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## Gender perspective in mathematical thinking ability

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**Abstract.** Mathematical thinking Ability in this research includes mathematical problem solving and mathematical representation. Mathematical problem solving and mathematical representation is important for students in the Study Program of Mathematics Education. Some research findings suggest that gender perspective affects not only differences in students' mathematical thinking Ability, but also influences in students' mathematics learning process. The primary purpose of this research is to analyze the gender perspective comprehensively in the achievement of students' mathematical thinking Ability as the result of the implementation of Calculus Textbook that supported with GeoGebra. This research used quantitative methods. The population of this research consisted of all students in the mathematics department a university in Central Java, Indonesia. The sample was groups of students in the Study Program of Mathematics Education who enrolled in Integral Calculus course. From these study programs, sample groups were selected randomly. This research used various instruments: Test of Mathematical Thinking Ability, and Observation Sheets. The data were analyzed by using *t*-test. From this research, it can be concluded that The achievement of the students' Mathematical Thinking Ability in terms of gender perspectives give no different results.

### 1. Introduction

Minimal learning outcomes in Mathematics Education Study Program is mathematical thinking ability. This mathematical thinking ability includes mathematical problem-solving ability and mathematical representation ability. This ability does not just appear in students but needs to be developed.

Mathematical problem solving is the heart of mathematics and the main purpose of mathematics learning [1,2]. If students have good problem-solving skills, then the student is expected to have sufficient reliable ability in completing problems both inside and outside mathematics. In the mathematical problem-solving process, several other high-level mathematical thinking skills are needed. One of the higher-order mathematical thinking skills needed is mathematical representation ability [3] which is an expression of ideas and struggles to find a solution of mathematics problem [4].

Problem-solving in mathematics and mathematical representation should be recognized in differential calculus learning. The goal of learning mathematics is problem-solving, which also be the center of mathematics [5]. Students who have a good ability to solve the mathematical problem will have good ability to analyze problems and apply the solution in a range of conditions. The common indicators to discuss problem-solving in mathematics understand the problem; selecting an appropriate way to figure the problem out; carrying the chosen way to solve the problem, and reviewing the process of problem-solving [6].

The expression of ideas and efforts to solve problems in mathematics is called mathematical representations [7]. The mathematical representation is essential, especially in learning mathematics,



since it can lead students to solve problems. There are several rationales for the essence of mathematical representation: fluency in building a strong-flexible concept and mathematical thinking [8]. Mathematical representation may support students to break a concrete mathematical idea into simpler problem. Also, students seem to be should have a good mathematical representation ability to have an independent ability in building a concept in learning mathematics. Mathematical representation indicators lead students to present the problem into other mathematical ideas, for instances: images, diagrams, expressions, written words, and texts.

Students of Mathematics Education Study Program in the first year get calculus courses. Characteristics calculus is much-using graphics that are difficult to make manually. Therefore, Information and Communication Technology is needed to make students more easily understand the material and avoid misperceptions. In previous research, a Calculus Textbook that Supported with Geogebra is has been developed to improve the ability of students to solve the problem. The book has been tested for validity. This book contains material that is complemented by how to use GeoGebra software as a medium [9].

On the other hand, in addition to the proper use of textbooks and media, gender is also a factor that influences students' mathematical thinking ability. Some research findings suggest that gender perspective affects not only differences in students' mathematical thinking ability, but also influences in students' mathematics learning process. Gender is nature and behavior that attached to men and women formed socially and culturally [10,11]. Gender differences, besides causing physiological differences, also affect psychological differences in learning. So, male and female students have differences in the process of learning mathematics.

Various research findings reveal that gender differences not only affect the ability to think mathematically, but also the process of obtaining mathematical knowledge [10,12]. Also, it was also found that male students have more interest in mathematics than female students. Female students have higher mathematical anxiety than male students [10].

Those facts show that problem-solving in mathematics and mathematical representation ability is decisive to be developed in students. Therefore, it is deemed necessary to conduct research that aims to comprehensively analyze a gender perspective in the achievement of problem-solving in mathematics and mathematical representations as a result of the implementation of Calculus Text Books supported by GeoGebra.

## 2. Methods

This research aims to analyze the gender perspective in the achievement of students' mathematical thinking ability as the result of the implementation of Calculus Textbook, which is supported by GeoGebra.

Research which used quantitative methods used all students in the mathematics department in a university in Central Java, Indonesia as population. Meanwhile, the sample was groups of students of Mathematics Education who enrolled in the course of Integral Calculus. From these study programs, a sample group was selected randomly. Furthermore, this research used a test of mathematical thinking ability, observation sheets, and interview guide. The data were analyzed by using *t*-test.

