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# Analysis of Student's Difficulty in Solving Mathematical Problems in Linear Programs

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**Abstract**

This research aims to analyze students' difficulties in solving mathematical problems on linear programming material using qualitative descriptive methods based on the Polya heuristic. This research involved students with high, medium, and low abilities through analysis of written tests and student interviews. Data was collected from 30 class XI students at SMA X using specially designed written tests and in-depth interviews. Data analysis was carried out using thematic analysis techniques. The research results show that students with high abilities do not experience difficulties in working on contextual problems in linear programming material. Students with moderate abilities experience difficulty in determining the sign of inequality and the set of solution areas. Meanwhile, students with low abilities experience difficulties in various aspects, including understanding basic concepts and applying problem-solving steps. Specific examples of difficulties experienced include errors in drawing graphs and determining intersection points. As a recommendation, teachers are advised to introduce and explain problem-solving according to Polya's heuristics more concretely and systematically. For example, using Polya steps in varied practice sessions and providing specific feedback at each stage of problem-solving. In this way, students' understanding of linear programming material can be significantly improved.

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## 1 INTRODUCTION

Education is a human need throughout life because it allows humans to live by their goals and functions (Jiwanto et al., 2012; Mahdayani, 2016). In the modern concept, education is not only seen as a transfer of knowledge from teacher to student but becomes one of the means for students' preparation to face the current global challenges. (Hadi et al., 2018). Mathematics is one of the most essential things in education in all fields. (Widyastuti et al., 2017a). Advances in life based on science and mathematics are focused on mathematical research by some countries (Adu et al., 2015).

Mathematics is not only a science but also a fundamental means of solving problems in everyday life. (Ferdianto & Setiyani, 2018; Ozdamli et al., 2013; Surya et al., 2017). Mathematics is an essential part of the progress of science and technology, and it is essential to improve the high level of thinking in

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mathematics. (Sugiarti, 2017). Math is compulsory from elementary school to high school. (Murtafiah et al., 2018), It is to encourage students to engage in rational and logical mindset because they improve their ability to think and build relationships (Hasibuan, 2018; Putra et al., 2018). Therefore, the goal of learning should be to promote mathematical understanding and thinking. (Pehkonen et al., 2013).

The world's math curriculum is trying to solve the problem with a demand for learning through problem-solving because that is an important aspect of mathematics (McLeod & Schoenfeld, 2019). Students should have the ability to solve problems whose main goals of math learning are methods, procedures, and strategies so far (Pujiastuti et al., 2014; Surya et al., 2017). Mathematical problem-solving is an essential skill in mathematical learning that helps students improve understanding related to analytical thinking so that it becomes critical and creative. (Hidayat & Sariningsih, 2018a; Jones et al., 2014; Novita & Putra, 2016). Learning how to solve a math problem is learning how to use mathematical thinking, to be explored, and to use the appropriate knowledge. (Hendriana, Johanto, et al., 2018). Therefore, the problem is using the knowledge, skills, and understanding you have to solve the problem in an unknown situation (Hendriana et al., 2017; Hendriana, Hidayat, et al., 2018; Hidayat & Sariningsih, 2018b; Isnaeni & Maya, 2014).

Students who like math and who have high abilities say math is a fascinating subject, while those who have low abilities say that studying it is boring, creating fear and anxiety (Novriani & Surya, 2017). Some students feel compelled to learn mathematics because they do not understand the purpose of learning mathematics, and the teacher does not provide exciting examples related to mathematical concepts in everyday life (Khiat, 2010).

Low achievement is proof that students have difficulty solving mathematical problems characterized by workmanship errors, which indicates that students are not optimal in absorbing learning material information (Widyastuti et al., 2017b). The implication is that teachers must focus on the possible difficulties students face when facing mathematical problems and solutions (Yeo, 2009).

Several *researches* show that math is a complex subject that many students have experienced at an educational level (Wijaya et al., 2019). Understanding students' difficulties in learning is the first step in designing and managing math learning. (Çiltas & Tatar, 2011; Saleh et al., 2018; Tambychik & Meerah, 2010; Wijaya, 2016; Wijaya et al., 2014). In this regard, analyzing students' difficulties may be the first step in improving students' performance (Brodie, 2014; Mutohir et al., 2018; Muttaqin et al., 2017).

Based on the explanation above, this study aims to determine students' difficulty in solving mathematical problems in linear program material. Teachers and researchers can use this as a guide to plan a better approach to produce a more meaningful teaching and learning process.

