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Analysis of Mathematical Problem Solving Ability Viewed from Gender Differences in Public High Schools

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Abstract. This study aims to analyze students' mathematical problem solving abilities in terms of *gender differences* and describe the obstacles in solving problems in the form of linear programming story questions. This type of research is descriptive with a qualitative approach. The research subjects were 18 students of class XI MIA 2 including 9 male students and 9 female students and the supporting subjects were compulsory mathematics teachers and specialization mathematics teachers. The results of the study using the Polya indicator in terms of *gender differences* showed the overall average score obtained by female students with a score of 49.07 was superior to male students who scored 42.3 6 . This shows that there are differences in abilities due to *gender* in solving a problem such as students not writing down important information they encounter, not writing down the strategies used in solving problems, lack of accuracy in doing calculations and not getting used to re-checking the answers obtained.

Keywords: Analysis, *Gender*, Problem Solving, Polya Theory

Abstrak. *Penelitian ini bertujuan untuk menganalisis kemampuan pemecahan masalah matematis siswa ditinjau dari perbedaan gender serta mendeskripsikan kendala dalam menyelesaikan masalah berbentuk soal cerita program linear. Jenis penelitian deskriptif dengan pendekatan kualitatif. Subjek penelitian yaitu 18 orang siswa kelas XI MIA 2 diantaranya 9 siswa laki-laki dan 9 siswa perempuan serta subjek pendukung yaitu guru matematika wajib dan guru matematika peminatan. Hasil penelitian menggunakan indikator Polya ditinjau dari perbedaan gender menunjukkan nilai rata-rata keseluruhan yang diperoleh siswa perempuan dengan nilai 49,07 lebih unggul daripada siswa laki-laki yang memperoleh nilai 42,36. Hal ini menunjukkan bahwa terdapat perbedaan kemampuan yang disebabkan gender dalam memecahkan suatu masalah seperti siswa tidak menuliskan informasi penting yang ditemui, tidak menuliskan strategi yang digunakan dalam menyelesaikan soal, kurangnya ketelitian dalam melakukan perhitungan serta tidak terbiasa melakukan pengecekan kembali jawaban yang diperoleh.*

Kata kunci: *Analisis, Gender, Pemecahan Masalah, Teori Polya*

INTRODUCTION

Mathematical problem solving is an important part of mathematics learning in students to be improved, where in teaching and learning activities, students can gain experience using the knowledge they already have so that their application in life affects curiosity, attention and thoroughness (Hadi & Radiyatul, 2014). Problem solving is also an effort to find a solution to a problem that was encountered and known beforehand (Dewi, 2020). However, in reality students' mathematical problem solving abilities in Indonesia are still relatively low. The questions tested by PISA in 2015, Indonesia ranked 67 out of 75 countries, in 2018 it was ranked 73 out of 78 countries. This result is also evidenced by 71% of students not achieving the minimum mathematical competence set by PISA, meaning that many Indonesian students have difficulty facing situations that require problem solving using mathematics (Kemendikbud, 2019).

Mathematical problem solving ability can be measured using problem solving indicators according to Polya, namely, 1) *Understanding the problem,* 2) *Devising a plan* 3) *Carry out the plan* and 4) *Looking back* (Chang, 2010). Students' mathematical problem solving abilities can be influenced by various factors, one of which *is gender* (Kemendikbud, 2019). *Gender* factors are influential in learning mathematics because of the differences in the abilities of boys and girls (Dilla et al., 2018). This difference factor also affects problem solving abilities such as basic knowledge and student intelligence (Irawan et al., 2016). Relevant research conducted by Davita & Pujiastuti shows that low problem solving is also influenced by *gender differences*. The results of the written test research used the Polya indicator, where the average score of female students was 80.12 and male students were 74.57 (Davita & Pujiastuti, 2020). In line with this research, researchers conducted interviews with mathematics teachers in class XI MIA 2 where students' mathematical problem solving abilities were relatively low, including students sometimes not being careful when calculating the answers obtained and the placement of completion steps that were not appropriate, the time for teaching and learning activities was relatively small, have not been able to simplify the problem into a mathematical model form, and there are also students who do it but do not

finish it, so there are students who are able to do it but are wrong in writing the final answer because they do not re-check the answers.

