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Mathematical Process Skills by Gender in Junior High Schools

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ABSTRAK

Memahami perbedaan keterampilan proses matematika antara siswa laki-laki dan perempuan di Sekolah Menengah Pertama sangat penting karena dapat membantu dalam merancang strategi pengajaran yang lebih efektif. Oleh karena itu, penelitian ini bertujuan untuk melihat keterampilan proses matematika siswa berdasarkan gender pada materi himpunan. Jenis penelitian yang digunakan adalah penelitian kuantitatif dengan tipe komparatif. Instrumen penelitian yang digunakan berupa angket keterampilan proses matematika siswa. Populasi penelitian ini adalah seluruh siswa SMP. Sampel yang digunakan dalam penelitian ini adalah siswa kelas VII A sebanyak 60 orang yang terdiri dari 30 siswa laki-laki dan 30 siswa perempuan. Teknik pengambilan sampel pada penelitian ini menggunakan simple random sampling*. Adapun teknik analisis data yang digunakan dalam penelitian ini adalah analisis deskriptif dan analisis inferensial. Analisis data deskriptif yang disajikan dalam distribusi frekuensi berupa angka-angka seperti mean, median, nilai minimum, dan nilai maksimum sedangkan teknik analisis statistik inferensial yang dilakukan berupa normalitas, homogenitas dan uji hipotesis berupa uji t. Hasil penelitian didapatkan bahwa untuk siswa laki-laki yang memiliki keterampilan proses matematika lebih unggul adalah siswa di SMP 21 Batanghari. Sedangkan untuk siswi perempuan yang memiliki keterampilan proses matematika lebih unggul adalah siswi di SMP Islam Al-Arif. Diperoleh bahwa terdapat perbedaan yang signifikan dari keterampilan proses matematika siswa laki-laki dan siswi perempuan di SMP 21 Batanghari dan SMP Islam Al-Arif.*

ABSTRACT

Understanding differences in mathematical processing skills between male and female students in junior high school is very important because it can help in designing more effective teaching strategies. Therefore, this research aims to look at students' mathematical process skills based on gender in the collection material. The type of research used is quantitative research with a comparative type. The research instrument used was a questionnaire on students' mathematical processing skills. The population in this study was all junior high school students. The sample used in this research was 60 class VII A students consisting of 30 male students and 30 female students. The sampling technique in this research used simple random sampling. The data analysis techniques used in this research are descriptive analysis and inferential analysis. Descriptive data analysis is presented in a frequency distribution in the form of numbers such as mean, median, minimum value and maximum value, while inferential statistical techniques are carried out in the form of normality, homogeneity and hypothesis testing in the form of the t test. The research results showed that male students who had superior mathematical processing skills were students at SMP 21 Batanghari. Meanwhile, female students who have superior mathematical processing skills are students at Al-Arif Islamic Middle School. It was found that there were significant differences in the mathematical processing skills of male and female students at SMP 21 Batanghari and SMP Islam Al-Arif.

1. INTRODUCTION

Education plays an important role in shaping the future of individuals and society. Through education, a person can obtain the knowledge and skills needed to face life's challenges (Sapdi, 2023; Yuni & Harini, 2024). A good education system will prepare students to become productive and responsible members of society (Birhan et al., 2021; Osberg & Biesta, 2021). At school, students study various subjects that hone students' cognitive abilities and social skills. The importance of education lies not only in the transfer of knowledge, but also in the development of character and moral values (Mudana, 2019; Rulianto & Hartono, 2018). In addition, effective education must be able to adapt to the changing needs of the times. Mathematics is a field of science that studies structures, relationships and patterns in numbers and shapes. In everyday life, mathematics plays an important role in various aspects, from financial planning to technology (Hwang & Tu, 2021; Santagata & Yeh, 2014). Logical and analytical thinking skills developed through mathematics help individuals solve problems effectively. Apart from that, mathematics also trains accuracy and perseverance in every step of problem solving (Hill et al., 2021; Kenedi et al., 2019). The mathematics learning process requires students to understand basic concepts before moving on to more

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complex topics. Mathematical mastery is not just about getting the right answer, but also about understanding the process behind the answer (Surya et al., 2017; Verschaffel et al., 2020). One of the skills required by students is mathematical process skills.