## 2 METHOD

This descriptive qualitative research is done by interpreting existing data to describe or provide a picture as it is of a real-life phenomenon. Moleong (2012) revealed that qualitative research is research that intends to understand phenomena about what is experienced by research subjects (e.g., behavior, perceptions, motivations, actions that occur in the field, etc., when the research is conducted) holistically and using description. In this study, researchers will analyze students' difficulties in solving mathematical problems in linear program material according to the heuristic Polya:

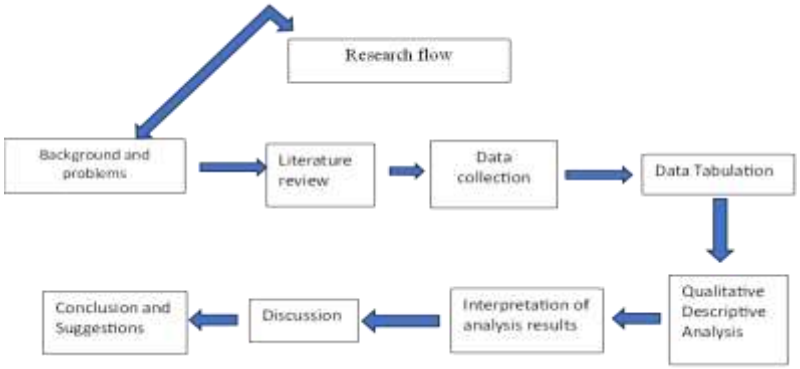


*Figure 1. Research Methd*

This research was conducted at a high school in East Java. The subjects of this study were students of class XI, even in the semester of 2019/2020, who had studied linear program material. Subject selection is done by using purposive sampling, which is one of the non-random sampling techniques where the researcher determines the sampling by determining specific characteristics that are by the research objectives so that it is expected to answer the research problem. In determining research subjects based on the previous year's report card grades for mathematics lessons, student grades are sorted from highest to lowest. From the order of these values, the researcher then determined students who were included in the high category ($80 < x \leq 100$), the medium category ($68 < x \leq 80$), and the low category ($x \leq 68$), and based on teacher recommendations. The subjects chosen in this study were 6 students, namely two students with high ability, two with medium ability, and two with low ability.

The research instrument was the researcher herself as the main instrument; the researcher served as planning, implementing, observing, collecting, interpreting, and reporting the research results. The researcher as a research instrument is an effort to obtain valid, valid, and focused information on information to answer research questions. In addition, researchers as instruments make it easy to explore interesting information. The instruments in this study were supported by using supporting instruments namely mathematics problem sheets, mathematical answer sheets, and interview guidelines.

Data validity is a concept in qualitative research. Moleong (2011: 330) states that to obtain and determine relevant data, its validity is searched by using data inspection techniques based on several criteria, namely:

a. Credibility to obtain data done in such a way that the data obtained can be trusted. In this study, the data credibility test was carried out, i.e. the researcher interviewed the subject thoroughly and in detail (Qomariyah et al., 2023).
b. transferability. Data transfer is carried out in situations and conditions of the existing (still raw) social research environment. In this study, the transferability test carried out was to describe in detail the ability of students to understand linear material (Budiarti et al., 2024).
c. dependability. The validity of the data obtained is controlled by looking for evidence in social realities that are done or held observations and re-interviews. Indeed, in this case, there are many difficulties, because an event or event is not repeated as before. But this is still being done because it is very good to be used as a balance. In this study, the dependability test is done by conducting an audit of the entire research process
d. confirmability to obtain objective data possible, the data that has been obtained in consultation with key informants. In this research, the confirmability test is done by digging into the actual data and not manipulating the data

The data analysis process in this study is based on Miles and Huberman, namely data collection, data reduction, data presentation, and concluding. At the data collection stage, subjects were given written test questions and linear program material consisting of 2 questions. Next, the subjects were asked to work on the problem based on their ideas and thoughts. In answering the questions, the research subjects were given a maximum of 45 minutes. Furthermore, test results are analyzed to diagnose any difficulties experienced by students in solving mathematical problems in linear program material and the causes of these difficulties. The diagnosis results of several research subjects are then checked and completed through interviews conducted by researchers with each subject to obtain oral and written data.

