
AN ANALYSIS OF MATHEMATICAL REASONING ABILITY IN PROBLEM SOLVING WORD PROBLEM BASED ON GENDER AT UNIVERSITAS MUHAMMADIYAH LAMONGAN

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ABSTRAK

Penelitian ini bertujuan untuk mendeskripsikan dan menganalisis kemampuan penalaran matematis dan pemecahan masalah matematika mahasiswa PGSD Universitas Muhammadiyah Lamongan berdasarkan gender pada soal cerita. Penelitian ini merupakan jenis penelitian deskriptif kualitatif. Subjek penelitian adalah 6 mahasiswa PGSD Universitas Muhammadiyah Lamongan yang dipilih berdasarkan kriteria kemampuan akademis yaitu mahasiswa dengan kemampuan penalaran tinggi, penalaran sedang, dan penalaran rendah. Teknik pengumpulan data dalam penelitian ini menggunakan instrumen tes, observasi, dan wawancara. Analisis data yang digunakan yaitu berdasarkan hasil tes, observasi, dan wawancara yang diperoleh siswa dan dinilai berdasarkan rubrik penilaian. Analisis data yang dilakukan peneliti menggunakan 6 subjek sebagai perwakilan yang terdiri dari 3 subjek laki-laki dan 3 subjek perempuan dengan kriteria hasil penilaian tinggi, sedang, dan rendah. Hasil analisis data kemampuan penalaran matematis dan pemecahan masalah siswa berdasarkan gender dalam menyelesaikan soal cerita yaitu kemampuan penalaran matematis siswa perempuan lebih unggul dibandingkan kemampuan penalaran matematis siswa laki-laki.

Kata kunci: Penalaran Matematis, Pemecahan Masalah, Gender

ABSTRACT

This study aims to describe and analyze the mathematical reasoning and problem solving abilities of PGSD students, Universitas Muhammadiyah Lamongan, based on the gender in resolving story problems. This research is a qualitative descriptive research. The research subjects were 6 PGSD students of Universitas Muhammadiyah Lamongan who were selected based on the criteria of academic abilities; students with high reasoning, moderate reasoning, and low reasoning. The data collection techniques were observation, test, and interview. The data analysis was based on the results of test, observation, and interview obtained by students and based on table rubrics. Data analysis was carried out by the researcher using 6 subjects as representatives consisting of 3 males and 3 females with criteria previously mentioned (high, moderate, low). The results of data analysis on mathematical reasoning and problem solving abilities based on gender were female students' mathematical reasoning abilities were superior than male students' mathematical reasoning abilities. Keywords: Mathematical Reasoning, Problem Solving, Gender

INTRODUCTION

Mathematics is one of the basic sciences, which currently has developed very rapidly, both in terms of material and use. Mathematics has an important role in educating students to become human beings who can think logically, critically, and rationally. The ability to solve problems is a very important part of mathematics, because in the learning process and the completion of students it is possible to gain experience using the knowledge and skills they already have to be applied to solving problems that are not routine in nature. Many of the great students who find it difficult when do the problem or problems in mathematics, because of the difficulty of understanding a concept of mathematical material which is then constructed into the calculation formula. Difficulties in learning mathematics are complex Difficulties occur at all stages of the completion process, starting from the first stage (about understanding what the problem is), planning the completion process and choosing the right strategy, and the stage of deciding whether it makes sense or not (Amin & Mariani, 2017). Mathematical problem solving is a process that uses the power and benefits of mathematics in solving problems which is also a method of finding solutions through the stages of problem solving (Marchis, 2013). To improve the ability to solve mathematical problems, it is necessary to develop skills in understanding problems, making mathematical models, solving problems, and interpreting solutions (Wismath & Orr, 2015).

Mathematical problem solving abilities can also be related to students' reasoning abilities. In accordance with what is formulated in the NCTM (National Council of Teachers of Mathematics) (NCTM, 2014), school math standards include content or material standards (mathematical content) and process standards (mathematical processes). Process standards include problem solving, reasoning and verification, connection, communication, and representation.