The above is also supported by an initial test conducted on 2 students of each *gender*, showing differences in working on a question. This explanation is necessary analysis using Polya in terms of *gender differences* in class XI MIA 2, with the aim of knowing the level of mathematical problem solving ability and the factors that influence it. So that the ability to solve mathematical problems in terms of *gender differences* can be used as a consideration for more focused learning in the classroom.

RESEARCH METHODS

This type of research is descriptive research is a depiction of a real, realistic phenomenon that is conceptualized in a systematic and directed manner (Rukajat, 2018). This research also uses a qualitative approach to an approach whose research is descriptive in nature describes the results of research in the form of analysis (Zakariah Askari, Afriani Vivi, 2021). The research subjects were 18 students of XI MIA 2 class in Public school in East Sumba, consisting of 9 male students and 9 female students and the supporting subjects were compulsory mathematics teachers and specialization mathematics teachers. This research uses purposive sampling technique. Research data in the form of written test results, questionnaires and interviews. The data analysis technique uses the Miles and Huberman model, namely data collection, data reduction, data presentation, conclusion drawing (Sugiyono, 2015). In this study, the validity of the data consisted of triangulation of methods including tests, interviews and questionnaires, triangulation of sources including compulsory mathematics teachers, mathematics teachers with specialization in class XI MIA 2 and students. The following is a scoring guideline for the description test (Pratiwi & Hidayati, 2022). namely:

Indicator Solution to problem	**Criteria**	**Score**
Understanding the problem	Students not yet can interpret information so don't write it down what is known and asked in the question	0
	Students are able to interpret some of the information and can only write elements that are known or vice versa	1
	Students are able to interpret information that is known or asked, but it is not correct.	2
	Students are able to interpret information and write down what is known or asked correctly.	3
Devising a plan	Students cannot planning a solution.	0
	The student plans a solution but is wrong.	1
	Students are able to plan solutions, but are not complete or half correct.	2
	Students are able to find a solution plan correctly.	3
C*carry out the plan*	Students have not been able to carry out the completion plan at all.	0
	Students carry out the plan but it is wrong.	1
	Students carry out the completion plan but only partially correct or half correct	2
	Students are able to carry out the completion plan but the answer is wrong or there is a slight error.	3
	Students are able to carry out the completion plan correctly	4
Looking back	Students have not been able to re-check.	0
	Students do check again but, not right.	1
	Students check back correctly and precisely .	2

Table 1. Problem solving indicators according to polya in solving linear programs

The score results obtained are then used (Rusydi & Fadhli, 2018) to determine the category of mathematical problem solving adapted from, namely:

Interval	Category of Mathematical Problem Solving Ability
X > 83	Very high
72 < X ≤83	High
63 < X ≤71	Currently
50 < X ≤63	Low
X ≤ 50	Very low

Table 2. Categories of mathematical problem solving

RESULTS AND DISCUSSION

The mathematical problem solving ability of students in XI MIA 2 class in SMA Negeri 1 Kambera was measured using a description test of 2 numbers on the Linear Program material with a time limit of 40 minutes. The mathematical problem solving ability of students using linear programming using the Polya indicator based on *gender* can be seen in the student's results in solving problems. The following is a table of student test results by *gender*.

Gender **(P/L)**	**Polya Indikator indicator**	**Total Score**	**Final score**	**Category**
L	Indicator 1	13	24,07	Very low
	Indicator 2	47	87,04	Very high
	Indicator 3	20	30,56	Low
	Indicator 4	10	27,78	Low
Average of All Male Indicators			42,36	S is
P	Indicator 1	36	66,67	High
	Indicator 2	40	74,07	High
	Indicator 3	24	33,33	Low
	Indicator 4	8	22,22	Very low
Average of All Female Indicators			49.07	Currently

Table 3. Problem solving ability test results

Based on the table, the results of the ability to solve problems using the Polya step have different abilities in solving linear programs. The highest score for male students was 66.67 in the medium category and female students scored 79.17 in the high category. The results of the written test were reviewed and adjusted with the results of the questionnaire and interview results to strengthen the validity of the data in the study. For clarity, the following is an explanation regarding problem-solving skills in terms of *gender.*

1. Understanding the problem

This stage is achieved when students write down the important information found correctly. The value of this indicator, for male students is 24.07 in the very low category and for female students is 66.67 in the medium category. The following are the answers of male students represented by INY and answers of female students represented by MKN.