Data reduction is the process of summarizing, selecting the main points, and simplifying data by removing unnecessary and abstracting. Thus, the reduced data will provide a clearer picture of the difficulties experienced by students in solving mathematical problems in linear programming material and the causes of these difficulties. The presentation of data is to compile information in a certain way so that it can make conclusions or take action. Presentation of data can be done in the form of brief descriptions, charts, relationships between categories, flowcharts, and the like. Withdrawal of conclusions is the last step which involves giving meaning to data that allows predictable causal relations through empirical laws. The initial conclusions put forward are still temporary and are said to be valid if strong evidence is found to support them. Then based on these conclusions, seek alternative solutions that might be able to overcome these problems.

## 3 Results and Discussion

The following is an analysis and table of the results of tests and interviews about students' difficulties in solving mathematical problems in linear program

material.

The study showed that competent students can solve mathematical problems in linear program material very well, even though the second student still made mistakes at the stage of understanding the problem, carrying out the planning of the settlement, and the stage of looking back.

The second student does not write an example in question number 1 does not write what is known and asked in question number 2, and makes a mistake in counting the number 2 problem that causes an error in the stage of looking back. However, the student in the interview can explain very precisely. In this case, it can be concluded that high-ability students have no difficulty in solving mathematical problems in linear program material.

Capable students are having a little difficulty in solving mathematical problems in linear program material. The first student does not write an example in question number 1, makes a mistake in determining the sign of inequality in problem number 2, and makes a mistake in determining the solution area in problem number 1 so that it causes an error at a later stage. At the time of the interview, students can explain all the mistakes they made but still look less confident in giving reasons. The second student made a mistake in determining the solution area in problem number 2. Therefore, it can be concluded that students with moderate ability had little difficulty in solving linear program problems. This is by (Djadir et al., 2018a; Zulhendri et al., 2022) Which states that students with moderate mathematics achievement experience factual difficulties

Students with low ability struggle to solve mathematical problems in linear program material (Abus & Usmiyatun, 2023; Choirudin et al., 2023; Cholily, 2023). The first student can understand the first problem and can transform it into a mathematical model, but cannot carry out the completion plan because he does not know the next step that must be taken. In question number 2 students do not understand the problem so they cannot solve it. While the second student did not understand problem number 1 so they made a mistake in making a mathematical model and could not solve the problem. In problem number 2, students do not write down what is known and asked but can turn problems into mathematical models. Therefore, students with low ability still experience many difficulties in solving linear program problems. This is by (Djadir et al., 2018b; Novianti & Priatna, 2019) which states that students with low mathematics achievement experience difficulties and obstacles in solving problems in mathematics (factual, conceptual, operational, and principles) in table 1.

**Table 1. The Difficulty of High-Ability Students (First Student)**

| Polya Stages | Indicators | Writing Test and Interview | Conclusion |
|---|---|---|---|
| **Understand the Problem** | a. Students cannot write down what is known and asked.<br>b. Students can write what is known and asked but are still wrong in writing.<br>c. Students can write what is known and asked even though it is still incomplete.<br>d. Students can write what is known and asked correctly and completely | Students write down and mention what is known and what is asked of the two questions correctly. | Students understand the problem |
| **Troubleshooting Planning** | a. Students cannot make mathematical models based on what is known and asked from the problem<br>b. Students can make mathematical models based on what is known and asked from the problem but are still wrong<br>c. Students can make mathematical models based on what is known and asked from the problem but still incomplete<br>d. Students can make mathematical models based on what is known and asked of the problem properly | Students write and explain how to make mathematical models based on what is known and asked of the two problems correctly. | Students can change problems into mathematical models |
| **Carry out Completion Planning** | a. Students cannot write the solution<br>b. Students can write out the solution but something is still wrong | tudents write and explain the steps in completing the linear program of both questions correctly and completely, namely how to draw graphs according to | Students can determine their problem- |

| | | | |
|---|---|---|---|
| | c. Students can write the completion but it's still incomplete<br>d. Students can write the completion correctly and completely | mathematical models, determine corner points, and determine the maximum or minimum value of the objective function. | solving strategies correctly. |
| **Looking back** | a. Students do not check again<br>b. The student checks again but is still wrong<br>c. Students check again, correctly | Students have checked again correctly | Students have checked again correctly |

