

The Analysis of Junior High School Students' Mathematical Reasoning Ability and Self – Concept in Terms of Gender

Nurviani^{1*}, T Herman², Turmudi³

¹Mathematics Education Study Program, Postgraduate School, Universitas Pendidikan Indonesia, Bandung, Indonesia

^{2,3}Department of Mathematics Education, Postgraduate School, Universitas Pendidikan Indonesia, Bandung, Indonesia

Author's email: nurviani27@upi.edu ; tatang_herman@upi.edu ; turmudi@upi.edu

*Corresponding author: nurviani27@upi.edu

Abstract. *This descriptive qualitative research aims to determine and to analyze students' mathematical reasoning ability and self-concept in terms of gender at junior high school students were grade VII based on triangular and rectangular material. The subjects of this study were all grade VII students of junior high school students as many as 22 students. The instrument of the research were written instruments consisted of four description questions and twenty items questions of self-concept. Those instruments were distributed online through a Google Form because the learning system was carried out online due to the Covid-19 pandemic. The measured indicators of mathematical reasoning were sketch drawing, analogies, proportional reasoning and generalizations. The results indicated that the mathematical reasoning ability of female students perform better than of male students. Besides, the analysis of students' self-concept based on questionnaire data on mathematical reasoning ability was in a good category.*

Keywords: *Mathematical reasoning ability, self-concept, gender*

1. INTRODUCTION

Education plays an important role in human survival. In this era of 21, people are demanded to be able to master various abilities. This ability is needed to be able to compete globally, one of these abilities is the reasoning ability. Given the importance of quality education, one of the efforts to achieve this goal is to improve students' learning and ability. It is listed in Permendiknas No. 22 the Year 2006 on Standard Content of Mathematics Subjects.

PISA (Programme for International Student Assessment) results with a focus on math literacy in 2003 showed that Indonesia was 38th out of 40 countries participating in PISA with a score of 360. Then in PISA results in 2012, Indonesia was ranked 64th out of 65 countries with a score of 375. This shows that mathematics ability in Indonesia is still relatively low. One of the factors of low mathematics ability in Indonesia is that students are not used to doing problems with high reasoning ability. According to Lithner (2008) reasoning is an adopted thought to produce statements and reach conclusions on problems that are not always based on formal logic so are not limited to evidence.

The results of this study are also in line with previous research conducted by Arkham (2014:94). He suggested that the reasoning for male students tends to be lower than the reasoning for female students in his research. This is due to the lack of thoroughness

of male students in solving problems so that the results achieved by male students tend to be less maximal. But, according to Tatang (2007:42) in his research, he suggested that students' ability in reasoning, communication, and mathematical connections, as well as problem-solving, is felt very poorly. From the description above, it shows that there need to be appropriate efforts to be able to develop the potential of each student.

In this case, the relation to students' reasoning ability can be said to vary, one of which is caused by gender differences. Some experts argue that female students are more conscientious in some ways compared to male students. This is in accordance with the stated by (Salmina and Nisa, 2008:46) that the mathematical reasoning ability of female students is superior to the mathematical reasoning ability of male students. Then on Guiso et research. Al. (2008) explained that the implementation of PISA analysis 2003 found that there was a negative correlation between gender equality and the gender gap in mathematics. This indicates that there are differences in mathematical training skills between male and female students.

Based on the description above, researchers suspect a link between mathematical reasoning ability and gender. Therefore, to support a student's mathematics reasoning ability, a positive attitude is needed in solving math problems, one of which is self-concept. The focus of this research is to analyze the reasoning skills of junior high school students and self-concept reviewed from gender.

2. LITERATURE REVIEW

2.1. *Students' Mathematical Reasoning Abilities*

According to NCTM (National Council of Teacher of Mathematics), mathematical reasoning can be characterized as one part of the mathematical thought process. So to know the students' reasoning ability is to see how students solve math problems. As for the indicators of mathematical reasoning ability used in this study according to, Sumarmo (2006) is as follows: 1) Sketching the situation and carrying out calculations based on certain rules or formulas; 2) Draw conclusions based on similarity (analogy); 3) Proportional reasoning and 4) Draw general conclusions based on patterns (generalizations).

