, 2016) 2015 showed that male students were more interested in work related to science than female. However, this is different from the results of OECD research (OECD, 2016) where 22% of women in Indonesia choose to work in the science sector compared to only 9% of men. In addition, 9 out of 10 Indonesian women choose to work in fields closely related to science, namely as health experts. The differences in students' interests indirectly influence their critical thinking skills.

The results of measuring critical thinking skills that have been carried out show that the abilities of female students are still higher than those of male students, although not significantly so. However, if we examine it further, research results show that the highest scorers on the critical thinking skills test are male students, but this is then offset by the low scores which are mostly occupied by men. This is also in accordance with the results of other research, where extreme grades for science and mathematics subjects are mostly filled by male students compared to female students (Halpern et al., 2007; Strand et al., 2006; Sulistyowarni et al., 2019; Putra et al., 2023).

The higher critical thinking skills of female students also cannot represent good quality in general when compared to male students. This is proven by the fact that all members of the Physics Olympiad team and those who represent the school in taking part in competitions at the University are mostly male students. Including school representatives in the 2019 National Science Olympiad for the field of physics, all of which were male students and all of them were also the population in this study. Even though the physics Olympiad questions are HOTS questions, critical thinking skills are included in the HOTS domain (Rochman & Hartoyo, 2018; Saphira et al., 2022; Jariyah & Husama, 2024). This picture is also justified by the results of research which shows that male students are more able to compete in physics competitions than female students (Wilson et al., 2016; Sarip et al., 2022).

The results of this research provide an overview of the critical thinking skills of State High School students in Makassar City which are in the low category. The results of this research also provide an illustration that female students' critical thinking skills are greater than male students. With the results of this research, researchers and teachers can develop students' critical thinking skills at stages appropriate to the students' abilities. The results of this research provide an illustration for the local education department to encourage the improvement of students' critical thinking skills.

IV. CONCLUSION AND SUGGESTION

Based on the results and discussion, it can be concluded that the critical thinking skills of class XI MIPA students at SMAN 2 Makassar,

SMAN 4 Makassar, SMAN 5 Makassar, SMAN 8 Makassar, and SMAN 16 Makassar are in the low category. Where the indicators of ability to analyze, ability to interpret (interpretation) and ability to conclude (inference) are in the low category. This shows that students in the city of Makassar are still not trained to think critically in working on questions in the form of applying Physics formulas and the critical thinking skills of class XI MIPA students in these five schools are dominated by female students compared to male students.

In connection with the results found in this research, the researcher proposed suggestions to the school, especially teachers, to be able to innovate more in the teaching and learning process to improve students' critical thinking skills. The researcher provides suggestions to future researchers, so that the results of this research can be used as comparison and reference material, especially for those who want to conduct similar research.

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