**Table 2. The Difficulty of High-Ability Students (Second Student)**

| Polya Stages | Indicators | Writing Test and Interview | Conclusion |
|---|---|---|---|
| **Understand the Problem** | a. Students cannot write down what is known and asked.<br>b. Students can write what is known and asked but are still wrong in writing.<br>c. Students can write what is known and ask questions even though they are still incomplete.<br>d. Students can write what is known and asked correctly and completely | In question number 1, students do not write down examples of many buses and minibusses, but they can explain them exactly. In question number 2, students can write and explain what is known and asked correctly. | Students understand the problem |
| **Troubleshooting Planning** | a. Students cannot make mathematical models based on what is known and asked from the problem<br>b. Students can make mathematical models based on what is known and asked from the problem but are still wrong<br>c. Students can make mathematical models based on what is known and asked from the problem but still incomplete.<br>d. Students can make mathematical models based on what is known and asked of the problem properly | Students write and explain how to make mathematical models based on what is known and asked of the two problems correctly. | Students can change problems into mathematical models |
| **Carry out Completion Planning** | a. Students cannot write the solution<br>b. Students can write out the solution but something is still wrong<br>c. Students can write the completion but it's still incomplete.<br>d. Students can write the completion correctly and completely | In problem number 1 students write and explain the steps in completing the linear program correctly and completely, namely how to draw graphs according to mathematical models, determine corner points, and determine the maximum or minimum value of the objective function. While in problem number 2 students can write down the solution even though there are still errors in counting, but students can explain correctly. | Students can determine their problem-solving strategies correctly. |
| **Looking back** | a. Students do not check again<br>b. The student checks again but is still wrong.<br>c. Students check again correctly | Students check again but something is still wrong. | Students are not careful in checking again |

**Table 3. Difficulty of Medium Capable Students (First Student)**

| Polya Stages | Indicators | Writing Test and Interview | Conclusion |
|---|---|---|---|
| **Understand the Problem** | a. Students cannot write down what is known and asked.<br>b. Students can write what is known and asked but are still wrong in writing.<br>c. Students can write what is known and asked even though it is still incomplete.<br>d. Students can write what is known and asked correctly and completely | In question number 1 students do not write down examples of many buses and minibuses, but students can explain it exactly. While in question number 2 students can write and explain what is known and asked correctly. | Students understand the problem |

| | | | |
|---|---|---|---|
| **Troubleshooting Planning** | a. Students cannot make mathematical models based on what is known and asked from the problem<br>b. Students can make mathematical models based on what is known and asked from the problem but are still wrong<br>c. Students can make mathematical models based on what is known and asked from the problem but still incomplete.<br>d. Students can make mathematical models based on what is known and asked of the problem properly | In problem number 1 students write and explain how to make mathematical models based on what is known and asked. While in problem number 2 students can make mathematical models even though there are errors in determining the sign of inequality, but students can explain how to make a mathematical model and realize mistakes in determining the sign of inequality. | Students can change problems into mathematical models |
| **Carry out Completion Planning** | a. Students cannot write the solution<br>b. Students can write out the solution but something is still wrong<br>c. Students can write the completion but it's still incomplete.<br>d. Students can write the completion correctly and completely | In problem number 1 students can write a solution even though there is an error in determining the set of settlement areas, resulting in errors in determining the corner point and determine the minimum value of the objective function, but students realize mistakes in determining the set area and can explain it precisely. In problem number 2 students can write and explain the steps in completing the linear program of the two questions correctly and completely, namely how to draw graphs according to the mathematical model, determine the corner points, and determine the maximum or minimum value of the objective function. | Students can determine problem-solving strategies but are not careful in determining the solution areas in problem number 1. |
| **Looking back** | a. Students do not check again<br>b. The student checks again but is still wrong.<br>c. Students check again correctly | Students have rechecked, but not thoroughly | Students have rechecked, but not thoroughly |

**Table 4. Difficulty of Medium Capable Students (Second Student)**

| Polya Stages | Indicators | Writing Test and Interview | Conclusion |
|---|---|---|---|
| **Understand the Problem** | a. Students cannot write down what is known and asked.<br>b. Students can write what is known and asked but are still wrong in writing.<br>c. Students can write what is known and asked even though it is still incomplete.<br>d. Students can write what is known and asked correctly and completely | Students write down and mention what is known and what is asked of the two questions correctly. | Students understand the problem |
| **Troubleshooting Planning** | a. Students cannot make mathematical models based on what is known and asked from the problem<br>b. Students can make mathematical models based on what is known and asked from the problem but are still wrong<br>c. Students can make mathematical models based on what is known and asked from the problem but still incomplete. | Students write and explain how to make mathematical models based on what is known and asked of the two problems correctly. | Students can change problems into mathematical models |