Mathematical process skills are essential abilities that involve various cognitive and practical activities in understanding, applying, and solving mathematical problems (Hawes & Ansari, 2020; Ladyawati & Fathonah, 2023). These skills include the ability to understand basic concepts, create and follow logical arguments, and identify patterns and relationships between numbers or shapes (Nasution, 2014; Riyani & Hadi, 2023). Additionally, mathematical process skills involve the effective use of tools and strategies to solve complex problems, as well as the ability to communicate mathematical thinking clearly. These skills are essential in the development of critical and analytical thinking, which is not only useful in academics but also in everyday life and various professions. Mathematical process skills are very important because they enable individuals to understand and apply mathematical concepts in various real-life situations (Mutaf-Yıldız et al., 2020). Mathematical process skills include logical, analytical, and critical thinking abilities, all of which are necessary to solve problems effectively (Bakker et al., 2021; P. D. R. Pratiwi et al., 2023). By mastering mathematical process skills, a person can identify patterns, make predictions, and make decisions based on available data. These skills are also important in various professional fields, such as science, technology, engineering, and economics, where a deep understanding and application of mathematics is often the key to success (Geçici & Türnüklü, 2021). Additionally, mathematical process skills help develop communication and collaboration abilities, as individuals learn to explain thinking clearly and work together to solve complex problems.

Apart from influencing the way of learning, gender differences also influence mathematics anxiety (Anaya et al., 2022; Imro'ah et al., 2019). One of the factors that can cause mathematics anxiety is gender. This is due to differences in ways of thinking between men and women. Previous researchers stated that differences in thinking between men and women are influenced by the different physical and biological structures of the brain, which as a result can lead to differences in behaviour, development and cognitive processing (Papadakis et al., 2021; Yang et al., 2023). These differences will result in different ways of solving problems and processing anxiety. The differences between men and women certainly cause differences in thought patterns and different ways of dealing with various problems in learning (Nuralam & Yani, 2019; Young & Young, 2021). Men and women certainly have many differences in learning mathematics.

This research is in line with research conducted by Wijaya et al., (2018), there is a simultaneous influence of mathematics anxiety and gender on adaptive reasoning abilities, but partially only the mathematics anxiety factor has an influence on adaptive reasoning abilities. Many previous studies show differences in mathematics learning outcomes between male and female students, but these results often vary depending on the social context, culture, and teaching methods used (Hanggara et al., 2022; Mejía-Rodríguez et al., 2021). In addition, most research tends to use a quantitative approach without delving deeper into the psychological and social factors that might influence mathematical processing skills based on gender (Davita & Pujiastuti, 2020; Rodríguez et al., 2020). Therefore, this study not only measures the final results, but also understands the different mathematical process skills between male and female students. Based on the explanation above, researchers are interested in conducting research entitled Analysis of Mathematical Process Skills based on Gender at SMP 21 Batanghari and SMP Islam Al-Arif on Association material.

2. METHODS

The type of research used is quantitative research with a comparative type. Quantitative research is a type of research that produces data in the form of numbers about a phenomenon and analysis the data using statistical data (Khalaf et al., 2022). Comparative research is used to compare two or more research variables. This approach refers to the analysis of differences or relationships between identified variables, with the aim of understanding cause and effect or differences between these groups (Dietmaier, 2017; Yusanto, 2020). This method involves collecting data in the form of numbers or statistics which are then analysis quantitatively, thus allowing researchers to draw stronger generalizations or conclusions regarding the comparison or relationship between the variables studied (Creswell, 2014; Hodis & Hancock, 2016). The research instrument used was a questionnaire on students' mathematical processing skills on set material. Questionnaires are tools used in research to measure and evaluate students' ability levels in various cognitive and non-cognitive aspects. The mathematical process skills questionnaire is designed to measure and evaluate students' ability to understand and apply mathematical concepts effectively (Apriyantini et al., 2024). By using this questionnaire, educators can gain insight into the extent to which

students are mastering important skills in mathematics and identify areas that need improvement. The following is a grid of mathematical process skills instruments.