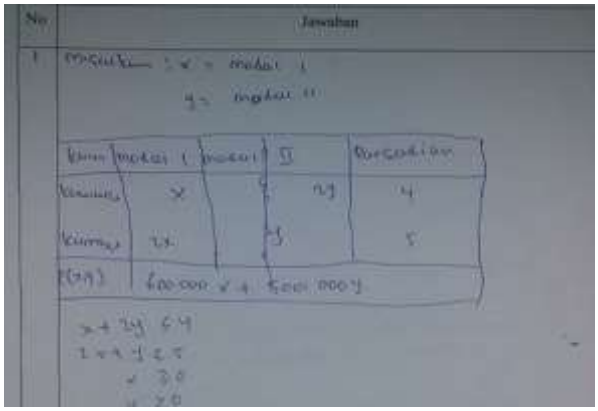

Figure 1. Results of understanding INY students' problems

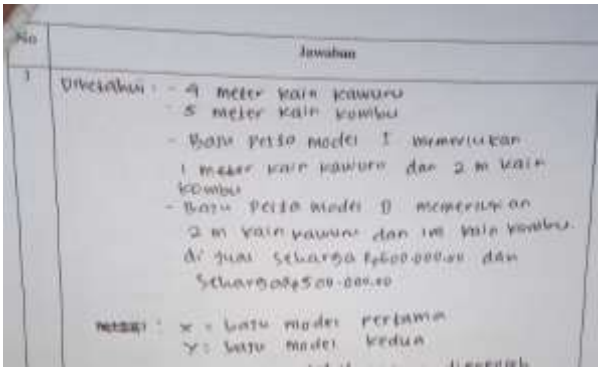

Figure 2. Results of understanding the problems of MKN students

The results of the INY students' work on the two questions showed that the students immediately worked by making examples so that they obtained the mathematical model and objective function in the next step, without writing down what was known and asked. Meanwhile, Figure 2 shows that MKN students are almost right by writing what they know: x = clothes model 1, y = clothes model 2 but does not write down what is asked so that they get a score of 2.

The results of tests, questionnaires and interviews showed that at the stage of understanding the problem, on average, male students tended not to state what was known and asked. This is because students are accustomed to working directly using examples. As for female students, almost all understand the problem well. According to Nurcholis (2021) stated that at this stage, both *genders* were able to understand well and mention important information obtained from the questions.

2. Find a plan

Finding a plan can be done by making a mathematical model and the objective function of an inequality using an example. The score obtained by male students for the indicator of finding a plan is 87.04 with a very high category, while female students are 74.07. The following are the answers obtained by male students represented by ELH and there are answers from female students represented by MKL.

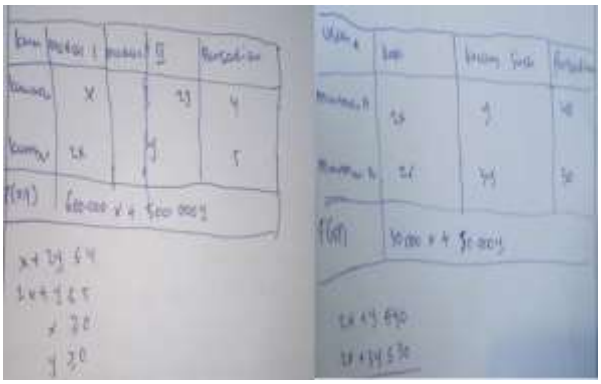

Figure 3. Results of finding the ELH penyelesaian completion plan

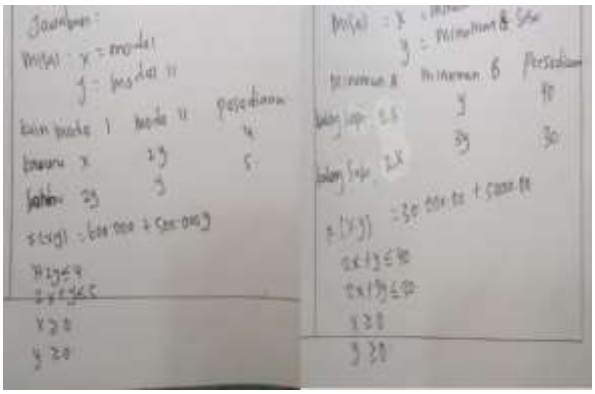

Figure 4. Results of finding MKL student plans

These results indicate that at the stage of finding a plan, ELH students have written the mathematical model and objective function correctly, but there are still a few mistakes in making the mathematical model for answer number 2. While Figure 4 above is the result of the MKL student test, it shows that number 1 has made a mathematical model and also made the objective function correctly and answer correctly and obtained a score of 3. The answer to question number 2 is correct in making the objective function, but is wrong in forming the model. mathematics, that is $2x + y \leq 40, 2x + 3y \leq 30$, the answer should be$2x + 2y \leq 40 \rightarrow\ x + y \leq 20, x + 3y \leq 30$ and get a score of 2.