In fact, each student has a different level of intelligence. This intelligence is what makes reasoned activities inseparable from their daily lives, including in solving mathematical problems. According to Susanto (2015) gender differences not only result in differences in ability in mathematics, but how to gain mathematical knowledge is also related to gender differences.

2.2. *Self – Concept*

In developing mathematical ability, especially mathematical reasoning ability, one of the aspects of psychology needed is self-concept of mathematics. Self concept is a person's belief, feeling or attitude about his or her ability to understand or do something in situations involving mathematics (Pamungkas, 2012). So it can be concluded that self-concept is one aspect of psychology that can grow and sacrifice the ability of mathematical reasoning for students, both female students and male students. Because gender differences in the self-concept can show complex patterns that are consistent.

3. RESEARCH METHODS

This research is a descriptive qualitative research that aims to know and analyze the mathematical reasoning ability of students using and self-concept reviewed from gender in one of the first high schools in Cianjur grade VII-A on triangular and quadrilateral material. The population in this study was all students of grade VIII junior high school in Cianjur, and the sample used was grade VIII A with a total of 22 students in the even semester of the 2019/2020 school year. There are 14 female students and 8 male students. Sampling using a purposive sampling. The purpose of this research is

to analyze students' ability to solve mathematical reasoning questions measured through tests and non-tests online through Google form because learning is done by a remote system due to the Covid-19 pandemic. Test in the form of a description or an essay as many as 4 points of the question. Each question is adjusted to indicators of reasoning ability. Non-test instruments in this study were questionnaires or student self-concept attitude scale consisting of 10 positive statements and 10 negative statements.

The data collected on the question of mathematical reasoning ability and the scale of students' self-concept attitudes amounted to 14 answers of female students and 8 answers of male students. In this study, students were given questionnaires after researching mathematical reasoning skills. The questionnaire in this study aims to find out the picture of students' mathematical reasoning ability and as supporting data of student test results. Criteria for assessment of mathematical reasoning ability using the assessment rubric, namely as follows:

Table 1. Mathematical Reasoning Assessment Rubric

Ability	No.	Assessment Indicators	Scor
Mathematical Reasoning	1.	The answers do not match the material	0
	2.	Wrong answer, but there are several reasons / paths that are written right	1
	3.	Correct answer, but incomplete reason / path or insufficient question penalty	2
	4.	Correct and accurate answers but in an interesting way using mathematical symbols are still lacking.	3
	5.	Perfect answers, provide reasons, compile proof (reasoning) in accordance with the material and draw mathematically from the statements obtained.	4

Source : Thompson, 2006

Guidelines for assessing students' mathematical understanding abilities using the percentage formula are as follows :

$$\text{Value} = \frac{\text{Score Student}}{\text{Maximal score}} \times 100\%$$

(Agung Purwoko, 2011)

In determining the category of level of reasoning ability of students in solving problems. Students' mathematical reasoning ability scores are converted in qualitative form by observing assessment guidelines of 81 – 100 in very high categories, 61 – 80 in high categories, 41 – 60 in medium categories, 21 – 40 in low categories and 0–20 in very low categories. Arikunto (2008) stated the results of self concept questionnaires in the analysis to find out the level of student self concept, namely high self concept 81 - 100%, medium self concept 51 - 80%, low self concept 30-50%, and very low self concept 0-29%. The communication ability test will be analyzed to find out the results of communication skills for each self concept category (high, medium, and low).

4. RESULTS AND DISCUSSION

4.1. Mathematical Reasoning Ability

We found that there were 4 female students with high reasoning ability and 5 female students with sufficient reasoning ability and 5 female students with low reasoning ability, with a total of 14 female students. As well as 3 male students with high ability and 5 male students with sufficient reasoning ability. Based on the results of mathematical reasoning ability analysis in the overall question, the average percentage reached 64.1% in male and 70.5% in female students, that means in grade VIII-A junior high school in Cianjur male students have lower reasoning ability compared to female students. The following table will be presented as an analysis table of students' mathematical reasoning ability on triangular and quadrilateral material:

Table 2. Percentage of Students' Mathematical Reasoning Ability

No.	Indicator	Percentage	
		Female	Male
1.	Sketch a situation and carry out calculations based on certain rules or formulas	66,1%	53,1%
2.	Draw conclusions based on the likeness (analogy)	76,8%	68,8%
3.	Proportional reasoning	73,2%	71,9%
4.	Draw general conclusions based on patterns (generalizations)	66,1%	62,5%
Average		70,5%	64,1%
Category		High	Moderate

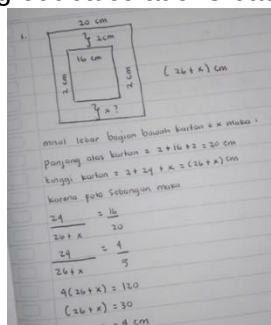
Table 2 above shows the overall percentage of each indicator of reasoning ability. On the indicators of drawing a sketch of the situation and carrying out calculations based on the results of students' answers, it can be seen that female students outperformed male students with a percentage of 66.1% while male students with a percentage of 53.1%. Then the indicators draw conclusions based on the similarity (analogy) of female students with a percentage of 76.8% while male students are 68.8%. For the proportional reasoning indicator, female students got a percentage of 73.2% while male students got 71.9%. Then the indicators draw general conclusions based on patterns (generalizations) of female students, namely, 66.1% and male students 62.5%. Based on this explanation, it can be seen that women have advantages in several indicators of mathematical reasoning. The following is an analysis of the mathematical reasoning abilities of the triangular and quadrilateral material on each indicator to be measured.

4.1.1 Sketch the situation and carry out calculations based on certain rules or formulas
In these indicators, students are expected to be able to carry out a settlement strategy based on a certain formula.

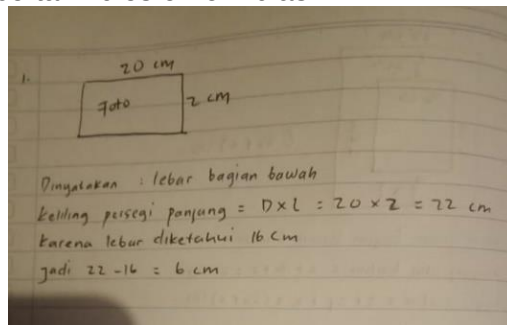
Ada sebuah foto yang ditempelkan pada karton berbentuk persegi panjang. Foto tersebut berukuran 16 cm × 24 cm dan lebar karton sebelah kanan, kiri, atas 2 cm. Jika foto dan karton merupakan sebangun maka tentukan lebar karton bagian bawah! Gambarkan sketsa situasi yang diketahui!

Figure 1. Sketch Drawing Indicator Problems

The following are the results of students' answers to the indicators of drawing sketches and carrying out calculations based on certain rules or formulas



(a)



(b)

Figure 2. Student Answers (a) Female Students; (b) Male Students

Figure 2 (a) shows that female students can make guesses with answers and estimate the sketches correctly. Whereas in Figure 2 (b) male study has been able to propose assumptions and the answers given are not correct because the students do not understand the questions given.

4.1.2. Draw conclusions based on the likeness (analogy)

In this indicator, students are expected to solve problems according to plan in concluding the statement.

Sebuah kebun berbentuk persegi panjang dengan ukuran $35m \times 15m$. Disekeliling kebun akan ditanami pohon pisang dan jarak antar pohon $2m$. Berapa banyak pohon pisang yang dapat ditanam?

Figure 3. Problem Analogy Indicators

The following are the results of students' answers on the indicators of drawing conclusions based on similarity (analogy)

Diketahui $\Rightarrow$ Panjang $35m$
 $\Rightarrow$ Lebar $15m$
 Keliling Kebun $\Rightarrow 2 \times (\text{Panjang} + \text{lebar})$
 $\Rightarrow 2 \times (35 + 15)$
 $\Rightarrow 2 \times 50$
 $\Rightarrow 100m$
 Banyak Pohon Pisang $\Rightarrow$ Keliling : Jarak
 $\Rightarrow 100 : 2$
 $\Rightarrow 50$ Pohon Pisang

(a)

2. Manfaat pisang
 luas = panjang $\times$ lebar
 $= 35 \times 15$
 $= 525$
 Jarak pisang $2m = 525 : 2 = 262,5$

(b)

Figure 4. Student Answers (a) Female Students; (b) Male Students

Figure 4 (a) shows that the female students can explain the steps to manipulate in determining the circumference of the garden and the number of banana trees that can be planted. Whereas in Figure (b) the male student answered the question incorrectly because it should be looking for the perimeter, not the area.