Table 1. Mathematical Process Skills Instrument Grid

Indicators	Number of Questions	Question Number
Observations	7	1,2,3,4,5,6,7
Communications	7	8,9,10,11,12,13,14
Measure	7	15,16,17,18,19,20,21
Drawing up Tables	5	22,23,24,25,26
Conclusion	4	27,28,29,30

The instrument for students' mathematical processing skills consists of 30 statements with a Likert scale of 1 to 4 with details: 1 (very bad), 2 (not good), 3 (good), 4 (very good). Then determine the distance criteria which can be seen in the Table 2.

Table 2. Categories of Mathematical Process Skills

Categories	Intervals
Very not Good	30.00-52.40
Not Good	52.50-74.90
Good	75.00-97.40
Very Good	97.50-120.00

The population of this study were all students at SMP 21 Batanghari and SMP Islam Al-Arif. The sample used in this research was 60 class VII A students consisting of 30 male students and 30 female students. The sampling technique in this research used simple random sampling. Simple random sampling is a sampling technique that is carried out randomly in administering questionnaires (Owusu-Fordjour et al., 2020). In the simple random sampling technique, each element of the population has the same chance, and members of the population are considered homogeneous (Arieska & Herdiani, 2018).

The data analysis techniques used in this research are descriptive analysis and inferential analysis. The first is descriptive data analysis presented in a frequency distribution in the form of numbers such as mean, median, minimum value and maximum value (Odhier et al., 2019). The second is inferential statistical data analysis which is carried out in the form of normality, homogeneity and hypothesis testing in the form of the t test. The normality assumption test is used to evaluate whether data distribution follows a normal distribution pattern or not, which is important for making the right decision regarding the selection of appropriate statistical analysis. The homogeneity test is used to check whether data variability is uniform across the groups or treatments tested (Basri et al., 2022; Sari et al., 2017) . Through these techniques, researchers can ensure that the data used for statistical analysis meets the necessary assumptions, so that the resulting analysis results are more valid and trustworthy. Hypothesis testing is used to test statements or predictions regarding a population based on a sample obtained, with steps that include formulating a null hypothesis and an alternative hypothesis, collecting data, and using statistical techniques to determine whether there is sufficient evidence to reject the null hypothesis. Meanwhile, the t test is used to compare the means of two independent sample groups or to test differences between sample and population means (Baba et al., 2017; Sugiyono, 2019).

This research procedure begins by distributing questionnaires to a sample of students who have been determined randomly or through systematic selection. During the process of filling out the questionnaire, students are asked to answer questions related to the mathematical process skills they want to measure (Purwanti et al., 2016; Zubaidah et al., 2017). The collected data is then analysis using statistical methods, such as descriptive analysis to get a general picture, and inferential analysis to determine the relationship or differences between the variables studied. The following image illustrates how this research procedure was carried out:

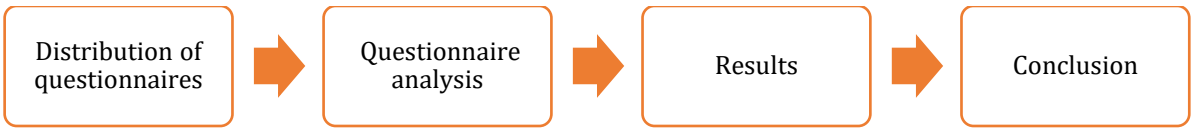

Figure 1. Research Procedures

3. RESULT AND DISCUSSION

Result

This research was conducted at SMP 21 Batanghari and SMP Islam Al-Arif class VII A with a total of 60 students. This research aims to look at students' mathematical processing skills based on gender. The data obtained in the questionnaire was analyzed using IBM SPSS Statistics 26 which consists of mathematical process skills based on gender. The following describes the descriptive statistical results of students' mathematical process skills at SMP 21 Batanghari and SMP Islam Al-Arif, presented in the following Table 3.