| | | | |
|---|---|---|---|
| | d. Students can make mathematical models based on what is known and asked of the problem properly | | |
| **Carry out Completion Planning** | a. Students cannot write the solution<br>b. Students can write out the solution but something is still wrong.<br>c. Students can write the completion but it's still incomplete.<br>d. Students can write the completion correctly and completely | In problem number 1 students write and explain the steps in completing the linear program correctly and completely, namely how to draw graphs according to mathematical models, determine corner points, and determine the maximum or minimum value of the objective function. In problem number 2 students can write down the solution even though there is an error in determining the set of settlement areas, it results in an error in determining the corner point and the maximum value of the objective function, but students realize the error in determining the set area and can explain it precisely | Students can determine problem-solving strategies, but they are still not very thorough |
| **Looking back** | a. Students do not check again<br>b. The student checks again but is still wrong.<br>c. Students check again correctly | Students have checked again, but there are still errors. | Students have rechecked, but not thoroughly. |

**Table 5. Difficulty of Low-Ability Students (First Student)**

| Polya Stages | Indicators | Writing Test and Interview | Conclusion |
|---|---|---|---|
| **Understand the Problem** | a. Students cannot write down what is known and asked.<br>b. Students can write what is known and asked but are still wrong in writing.<br>c. Students can write what is known and asked even though it is still incomplete.<br>d. Students can write what is known and asked correctly and completely | In question number 1 students can write what is known and asked. In question number 2 students write what is known and asked, but it is still wrong | Students do not understand the problem |
| **Troubleshooting Planning** | a. Students cannot make mathematical models based on what is known and asked from the problem<br>b. Students can make mathematical models based on what is known and asked from the problem but are still wrong<br>c. Students can make mathematical models based on what is known and asked from the problem but still incomplete.<br>d. Students can make mathematical models based on what is known and asked of the problem properly | In problem number 1 students write and explain how to make mathematical models based on what is known and asked. Whereas at number 2 students did not write mathematical models | Students have not been able to change problems into mathematical models |
| **Carry out Completion Planning** | a. Students cannot write the solution<br>b. Students can write out the solution but something is still wrong<br>c. Students can write the completion but it's still incomplete.<br>d. Students can write the completion correctly and completely | Students cannot write the solution | Students cannot write the solution |
| **Looking back** | a. Students do not check again<br>b. The student checks again but is still wrong.<br>c. Students check again correctly | Students do not check again | Students do not check again |

**Table 6. Difficulty of Low-Ability Students (Second Student)**

| Polya Stages | Indicators | Writing Test and Interview | Conclusion |
|---|---|---|---|
| **Understand the Problem** | a. Students cannot write down what is known and asked.<br>b. Students can write what is known and asked but are still wrong in writing.<br>c. Students can write what is known and asked even though it is still incomplete.<br>d. Students can write what is known and asked correctly and completely | In question number 1 students can write what is known and asked but is still wrong in writing it. Whereas in question number 2 students do not write down what is known and asked | Students do not understand the problem |

| | | | |
|---|---|---|---|
| **Troubleshooting Planning** | a. Students cannot make mathematical models based on what is known and asked from the problem<br>b. Students can make mathematical models based on what is known and asked from the problem but are still wrong<br>c. Students can make mathematical models based on what is known and asked from the problem but still incomplete.<br>d. Students can make mathematical models based on what is known and asked of the problem properly | In problem number 1 students write and explain how to make mathematical models based on what is known and asked but is still wrong. While in problem number 2 students write and explain how to make mathematical models based on what is known and asked correctly | Students can change problems into mathematical models, but there are still errors |
| **Carry out Completion Planning** | a. Students cannot write the solution<br>b. Students can write out the solution but something is still wrong<br>c. Students can write the completion but it's still incomplete.<br>d. Students can write the completion correctly and completely | Students cannot write the solution | Students cannot write the solution |
| **Looking back** | a. Students do not check again<br>b. The student checks again but is still wrong.<br>c. Students check again correctly | Students do not check again | Students do not check again |

This research focuses on the difficulties experienced by students in solving mathematical problems in linear programming material and uses a qualitative descriptive method based on the Polya heuristic. The results of this research provide a clear picture of the differences in levels of difficulty experienced by students with different abilities. Students with high abilities tend not to encounter significant obstacles in solving contextual problems, while students with medium and low abilities show various difficulties in the problem-solving process.

