

# ANALYSIS OF FIFTH GRADE STUDENTS' MATHEMATICAL PROBLEM-SOLVING SKILLS IN WHOLE-NUMBER OPERATIONS BASED ON POLYA'S STAGES

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**Abstract.** This study aims to analyze the mathematical problem-solving abilities of fifth-grade elementary school students in whole-number operations, using Polya's stages as a reference. This study uses a qualitative descriptive method with data collection through problem-solving tests and interviews. The tests were used to assess students' abilities across the four stages of Polya: understanding the problem, planning the solution, implementing the plan, and checking the results. Meanwhile, interviews were conducted with several students to explore their reasons for choosing the strategy, their thought processes, and the difficulties they encountered while solving the problems. The research subjects consisted of 34 fifth-grade students at a public elementary school in Cimahi City. The results showed that the problem understanding stage had the highest percentage of 86.2% (high category), followed by the planning stage with 71.8% (medium category). The stages of implementing the plan and checking the results each reached 48.2% and 46.4% (low category). These results confirm that students can understand the information in the questions but still experience difficulties applying strategies and checking results, so it is necessary to strengthen learning in these two stages to optimize problem-solving skills.

**Keywords:** mathematical problem-solving, Polya, whole-number operations, elementary school, descriptive qualitative.

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## INTRODUCTION

Mathematical problem-solving skills are essential basic competencies in elementary school mathematics education, as they help develop logical, analytical, creative, and critical thinking skills. Mastery of arithmetic operations with whole numbers is the foundation for understanding more complex mathematical concepts. Difficulties at this stage can hinder students' mathematical abilities at subsequent levels (Janggu et al., 2023). Previous research shows that even though students can recognize the information in a problem, they often face obstacles in converting that information into an appropriate mathematical model, choosing effective strategies, systematically implementing the steps to solve the problem, and verifying the solution obtained (Widyastuti & Airlanda, 2021).

In modern curricula, problem-based learning is gaining attention as an effective method for improving students' mathematical abilities. Frameworks such as Polya's stages, which include understanding the problem, planning the solution, implementing the plan, and reevaluating, have become a reference in many studies (Arifin & Janan, 2023; Jannah et al., 2023). Although students can generally understand the problem, many experience difficulties in the stages of planning a solution strategy and final evaluation, especially in the context of

arithmetic operations with whole numbers (Popon et al., 2024; Ramadhana et al., 2024). Research by Setiyawan and Hariastuti (2021) also shows that students often fail to identify relevant information when solving mathematical problems (Widyastuti & Airlanda, 2021).

In addition, studies use various approaches to analyze students' problem-solving abilities, including interviews and structured written tests. However, an in-depth analysis of how students go through Polya's stages in solving mathematical problems is still very much needed (Murni, 2019). Therefore, this study aims to explore the mathematical problem-solving abilities of fifth-grade students in integer arithmetic, focusing on Polya's stages and the classification of students' abilities into high, medium, and low categories.

The results of this study are expected to provide a comprehensive overview of students' problem-solving skills and serve as a basis for developing more effective learning strategies to strengthen these skills. Previous studies have shown that educators must focus on developing problem-solving skills to produce students who are not only proficient in arithmetic but also able to critically apply their knowledge in broader contexts (Hasanah & Imami, 2022; Pixyoriza et al., 2022).

With a more structured research approach based on Polya's stages of problem-solving, this study aims to identify specific difficulties students experience in solving number problems and to provide data-based recommendations to improve the quality of teaching in elementary schools. The conclusions of this study will be very useful to teachers in designing appropriate interventions to support students in developing their mathematical skills (Saparwadi & Cahyowatin, 2018).

## **METHODOLOGY**

This study uses a qualitative descriptive method to analyze students' mathematical problem-solving abilities using Polya's stages in the context of integer arithmetic operations. This approach was chosen because it focuses on an in-depth description of the process and results of problem-solving carried out by students, without manipulating variables; rather, it examines their abilities based on written answers and interviews. The exploratory nature of the qualitative descriptive method offers benefits for understanding students' problem-solving abilities and for revealing the various factors that influence how they solve problems. Maulana et al. (2023) showed that an in-depth analysis of students' mistakes, conducted through interviews, provided valuable insights into how they understand and solve problems.