The results of tests, questionnaires, interviews showed that both genders were able to find a solution plan by making a mathematical model, and the objective function correctly and correctly although there were some mistakes. In line with the explanation, according to Widi (2021) it shows that at the stage of implementing the plan, both *genders are* able to find a plan well, as evidenced by students being able to work on what they already know.

3. Executing the plan

Implementing the plan can be done using steps that have been known and discovered previously. The third indicator is implementing the plan with a score obtained by male students of 27.78 in the very low category and female students of 33.33 in the very low category. In this indicator, almost all students did not carry out the plan correctly because it was not accompanied by the right steps. The following are the answers of male students represented by MUKHW.

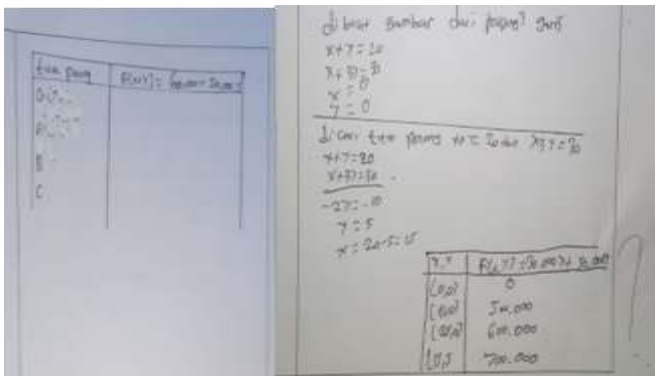

Figure 5. Results of implementing the MUKHW plan

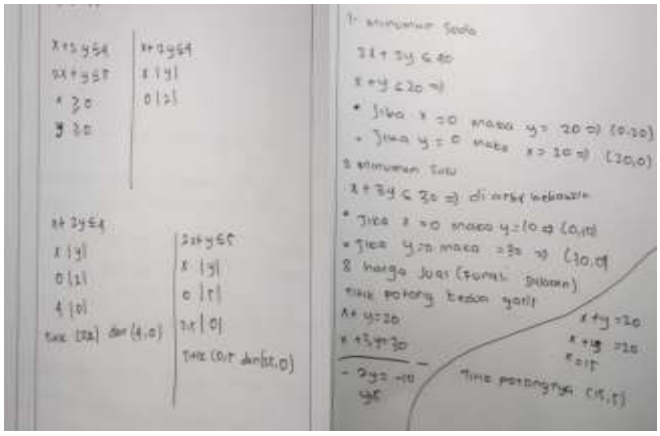

Figure 6. Results of implementing the EKT student plan

Figure 5 shows that number 1 did not give the right answer, while number 2, the student did not answer according to the completion steps and had not been able to carry out the completion plan. Figure 6 is the test results from EKT students, showing that the answer to number 1 only writes a small part of the answers from carrying out the plan and without a complete procedure, namely obtaining the intersection points of (0, 2), (4, 0) and (0, 5).), (4, 0) so, getting a score of 1. Meanwhile, question number 2 can only determine the cut point and get a score of 1. The results of tests, questionnaires and interviews show that both *genders* have not been able to carry out the plan correctly, because they have not been accompanied by right procedures. From the results, it was found that female students were superior to male students in carrying out the completion plan. In line with this research, According to (Davita & Pujiastuti, 2020), stated that the indicators of implementing student plan woman more better than male students. Meanwhile, (Annisa et al., 2021) argued that incomplete and appropriate student

answers resulted in incorrect final answers and on this indicator also female students tended to be more capable than male students.

4. Looking back

Students are said to be able to check or match the answers that have been obtained. The fourth indicator for the two questions is to look back at the answers with the average score obtained by male students of 27.78 in the very low category while the female students are 22.22 and are in the very low category. The following is the answer of one of the male students represented by BWS and the results of looking back from female students represented by HAL students.