Previous research supports these findings. For example, a study by Lestari and Yudhanegara (2015) found that students often had difficulty determining the sign of inequality and the set of solution areas in linear programming material. This is in line with the findings of this research which shows that students with moderate abilities experience similar difficulties. In addition, research by Nurhayati (2017) shows that students often make mistakes in drawing graphs and determining intersection points, which was also found to be the main difficulty for students with low abilities in this study.

Furthermore, this research recommends using the Polya heuristic more concretely and systematically in teaching. A study by Haji and Rahman (2018) shows that this approach is effective in increasing students' understanding of complex mathematical concepts. By applying Polya's steps in varied practice sessions and providing specific feedback at each stage of problem-solving, students' understanding of linear programming material can be significantly improved.

Overall, this discussion emphasizes the importance of a systematic and concrete teaching approach in helping students overcome difficulties in linear programming. With the support of empirical evidence from previous research, the recommendations provided are expected to help teachers in designing more effective teaching strategies to increase student understanding.

## 4 Conclusion

Based on data analysis and discussion, it can be concluded that subjects with high mathematical ability have no difficulty in working on contextual problems in Linear Program material, although the second subject made a few mistakes in calculating the value of $y$ due to a lack of accuracy when working on the problem. Meanwhile, subjects with medium mathematical abilities have difficulty determining signs of inequality and the set of settlement areas. Then, the subject of low mathematical ability had difficulty making mathematical models and determining the completion area and the solution.

Solutions to overcome the occurrence of student difficulties in solving mathematical problems in the linear program material, namely: a) by paying attention to the conclusions obtained, the teacher should, in the teaching and learning process, introduce and explain to students about problem-solving according to Polya's heuristics to be applied in various problem-solving exercises. b) student success in learning is not solely determined by student factors alone but also by factors outside the student, one of which is the teacher.

Therefore, for further research, it is recommended that research be conducted on the ability of mathematics subject teachers in the school, which is used as a place of research in applying problem-solving according to Polya's heuristics in solving story problems.

It might cause students difficulties in solving story problems according to Polya's heuristics because of the low ability of teachers to apply the theory, so students are not accustomed to using the problem-solving stages according to Polya's heuristics in problem-solving.

## 5 References


Abus, O., & Usmiyatun. (2023). TAYO Cards in Understanding Numbers 1-10 for Early Childhood , Improve ? *JTLM*, *1*(1), 1–12.

Adu, E., Assuah, C., & Asiedu-Addo, S. (2015). Students' Errors in Solving Linear Equation Word Problems: Case Study of a Ghanaian Senior High School. *African Journal of Educational Studies in Mathematics and Sciences*, *11*(0), 17–30.

Brodie, K. (2014). Learning about Learner Errors in Professional Learning Communities. *Educational Studies in Mathematics*, *85*(2), 221–239.

Budiarti, E., Lestari, J. T., & Hagenimana, E. (2024). The educational game" MARIO" for early childhood number recognition to improve cognitive abilities: Attempts and Problems. *Journal of Teaching and Learning Mathematics*, *2*.

Choirudin, Sugianto, R., Darmayanti, R., & Muhammad, I. (2023). Teacher Competence in The Preparation of Test and Non-. *JTLM*, *1*(1).

Cholily, Y. M. (2023). Analysis of Mathematical Communication Ability on Problem-Solving Pythagoras Theorem Viewed From Students' Cognitive Style. *Journal of Teaching and Learning Mathematics*.

Çiltas, A., & Tatar, E. (2011). Diagnosing Learning Difficulties Related to the Equation and Inequality that Contain Terms with Absolute Value. *International Online Journal of Education Sciences*, *3*(2), 461–473.

Djadir, Upu, H., & Sulfianti, A. (2018a). The Profile of Students' Mathematical Problem Solving on the Topic of Two-Variable Linear Equation Systems Based on Thinking Styles. *Journal of Physics: Conference Series*, *1028*(1). https://doi.org/10.1088/1742-6596/1028/1/012164

Djadir, Upu, H., & Sulfianti, A. (2018b). The Profile of Students' Mathematical Problem Solving on the Topic of Two-Variable Linear Equation Systems Based on Thinking Styles. *Journal of Physics: Conference Series*, *1028*(1). https://doi.org/10.1088/1742-6596/1028/1/012164

Ferdianto, F., & Setiyani, S. (2018). Pengembangan Bahan Ajar Media Pembelajaran Berbasis Kearifan Lokal Mahasiswa Pendidikan Matematika. *JNPM (Jurnal Nasional Pendidikan Matematika)*, *2*(1), 37.