4.1.3. Proportional reasoning

In these indicators, students are expected to think logically in dealing with problems.

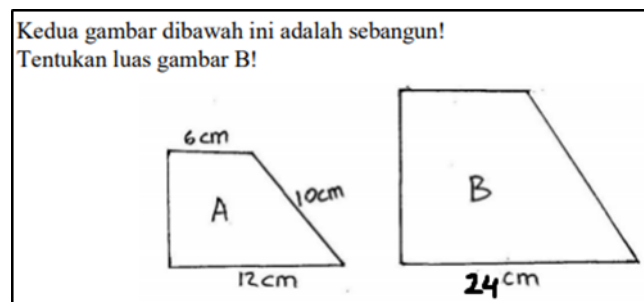


Figure 5. Problem Proportional Reasoning Indicators

The following are the results of students' answers to proportional reasoning indicators.

3. Dik: $\frac{A}{B} = \frac{10cm}{x}$
 Ditanyakan: Luas B
 Jarak: $\frac{A}{B} = \frac{10cm}{x}$
 $\Rightarrow \frac{6}{12} = \frac{10}{x}$
 $\Rightarrow 6x = 120$
 $\Rightarrow x = 20$
 Luas B = $\frac{1}{2} \times (24 + 12) \times 20$
 $= \frac{1}{2} \times (36) \times 20$
 $= 360$

(a)

3. Diketahui: $\frac{A}{B}$ Sebangun Segitiga dan Segiempat
 Ditanyakan: Luas B
 Jarak: $\frac{A}{B} = \frac{10cm}{x}$
 $\Rightarrow \frac{6}{12} = \frac{10}{x}$
 $\Rightarrow 6x = 120$
 $\Rightarrow x = 20$
 Luas B = $\frac{1}{2} \times (24 + 12) \times 20$
 $= \frac{1}{2} \times (36) \times 20$
 $= 360$

(b)

Figure 6. Student Answers (a) Female Students; (b) Male Students

Figure 6 a) and Figure b) show students are able to find patterns or provide solutions to find patterns correctly. Both female and male students can analyze the questions well even though they have different solutions, but the answers given are correct.

4.1.4. Draw General Conclusions Based on Patterns (Generalization)

On these indicators, students are expected to be able to formulate valid arguments.

- a. Mungkinkah dua sudut yang berhadapan dalam jajar genjang saling berpelurus? Jelaskan!

b. Dua sudut yang berdekatan dalam jajar genjang jumlahnya sama dengan 180° . Benarkah pernyataan tersebut? Jelaskan!

Figure 7. Problem Generalization Indicators

Following is the results of students' answers to the indicators of drawing general conclusions based on patterns (generalizations).

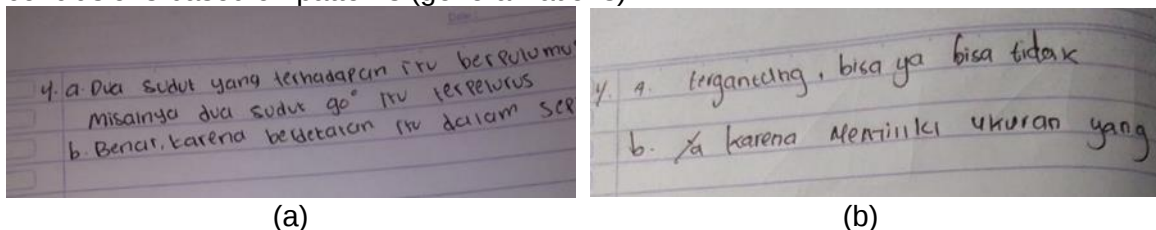


Figure 8. Student Answers (a) Female Students; (b) Male Students

In Figure 8 (a) female students can make conclusions from questions and provide reasons for the correctness of the conclusion, while in Figure 8 (b) male students have not been able to understand the questions well. Students cannot give answers correctly and tend to write down writing in writing.