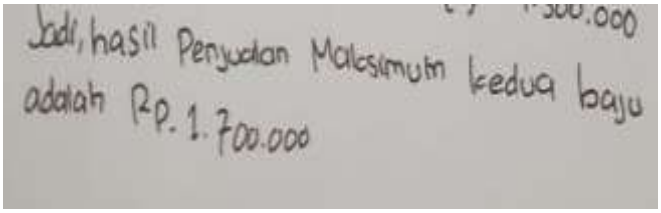

Figure 7. The results of looking back from BWS students

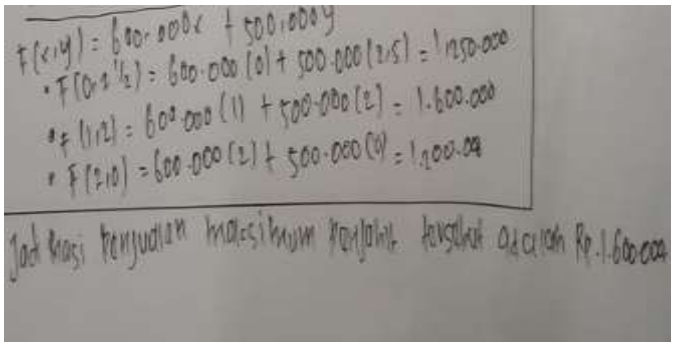

Figure 8. Results of looking back at the results of HAL students

Figure 7 is the result of answers from BWS students, showing that BWS students provide final conclusions and write down the maximum value is Rp. 1,700,000 and get a score of 2. While Figure 8 is the result of the HAL student test on the question, indicating that the student was wrong in conclude the answer by stating the maximum sales result of Rp. 1,600,000 and obtaining a score of 1.

The results of tests, questionnaires and interviews showed that almost all students did not look back at the answers obtained and tended to ignore giving conclusions. The average value of students shows a non-obtrusive difference, where the male score is 27.78 and the female score is 22.22. According to (Annisa et al.,

2021) said that both *genders* were unable to re-check the answers they obtained. Meanwhile, according to (Nurcholis et al., 2021) stated that both *genders* have not been able to carry out problem solving at the re-examination stage, this is caused by students who tend to ignore this stage because they have got the final answer. Based on the explanation above, in general the values of each indicator are as follows:

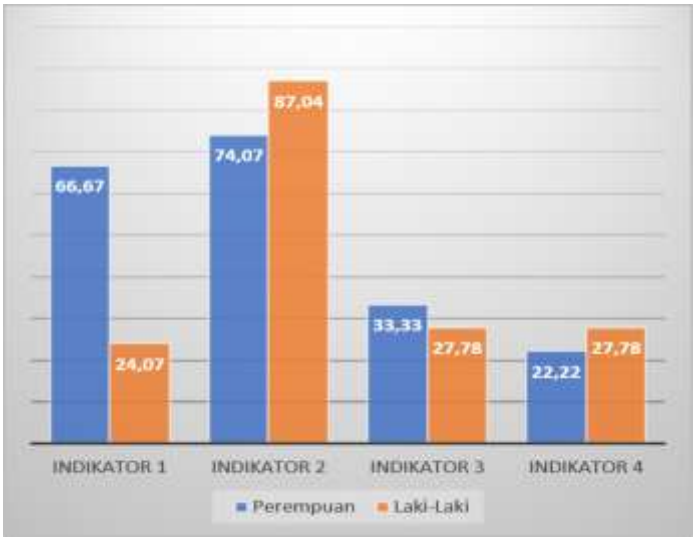

Figure 9. Comparison graph of abilities by gender

Based on the graphic image, the average value of the first and third indicators of female students is superior to that of male students, while on indicator two and indicator four male students are superior to female students.

CONCLUSION

The results of the study measured using the Polya indicator in terms of *gender differences* showed that for indicators of understanding problems and implementing plans, female students were superior to male students, while in indicators of finding plans and looking back, male students were superior to female students. However, in general, overall mean score shows that female students with a score of 49.07 are superior to male students with a score of 4 2.36. The influencing factors include lack of understanding of the problem in the questions given, not working carefully, rarely practicing questions and *gender factors*.

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