Hadi, S., Retnawati, H., Munadi, S., Apino, E., & Wulandari, N. F. (2018). The Difficulties of High School Students in Solving Higher-Order Thinking Skills Problems. *Problems of Education in the 21st Century*, *76*(4), 520–532.

Hasibuan, E. K. (2018). Analisis Kesulitan Belajar Matematika Siswa pada Pokok Bahasan Bangun Ruang Sisi Datar di SMP Negeri 12 Bandung. *AXIOM*, *7*(1), 18–30.

Hendriana, H., Eti Rohaeti, E., & Hidayat, W. (2017). Metaphorical Thinking Learning and Junior High School Teachers' Mathematical Questioning Ability. *Journal on Mathematics Education*, *8*(1), 55–64.

Hendriana, H., Hidayat, W., & Ristiana, M. G. (2018). Student Teachers' Mathematical Questioning and Courage in Metaphorical Thinking Learning. *Journal of Physics: Conference Series*, *948*(1).

Hendriana, H., Johanto, T., & Sumarmo, U. (2018). The role of problem-based learning to improve students' mathematical problem-solving ability and self confidence. *Journal on Mathematics Education*, *9*(2), 291–299. https://doi.org/10.22342/jme.9.2.5394.291-300

Hidayat, W., & Sariningsih, R. (2018a). Kemampuan Pemecahan Masalah Matematis dan Adversity Quotient Siswa SMP Melalui Pembelajaran Open Ended. *Jurnal Nasional Pendidikan Matematika*, *2*(1), 109.

Hidayat, W., & Sariningsih, R. (2018b). Kemampuan Pemecahan Masalah Matematis dan Adversity Quotient Siswa SMP Melalui Pembelajaran Open Ended. *Jurnal Nasional Pendidikan Matematika*, *2*(1), 109.

Isnaeni, I., & Maya, R. (2014). Meningkatkan Kemampuan Komunikasi Dan Disposisi Matematik Siswa Sekolah Menengah Atas Melalui Pembelajaran Generatif. *Jurnal Pengajaran Matematika Dan Ilmu Pengetahuan Alam*, *19*(2), 159–165.

Jiwanto, I. N., Purwanto, J., & Murtono, M. (2012). Analisis Kesulitan Siswa Dalam Memecahkan Masalah Fisika Menurut Polya. *Prosiding Seminar Nasional Fisika Dan Pendidikan Fisika Vol 3*, 414–422.

Jones, I., Swan, M., & Pollitt, A. (2014). Assessing Mathematical Problem Solving Using Comparative Judgement. *International Journal of Science and Mathematics Education*, *13*(1), 151–177.

Khiat, H. (2010). A Grounded Theory Approach: Conceptions of Understanding in Engineering Mathematics Learning. *Qualitative Report*, *15*(6), 1459–1488.

Mahdayani, R. (2016). Analisis Kesulitan Siswa dalam Pemecahan Masalah Matematika pada Materi Aritmetika, Aljabar, Statistika, dan Geometri. *Jurnal Pendas Mahakam*, *1*(1), 86–98.

McLeod, D. B., & Schoenfeld, A. H. (2019). Mathematical Problem Solving. In *The College Mathematics Journal* (Vol. 18, Issue 4).

Murtafiah, W., Sa'dijah, C., Candra, T. D., Susiswo, S., & As'ari, A. R. (2018). Exploring the Explanation of Pre-Service Teacher in Mathematics Teaching Practice. *Journal on Mathematics Education*, *9*(2), 259–270.

Mutohir, T. C., Lowrie, T., & Patahuddin, S. M. (2018). The Development of a Student Survey on Attitudes Towards Mathematics Teaching-Learning Processes. *Journal on Mathematics Education*, *9*(1), 1–14.

Muttaqin, H., Putri, R. I. I., & Somakim, S. (2017). Design Research on Ratio and Proportion Learning by Using Ratio Table and Graph with OKU Timur Context at the 7th Grade. *Journal on Mathematics Education*, *8*(2), 211–222.

Novianti, & Priatna, B. A. (2019). Students ' Difficulties Analysis in Solving Systems of Linear Equations in Two Variables. *STEMEIF*, 56–61.