Table 3. Description of Mathematical Process Skills by Gender

School	Gender	Intervals	F	Percentage	Categories	M e	M ed	Min	Max
SMP 21 Batanghari	Male	30.00-52.40	0	0%	Very not Good	72.35	62.00	31.00	90.00
		52.50-74.90	2	13.3%	Not Good				
		75.00-97.40	10	66.7%	Good				
		97.50-120.00	3	20%	Very Good				
	Female	30.00-52.40	0	0%	Very not Good				
		52.50-74.90	3	20%	Not Good	62.56	72.00	30.00	96.00
		75.00-97.40	7	46.7%	Good				
		97.50-120.00	5	33.3%	Very Good				
SMP Islam Al-Arif	Male	30.00-52.40	0	0%	Very not Good	64.35	70.00	33.00	95.00
		52.50-74.90	2	13.3%	Not Good				
		75.00-97.40	9	60%	Good				
		97.50-120.00	4	26.7%	Very Good				
	Female	30.00-52.40	0	0%	Very not Good				
		52.50-74.90	1	6.6%	Not Good	73.60	71.00	32.00	92.00
		75.00-97.40	10	66.7%	Good				
		97.50-120.00	4	26.7%	Very Good				

Based on the table above, SMP 21 Batanghari consists of 30 students divided into 15 female students and 15 male students. 13.3% of male students or 2 people have poor mathematical processing skills, 66.7% or 10 people have good mathematical processing skills, and 20% or 3 people have very good mathematical processing skills. Meanwhile, the statistical average is 72.35, the median is 62.00, the minimum score is 31, and the maximum score is 90. For female students, 20% or 3 people have poor mathematical processing skills, 46.7% or 7 people have poor mathematical processing skills. good and 33.3% or 5 people have very good mathematical process skills. The average score for female students' mathematical processing skills is 62.56 with a median of 72.00, a minimum score of 30, and a maximum of 96.

SMP Islam Al-Arif consists of 30 students divided into 15 female students and 15 male students. 13.3% or 2 male students have poor mathematical processing skills, 60% or 9 people have good mathematical processing skills, and 26.7% or 4 people have very good mathematical processing skills. Meanwhile, the statistical average is 64.35, the median is 70.00, the minimum score is 33, and the maximum score is 95. For female students, 6.6% or 1 person has poor math processing skills, 66.7% or 10 people have poor math processing skills. good and 26.7% or 4 people have very good mathematical process skills. The average score for female students' mathematical processing skills is 73.60 with a median of 71.00, a minimum score of 32, and a maximum of 92. Based on the results obtained, it is known that male students who have superior mathematical processing skills are students at SMP 21 Batanghari. Meanwhile, female students who have superior mathematical processing skills are students at SMP Islam Al-Arif.

After the data was analyzed descriptively, the data was analyzed using inferential statistics to determine differences in mathematical processing skills for each gender in classes A and B, which consisted

of testing assumptions and hypotheses. This assumption test consists of a normality test and a homogeneity test (Annisak et al., 2024). The results of the assumption test in Table 4.