## 3. Results and discussion

### 3.1. Results of mathematical thinking ability data analysis

Data of students' mathematical thinking ability is obtained from a score of Mathematical Thinking Ability Test. The scores of the Mathematical Thinking Ability Test are analyzed descriptively first. Descriptive statistics used mean ( $\bar{x}$ ) and standard deviation (*s*) of students' mathematical thinking ability scores based on gender and overall. Descriptive statistics of students' mathematical thinking ability can be seen in Table 1.

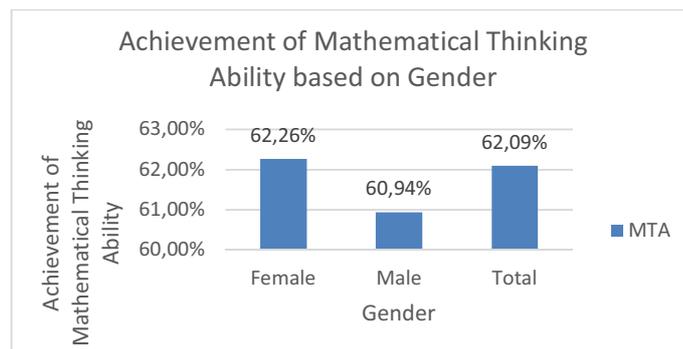
**Table 1.** Descriptive statistics of students' mathematical thinking ability

MPK	STAT	MTA	
		Posttest	<i>n</i>
<i>M</i>	$\bar{x}$	24,3750	8
	<i>s</i>	6,39056	
<i>F</i>	$\bar{x}$	24,9057	53
	<i>s</i>	6,28877	
TOTAL	$\bar{x}$	24,8361	61
	<i>s</i>	6,25081	

Based on the descriptive statistics of the above mathematical thinking ability, in general, it can be said that overall, the average achievement of mathematical thinking ability of male students is equivalent to female students.

### 3.2. Results of mathematical thinking ability achievement data analysis

Data on achievement of students' mathematical thinking ability is obtained from the posttest of mathematical thinking ability score. As seen in Table 1 above, descriptively, the mean of male students' mathematical thinking ability achievement score is equivalent to female students' mathematical thinking ability achievement score. The bar chart about the achievement of students' mathematical thinking ability based on gender can be seen in Figure 1.

**Figure 1.** Achievement of student mathematical thinking ability based on gender

There is a similar achievement of mathematical thinking ability for male and female students in the middle group. Furthermore, the mathematical thinking ability student achievement overall, also included in the same category, namely middle.

### 3.3. Achievement of students' mathematical thinking ability based on gender

Before the mean difference test, the normality test is done first. If data is normally distributed, the homogeneity test of two groups of data is following. If data is not normally distributed, the mean difference test is performed with nonparametric statistics. To test the normality of data, Kolmogorov-Smirnov Z Test (K-S Z) was used. Results of the normality test of mathematical thinking ability achievement can be summarized in Table 2.

**Table 2.** Result of data normality test for mathematical thinking ability achievement based on gender

STAT	Gender	
	M	F
N	8	53
Kolmogorov-Smirnov Z	0,705	0,495
Sig	0,704	0,967
H <sub>0</sub>	Accepted	Accepted

From Table 2, it can be seen that sig value for testing the normality of data on the students' mathematical thinking ability achievement, both male and female is more than 0.05, so H<sub>0</sub> is accepted. This means that data of students' mathematical thinking ability achievement, both male and female are normally distributed. Because both data groups are normally distributed, then the two data are tested for variance homogeneity. The results of variance homogeneity test of two data groups can be seen in Table 3.

**Table 3.** Results of variance homogeneity test data on mathematical thinking ability achievement based on gender

STAT	Gender	
	M	F
F	0,002	
<i>df</i> 1	1	
<i>df</i> 2	59	
Sig	0,963	
H <sub>0</sub>	Accepted	

Table 3 shows that the sig value of homogeneity test data of students' mathematical thinking ability achievement based on gender is more than 0.05, so H<sub>0</sub> is accepted. So, it can be concluded that data is taken from the same variances. Furthermore, to find out whether there is a mean difference between students' mathematical thinking ability achievement based on gender used t-test. The results are summarized in Table 4.

**Table 4.** Results of *t* test on of mathematical thinking ability achievement based on gender

STAT	Gender	
	M	F
Mean	24,3750	24,9057
<i>t</i>	0,222	
<i>Sig</i> (1 – tailed)	0,825	
H <sub>0</sub>	Accepted	

From Table 4, it can be seen that sig value for t-test of mathematical thinking ability achievement is more than 0.05, so H<sub>0</sub> is accepted. This means that male students' mathematical thinking ability achievement is equivalent to female students.

#### 4. Conclusion

From this research, it can be concluded that the achievement of the students' mathematical problem solving and mathematical representation ability in terms of gender perspectives give no different results.

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