Novita, R., & Putra, M. (2016). Using Task Like PISA's Problem to Support Students's Creativity in Mathematics. *Journal on Mathematics Education*, *7*(1), 31–42.

Novriani, M. R., & Surya, E. (2017). Analysis of Student Difficulties in Mathematics Problem Solving Ability at MTs Swasta IRA Medan. *International Journal of Sciences : Basic and Applied Research (IJSBAR)*, *33*(03), 63–75.

Ozdamli, F., Karabey, D., & Nizamoglu, B. (2013). The Effect of Technology Supported Collaborativelearning Settings on Behaviour of Students Towards Mathematics Learning. *Procedia - Social and Behavioral Sciences*, *83*, 1063–1067.

Pehkonen, E., Näveri, L., & Laine, A. (2013). On Teaching Problem Solving in School Mathematics. *CEPS Journal*, *3*(4), 9–23.

Pujiastuti, H., Kusumah, Y. S., Sumarmo, U., & Dahlan, J. A. (2014). Inquiry Co-operation Model for Enhancing Junior High School Students ' Mathematical Problem Solving Ability. *International Journal of Contemporary Educational Research (IJCER)*, *1*(1), 51–60.

Putra, H. D., Putri, A., Lathifah, A. N., & Mustika, C. Z. (2018). Kemampuan Mengidentifikasi Kecukupan Data pada Masalah Matematika dan Self-Efficacy Siswa MTs. *JNPM (Jurnal Nasional Pendidikan Matematika)*, *2*(1), 48.

Qomariyah, S., Darmayanti, R., Rosyidah, U., & Ayuwanti, I. (2023). Indicators and essay problem grids on three-dimensional material: Development of instruments for measuring high school students' mathematical problem-solving ability. *JEMS: Jurnal Edukasi Matematika Dan Sains*, *11*(1), 261–274.

Saleh, M., Prahmana, R. C. I., Isa, M., & Murni, M. (2018). Improving The Reasoning Ability of Elementary School Student Through The Indonesian Realistic. *Journal On Mathematics*, *9*(1), 41–54.

Sugiarti, L. (2017). Kesulitan Siswa Dalam Menyelesaikan Soal Operasi Bentuk Aljabar. *Prosiding Seminar Nasional Etnomatnesia*, 323–330.

Surya, E., Putri, F. A., & Mukhtar. (2017). Improving mathematical problem-solving ability and self-confidence of high school students through contextual learning model. *Journal on Mathematics Education*, *8*(1), 85–94. https://doi.org/10.22342/jme.8.1.3324.85-94

Tambychik, T., & Meerah, T. S. M. (2010). Students' Difficulties in Mathematics Problem-Solving: What do They Say? *Procedia - Social and Behavioral Sciences*, *8*, 142–151.

Widyastuti, P. D., Mardiyana, M., & Saputro, D. R. S. (2017a). The Analysis of Students ' Difficulties in Solving Systems of Linear Equations in Two Variables. *4 Th ICRIEMS Proceedings*, 243–248.

Widyastuti, P. D., Mardiyana, M., & Saputro, D. R. S. (2017b). The Analysis of Students ' Difficulties in Solving Systems of Linear Equations in Two Variables. *4 Th ICRIEMS Proceedings*, 243–248.

Wijaya, A. (2016). Students' Information Literacy : A Perspective From Mathematical Literacy. *Journal on Mathematics Education*, *7*(2), 73–82.

Wijaya, A., Heuvel-Panhuizen, M. Van Den, Doorman, M., & Robitzsch, A. (2014). Difficulties in Solving Context-Based PISA Mathematics Tasks : An Analysis of Students' Errors. *The Mathematics Enthusiast*, *11*(3), 555–584.

Wijaya, A., Retnawati, H., Setyaningrum, W., Aoyama, K., & Sugiman. (2019). Diagnosing Students' Learning Difficulties in the Eyes of Indonesian Mathematics Teachers. *Journal on Mathematics Education*, *10*(3), 357–364.

Yeo, K. K. J. (2009). Secondary 2 Students' Difficulties in Solving Non-Routine Problems. *International Journal for Mathematics Teaching and …*, 1–30.

Zulhendri, Ahmad Fauzan, Made Arnawa, Edwin Musdi, & Yerizon. (2022). Analysis Of Mathematics Student Error To Solve Problems Of Linear Programs. *International Journal Of Humanities Education and Social Sciences (IJHESS)*, *1*(5), 774–780. https://doi.org/10.55227/ijhess.v1i5.156