Reasoning is a fundamental component in mathematics (Lithner, 2000). Reasoning is a thinking activity to draw conclusions, making new statements based on statements that have been proven beforehand. Realizing the importance of mathematical reasoning, learning skills and independence in students, teachers are expected to strive for learning by implementing learning strategies that can provide opportunities and encourage students to practice mathematical reasoning skills and independent learning (Putra & Ikhsan, 2019). Teachers need to apply learning that supports students to reason independently, in strict reasoning, the main thing is to distinguish evidence from statements, valid demonstrations from invalid experiments. The main thing in the reasoning is to distinguish between something that is more reasonable than the less plausible (Lithner, 2000).

Through mathematical reasoning students can propose assumptions and then compile evidence, manipulate a mathematical problem and can draw conclusions correctly and correctly. The reasoning ability of students from one another is not the same so that the

problem solving done by each student is also different. One of the thinking activities that can practice reasoning skills is solving math problems. Problem solving is the highest type of learning that can help and develop high-level intellectual skills, namely mathematical reasoning, so that special attention is needed to students' reasoning and problem solving abilities. Problem solving is the highest type of learning that can help and develop high-level intellectual skills, namely mathematical reasoning.

The Women Studies Encyclopedia explains that gender is a cultural concept, trying to make a distinction in terms of roles, behavior, mentality, and emotional characteristics between men and women that develop in society. Humans are born in various physical forms, with different skin colors, gender, talents, motor and sensory abilities, and so on. (Brown & Kanyongo, 2010) They found how important differences are in problem solving strategies where girls tend to use "concrete solutions to strategies such as modeling and calculation, while boys tend to use solutions that are more abstract strategies that reflect conceptual understanding". Research has confirmed the gender differences, even in elementary education, mathematics self-concept, the ability of self, and interest in, suggesting that boys generally have better motivation profile in mathematics than girls (Felson & Trudeau, 2014). The differences were most significant for middle school and university students than for students at a lower level of education. Demonstrating the need to explore gender differences in academic motivation, previous research has

concluded that, for example, math self-concept can be positively associated with achievement in boys but can even have a negative effect on girls' achievement. It also suggests that the impact of interest on math achievement may be slightly more important for girls than for boys (Reilly et al., 2017). In terms of gender differences associated with emotions provoked by mathematics, among which the study of mathematics anxiety stands out, the research shows that at this point, although value-expectations theory does not develop a specific theoretical framework for dealing with gender differences, it can be used to facilitate interpretation of the differential impact of the confidence and score value (Rodríguez et al., 2020). Based on these considerations, the main objective of this study was to analyze students' mathematical reasoning abilities and problem solving based on gender.

METHODS

The approach used in this research is a descriptive approach. Descriptive research is research that belongs to the type of qualitative research. Qualitative research is research that intends to understand the phenomena experienced by research subjects such as behavior, perceptions, actions, and others by describing them in words and language by utilizing various scientific methods. Subjects in the study were 6 students consisting of 3 male subjects and 3 female subjects selected based on academic ability criteria, namely students with high, medium, and low abilities. This study used an instrument consisting of test questions, interview guidelines and

observations. The data obtained from this study are the results of the geometric story problem test which aims to see the mathematical thinking skills of students in terms of gender and the results of interviews between researchers and interview subjects. The data analysis used is based on the results of tests, observations, and interviews obtained by students and is assessed based on an assessment rubric. Data analysis conducted by researchers was using 6 subjects.