Table 4. Test of Normality of Mathematical Processing Skills Based on Gender

School	Gender	Sig	Distribute
SMP 21 Batanghari	Male	0.226	Normal
	Female	0.398	Normal
SMP Islam Al-Arif	Male	0.147	Normal
	Female	0.076	Normal

Table 4 provides information on the distribution of data in classes A and B based on gender. In the normality test, the data is normally distributed if the sig value is > 0.05. The significance value can be seen from the Kolmogorov-Smirnov results table (Christidamayani & Kristanto, 2020). Based on the male gender table at SMP 21 Batanghari, the significance value is 0.226. This means that the mathematical processing skills of male students are normally distributed. Meanwhile, the significance value for female gender at SMP 21 Batanghari has a respective significance value of 0.398. This shows that the data on mathematical processing skills for women is normally distributed.

Based on the male gender table at SMP Islam Al-Arif, the significance value is 0.147. This means that the mathematical processing skills of male students are normally distributed. Meanwhile, the significance value of female gender at SMP Islam Al-Arif has a significance value of 0.076. This shows that the data on mathematical processing skills for women is normally distributed. After the data is declared to be normally distributed, a homogeneity test is carried out as a second assumption test. The homogeneity test results in Table 5.

Table 5. Test the Homogeneity of Mathematical Processing Skills Based on Gender

School	Gender	Sig
SMP 21 Batanghari	Male	0.078
	Female	0.067
SMP Islam Al-Arif	Male	0.083
	Female	0.074

Table 5 provides information regarding the homogeneity of data based on gender. In this homogeneous test, data is said to be homogeneous or have similarities if the significance value obtained is greater than 0.05. Based on the table, it is known that the significance value at SMP 21 Batanghari for males is 0.078 and for females the significance value is 0.067. This shows sig > 0.05, which means the data is homogeneous. SMP Islam Al-Arif for males is 0.083 and for females the significance value is 0.074. This shows sig > 0.05, which means the data is homogeneous.

After the data is declared to be normally distributed and homogeneous, a hypothesis test is carried out, namely the t test. The condition in the t test is that if the significance value is > 0.05 then it can be said that there is no difference in the variables. If the significance value is <0.05 then the variables have a significant difference. The t-test of students' mathematical process skills is explained in Table 6. From the table it is known that there is a significant difference in the mathematical processing skills of the male gender, this is proven by the sig (2-tailed) value < 0.05, the female gender also has a significant difference in mathematical processing skills. This is proven by the sig (2-tailed) value < 0.05.

Table 6. T-test of Mathematical Processing Skills by Gender

School	Gender	Q	df	Sig. (2-tailed)	Mean Difference
SMP 21 Batanghari	Male	16.346	15	0.046	75.55323
	Female	17.587	15	0.038	70.55323
SMP Islam Al-Arif	Male	15.825	15	0.027	60.55223
	Female	16.976	15	0.032	65.55223

Discussion

Mathematical process skills are the main foundation in understanding and solving mathematical problems effectively. Mastering mathematical process skills does not only mean having the ability to calculate, but also being able to analyze, formulate strategies, and carry out problem solving systematically and logically (Trihono, 2022; Tyera et al., 2022). The importance of this skill lies in its ability to help students

develop critical, creative, and analytical thinking patterns, which are skills that are indispensable in various areas of life. The role of gender in mathematical process skills has become an interesting and relevant research subject in the field of education (Sesanti & Bere, 2020; Warsini, 2019). Although the empirical evidence varies, several studies show differences in the approaches, preferences, and results of mathematical process skills between male and female students (Apriyono, 2018; Mulyati & Evendi, 2020). For example, some studies show that female students tend to use a more systematic and problem-solving-oriented approach, while male students may prefer an approach that is more intuitive or based on understanding broad mathematical concepts. The role of gender in mathematical process skills is complex and influenced by social, cultural, and environmental factors.