Based on the results of the analysis of the student answer sheets, the level of mastery of mathematical reasoning abilities of female students is better than that of male students. This can be seen in every indicator of mathematical reasoning ability. From the above discussion, in general, the mathematical reasoning ability of VIII-A students at SMP Negeri 1 Cianjur was still relatively high. It was obtained from the average score of male and female students, namely 70.5% and male students 64.1%. Students can analyze mathematical situations using patterns and relationships, but the steps are not systematic, so they are less able to formulate valid arguments, and are less able to draw logical conclusions.

4.2. Self-Concept Questionnaire Analysis

The results of the data that have been collected from distributing questionnaires to 22 students in class VII A, the data obtained from the whole see the level of self-concept (high, medium, and low). The results of this research analysis about mathematical reasoning skills were reviewed from the student's self-concept. It has previously been known that from the results of the questionnaire there were seen students with different levels of self-concept. There are 7 students with a high self-concept category, 11 students with medium self-concept, and 4 students with low self-concept levels. The results of the self-concept level are obtained with a Likert scale, the overall data will be presented in the table 6 below.

This can be seen from the large number of students who are classified as high and medium self-concept levels. With an average of 74.0% female students in the high category and 69.5% male students in the moderate category.

Table 3. Results of Students' Self Concept Questionnaires on Reasoning Ability

Self-Concept Level	Student Code		Total Student
	Female	Male	
High	S-6, S-9, S-12, S-14 dan S-22	S-5 dan S-18	7
Moderate	S-1, S-3, S-7, S-10, S-11, S-13, S-17, dan S-19	S-8, S-15 dan S-21	11
Low	S-2	S-4, S-16 dan S-20	4
Average	74,0%	69,5%	
Category	High	Moderate	

Based on the results of the questionnaire, it shows that the students' self-concept on mathematical reasoning abilities can be categorized as good. Students with good self-concepts, when given tests of mathematical reasoning questions, can state everyday events. So it can be said that students' self-concept in mathematical reasoning abilities at one of junior high school in Cianjur is in a good category.

4.3. Discussion

Based on the description above, then in general the mathematical reasoning ability of students VIII in one of the junior high schools in Cianjur is still relatively well-obtained from the average score of male and female students of 70.5% and male students 64.1%. This is grounded in considering that female students are able to analyze mathematical situations using patterns and relationships, but male students are in an in systematical pace of workmanship so that they are less able to make valid arguments and less able to examine the problem well. They said that the test was very difficult, and some of them also stated that they rarely get reasoning questions such as those about the test.

One solution to overcome this problem of gender-related reasoning ability can be used an appropriate approach or learning model as well as the provision of a perception and motivation to students. Because based on the results of research on a good self-concept, it can suppress the weak ability of reasoning. In addition, to bridge the differences in gender characteristics in class learning, teachers can create a group of learning that is joined between male and female students so that male students can develop their own characteristic reasoning skills. It is better to use more about mathematical reasoning skills that can make students develop mathematical reasoning skills and familiarize students to solve problems that are not routine to both female and male students by paying attention to the self-concept that exists in students because self-concept is one of the factors that influence in student success.

CONCLUSION

Based on the analysis in this study, it can be concluded that the students' reasoning ability for each indicator is well-achieved, in this case it can be seen from the average of each indicator of mathematical reasoning ability. On the indicators drawing a sketch of the situation and carrying out calculations based on the results of the students' answers, it appears that female students outperformed by a percentage of 66.1% while male students with a percentage of 53.1%. Then in the indicator draw conclusions based on the similarity (analogy) of female students with a percentage of 76.8% while male students are 68.8%. For proportional reasoning indicators, female students get a percentage of 73.2% while male students 71.9%. Then the indicators draw general conclusions based on the pattern (generalization) of female students, namely 66.1% and male students 62.5%. Based on the results of the questionnaire, it shows that the self-concept that students have towards mathematical reasoning ability can be categorized as high and medium. This can be seen from the average female students of 74.0% who belong to the high self-concept level and 69.5% of male students who belong to the medium self-concept. So it can be said that the self-concept of students in mathematical reasoning ability in the junior high school is in the category of

good. One solution to overcome this problem of gender-related reasoning ability can be used an appropriate approach or model of administration and provision of a perception and motivation to students.

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