Table 1 Rubric for Problem Solving and Mathematical Reasoning Questions for Students

Rated aspect	Assessment indicators	Score
Understand the problem	1. No answers, misinterpreted or completely wrong	0
	2. Write down what is known / asked / sketched / model but is wrong or doesn't understand the problem at all, ignores some of the questions and ignores the condition of the problem	1
	3. Understand the information or problem inaccurately / completely, understand the complete problem of results or no results	2
	4. Managed to understand the problem thoroughly	3
Make a completion plan	1. There is no sequence of completion steps at all or making no plans at all and the	0

	completion plan is irrelevant	
Solve the problem	2. Solution strategies / steps exist but are irrelevant or not / unclear, creating problem solving plans that cannot be implemented	1
	3. Problem-solving strategies / steps and plans leading to correct but incomplete or wrong answers	2
	4. Present correct completion steps	3
	1. There is no solution at all / no calculation	0
Check again	2. There is a workaround, but unclear / wrong procedure, carries out the correct procedure and may result in the correct answer but miscalculation	1
	3. Using certain procedures that are correct but calculations are incorrect / incomplete	2
	4. Using the right specific procedure / doing the right process and getting the right results	3
	1. If you do not write down conclusions and do not check the process as well as the answer results / There is no examination or other information	0
	2. If you write down	1

conclusions and / or check the process inaccurately or if you only write conclusions or check the process properly / there is an examination but it is not complete	
3. If you write down conclusions and check the process properly / Check is done to see the correctness of the process	2

Source: Adapted from (Amam, 2017)

RESULTS AND DISCUSSION

Based on the results of interviews and the results of problem solving tasks, the following are obtained :

1. High Reasoning Ability Students

a. Result of Problem Solving Task Work

Based on the results of student work, it appears that students can understand the problems in the questions well. The self-discipline student correctly writes what is known in the question (sufficient condition) and what is asked in the question as a necessary condition. Students are able to write mathematical modeling of the problem "area of the image and size outside the frame"

After understanding the problem, the next step is to plan for problem solving. The problem solving plan at this stage students does not clearly explain the relationship between what is known and what is being asked in the questions. Students immediately "make illustrations from pictures". The next planning step for students to use substitution by using all known

elements in the questions to answer existing problems.

The next step is to implement a problem-solving plan. Problem solving which is done by students using the substitution method. It can be seen that students substitute the equation for the width of the frame = $(15 - 2x)(12 - 2x) = 88$

The last stage is to check the answers obtained. At this stage, students write down how students can check the answers that have been obtained.

b. Interview result

Based on the results of the interview, students were able to explain what was known and what was asked about the questions correctly and precisely. Furthermore, in the problem solving stage students are able to explain precisely the meaning of the questions and the formulas used. Students explain the size and area of the image. In the final stage, namely checking the answers again, students are able to explain how to check the answers that have been obtained.

c. Data validation

Based on the results of data through written tests and interviews on the questions, it was found that students had the same tendency to answer the two data collection methods used. Students are able to understand problems well, carry out and plan solutions and solve problems correctly, and are able to check the answers obtained by using known elements in the questions.

d. Data analysis

Based on data obtained through written tests and interview results, students are able to solve problems on the questions. This is evident from the

stages of problem solving carried out by students correctly. Students are able to understand problems well. Then students are able to do problem solving planning and be able to solve problem solving appropriately. Furthermore, students are able to re-check the answers obtained using known elements in the questions.

2. Exposure and Data Analysis of Students with Moderate Reasoning Ability

a. Result of Problem Solving Task Work

Based on the results of student work, it appears that students can understand the problems in the questions. This can be seen where students are able to write down what is known in the questions (sufficient conditions) and what is asked in the questions as a necessary condition. Students are able to write mathematical modeling of the problem "area of the image and size outside the frame".

After understanding the problem, the next step is to plan for problem solving. In problem solving planning, students do not clearly explain the relationship between what is known and what is being asked in the questions. The next planning step for students to use the substitution method by using all known elements in the questions to answer the existing problems. The next step is to implement a problem-solving plan. Carrying out the plan is in principle solving problems. The problem solving done by students uses the substitution method. It can be seen that students substitute the equation ($2x^2 - 27x + 46 = 0$). The last stage is to check the answers obtained. At this stage students do not write down how

students check return the answers that have been obtained

b. Interview result

Based on the results of the interview, students were able to explain what was known and what was asked about the questions correctly and accurately. Furthermore, in the problem solving stage students are able to explain precisely the size and area of the image used. Students explain the shape of the picture. In the final stage, namely checking the answers again, students are able to explain how to check the answers that have been obtained.

c. Data validation

Based on the results of the data obtained through written tests and interviews on the questions, it is known that students have the same tendency to answer the two data collection methods. Students are able to understand problems well, plan solutions and solve problems correctly, and be able to check known answers to questions.

d. Data analysis

Based on data obtained through written tests and interview results, students are able to solve problems on the questions. This is evident from the stages of problem solving carried out by students correctly. Students are able to understand problems well. Then students are able to plan problem solving and be able to solve problem solving appropriately. Furthermore, students are able to recheck the answers obtained using known elements in the questions.