Based on the data testing that has been carried out, the data is normally distributed as proven by the normality test using the Kolmogorov-Smirnov test. It can be concluded that the data is normally distributed with the Kolmogorov-Smirnov test showing a significance value of > 0.05. Therefore, with a significance value greater than 0.05, it can be said that the data for the normality test is regularly distributed. The homogeneity test is the second test which is based on the results of the three tables analyzed. The criteria are if sig < 0.05 then the data is ready to be analyzed using the Anova test with the SPSS version 26 program. In the t test the results show that there are significant differences in mathematical processing skills based on gender, this is proven by the sig value. (2-tailed) < 0.05. Based on the results of the statistical description, it is known that male students who have superior mathematical processing skills are students at SMP 21 Batanghari. Meanwhile, female students who have superior mathematical processing skills are students at SMP Islam Al-Arif.

Much research has been carried out regarding process skills in mathematics learning, one of which is research (Rahmananda et al., 2024). In his research, he conducted experiments to improve students' processing skills in solving mathematical problems. The weakness of this research is that Alan only used two sample classes at the same school. The results and conclusions obtained are not universal. There are other studies that do not compare process skills between genders (Mutlu, 2020). Meanwhile, other research evaluates the process skills possessed by students (Yiğit Özüdoğru & Demiralp, 2022). However, in this study, the comparison of students' processing skills on set material was carried out by comparing male and female students in each school, with the indicators of observing, measuring, compiling tables, communicating. We can know the comparison of processing skills for each gender.

The novelty of this research focuses on mathematical process skills, not just final results or test scores by paying attention to gender differences, this research can identify specific aspects where male and female students may need different teaching approaches (Babys, 2020; Hidayanti et al., 2020). This research can provide insight into how gender influences the mathematics learning process at a crucial age in junior high school (Pratiwi & Alyani, 2022). In addition, this research also considers contextual variables that are often overlooked in previous studies, such as the classroom environment and teaching methods used, which can provide a more comprehensive picture of the factors that influence mathematics skills based on gender (Annisa et al., 2021). Thus, the results of this research not only enrich the academic literature but also offer practical recommendations for educators and policy makers to improve mathematics education to be more inclusive and effective.

This research has significant implications in the development of more inclusive and effective learning strategies. The results of this research can provide in-depth insight into the differences in mathematical processing skills between male and female students, which can then be used by educators and policy makers to design curricula and teaching methods that are more responsive to gender needs (Kusumaningsih et al., 2020; Pratama et al., 2023). In this way, the gender gap in mathematics achievement can be minimized, and students' academic potential can be optimized through a more tailored approach. In addition, the findings of this research can encourage efforts to increase students' self-confidence and interest in mathematics, especially for groups that have been underrepresented or left behind in this subject.

The limitation of this research is that the limited sample which only includes students from certain schools can affect the generalization of the findings. Second, external factors such as socio-economic background, family support, and teaching quality were not fully controlled in this study, so they could influence the results. Third, data collection methods that rely on math skills tests may not fully capture students' abilities holistically, because non-cognitive aspects such as motivation and math anxiety are not measured. Fourth, potential bias in gender measurement could occur if a student's gender identification does not match the student's own identity, which could affect the analysis results. Based on the results of the research it is recommended that schools and educators pay more attention to gender differences in mathematics learning. Teaching strategies tailored to the needs of each gender can be implemented to improve mathematical process skills evenly. In addition, training for teachers to understand and overcome gender bias in mathematics teaching is needed. Further research is also recommended to explore other

factors that influence math skills, such as teaching methods, learning environments, and parental support, to create a comprehensive and inclusive approach.

4. CONCLUSION

Based on the research results, it can be concluded that male students who have superior mathematical processing skills are students at SMP 21 Batanghari. Meanwhile, female students who have superior mathematical processing skills are students at SMP Islam Al-Arif. There are significant differences in the mathematical processing skills of male and female students at SMP 21 Batanghari and SMP Islam Al-Arif. This research is important because it can provide in-depth insight into how gender factors influence analytical abilities, problem solving, and understanding of mathematical concepts. It is hoped that the results of this research can help educators in designing more inclusive and effective teaching strategies. It is hoped that future research will examine mathematical process skills at a higher level by varying the mathematical process skill variable with other variables.

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