3. Exposure and Data Analysis of Students with Low Reasoning Ability

a. Result of Problem Solving Task Work

Based on the results of student work, it can be seen that students have not been able to work on questions based on existing orders. Students do not write down what is known and what is asked. Students immediately write down the problem solving stage. At the problem solving stage, students carry out a substitution process. The substitution steps taken by students are not right.

b. Interview result

Based on the results of interviews with students, it was found that students did not understand the questions from the questions and were unable to solve the questions perfectly.

c. Data validation

Based on the results of the data obtained through written tests and interviews on the questions on the two data collection methods. Students have not been able to understand problems well, plan solutions and solve problems correctly, and have not been able to check the answers obtained by using known elements in the questions.

d. Data Analysis

Based on data obtained through written tests and interview results, students have not been able to solve the problems in the questions. This is evident from the inaccurate stages of problem solving by students. Students have not been able to understand the problem well. Then students do not plan to solve problems and are unable to solve problems appropriately

Table 2 the results of the assessment of the research subjects

Research subject	Gender	Reasoning and problem-solving test scores	Test score criteria	Interview value	Observation value
Subject 1	Male	10	Excellent	Excellent	Excellent
Subject 2	Male	8	Very good	Very good	Very good
Subject 3	Male	4	Good	Good	Good
Subject 4	Women	12	Excellent	Excellent	Excellent
Subject 5	Women	10	Excellent	Excellent	Excellent
Subject 6	Women	4	Good	Good	Good

CONCLUSION

The conclusion in this study is that most of the research subjects experienced difficulty in solving the reasoning test questions given. They said that the test questions were difficult and some of them also stated that they rarely get reasoning questions like the test questions. However, from the results of the assessment and the average score obtained, it can be said that the mathematical reasoning ability of female students is superior to that of male students. This is because most male students tend to be less careful,

less thorough, and less confident in solving these reasoning test questions, so that the results of male students' reasoning test questions are still considered less than optimal.

Based on the analysis and discussion, the following conclusions were obtained:

1. The ability of mathematical reasoning and problem solving in students with high reasoning ability.
 - a. Students with high reasoning abilities are able to determine the sufficient and necessary

- requirements to be able to solve problem solving.
- b. Students with high reasoning abilities are able to explain the relationship between what is known and what is being asked in the question precisely even though it is not so detailed.
 - c. Students with high reasoning abilities are able to complete the correct and precise steps.
 - d. Students with high reasoning abilities are able to check their answers using known elements in the questions.
2. Mathematical reasoning and problem solving abilities in students with high reasoning abilities.
 - a. Students with moderate reasoning abilities are able to determine the sufficient and necessary requirements to be able to solve problem solving.
 - b. Students with moderate reasoning abilities can explain the relationship between what is known and what is being asked in the question precisely even though it is not so detailed.
 - c. Students with moderate reasoning abilities are able to complete the correct and precise steps.
 - d. Students with moderate reasoning abilities are able to check their answers using known elements in the questions.
3. Mathematical reasoning and problem solving abilities in students with low reasoning abilities.
 - a. Students with low reasoning abilities are not able to determine the sufficient and necessary requirements to be able to solve problem solving.
 - b. Students with low reasoning abilities cannot explain the relationship between what is known and what is asked in the question precisely even though it is not so detailed.
 - c. Students with low reasoning abilities are not able to complete the correct and correct steps.
 - d. Students with low reasoning abilities are unable to check their answers using known elements in the questions.

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