### **Research Subject**

The subjects in this study consisted of 34 fifth-grade students at a public elementary school in Cimahi City. The subjects were selected using a total sampling technique, because all students in the class were involved as research participants. The selection of fifth grade was based on the assumption that students at that level had already fully learned arithmetic operations with whole numbers.

### **Data Collection Techniques**

The data collection technique used problem-solving tests in the form of essay questions compiled based on Polya's four stages of problem solving, namely (1) understanding the problem, (2) planning the solution, (3) implementing the plan, and (4) checking the results. The research instrument was a test containing a number of contextual questions related to integer operations, including addition, subtraction, multiplication, and division, and was supplemented with several interview questions as supporting data. Participants were asked to describe each stage of the solution systematically according to Polya's procedure. The test was conducted in a single session, with a 60-minute time limit. In addition to the written test, structured interviews were conducted with selected students to obtain more in-depth insights into their problem-solving processes. The interviews focused on students' understanding of the problems, the strategies they chose, the difficulties they encountered, and how they checked their work. The interview data were used to reinforce the test results' findings and to provide a more comprehensive picture of students' problem-solving abilities at each stage.

### **Data Analysis Techniques**

Data analysis in this study was carried out in three main stages, namely data reduction, data presentation, and conclusion drawing. The data reduction stage involved selecting, identifying, and classifying students' answers according to the indicators in each stage of Polya's problem-solving process. In addition, interview transcripts were examined to identify patterns in students' reasoning, the types of difficulties they experienced, and the factors that influenced their success or failure in solving problems. Next, in the data presentation stage, the analysis results were compiled into tables and achievement percentages to provide a clear picture of the students' success rates at each stage of problem-solving, and were supplemented with relevant excerpts from answers and interview results to reinforce the findings. The final stage is drawing conclusions, which involves formulating an interpretation of students' problem-solving abilities based on the findings from each stage of Polya and the interview results, to

provide a comprehensive picture of students' thought processes in solving mathematical problems. To calculate the percentage of student ability, the following formula is used:

$$P = \frac{n}{N} \times 100\%$$

Explanation:

P = Percentage score,

n = Score obtained by the student,

N = Ideal score

### Student Ability Level Criteria

The grouping of student abilities refers to the following criteria (Jedaus et al., 2019):

Table 1. Student Ability Level Criteria

Category	Value Range
High	( $X > 80$ )
Medium	( $65 \leq X \leq 80$ )
Low	( $X < 65$ )

## RESULTS AND DISCUSSION

### RESULT

The results of the problem-solving test given to 34 fifth-grade students show that students' ability to solve arithmetic problems using Polya's stages varies across several categories. According to the classification results, 12 students were in the low category, 15 in the medium category, and 7 in the high category. These findings indicate that the majority of students were in the medium category, while the number of students with low abilities was also quite large. This condition suggests that although some students were able to understand the problems and apply the steps to solve them effectively, many still encountered obstacles, especially during the implementation and evaluation stages. Details of the students' answers are presented with the symbol T for correct answers and F for incorrect answers.

Table 2. Student Responses

No. Soal	Understanding the Problem			Devise a Plan			Carry out the Plan			Look Back		
	T	F	%	T	F	%	T	F	%	T	F	%
1	34	0	100	28	6	82	21	13	62	21	13	62
2	32	2	94	27	7	79	12	22	35	12	22	35
3	29	5	85	25	9	74	21	13	62	19	15	56
4	26	8	76	22	12	65	13	21	38	12	22	35
5	26	8	76	20	14	59	15	19	44	15	19	44

Based on the results of the problem-solving ability test given to 34 fifth-grade students, the percentage of achievement at each stage of Polya's problem-solving process was as follows: (1) understanding the problem at 86.2%, (2) planning the solution at 71.8%, (3) implementing the plan at 48.2%, and (4) checking the solution at 46.4%.

Table 3. Percentage of Student Ability Based on Polya's Stages

Polya Stages	Percentage	Category
Understanding the Problem	86,2%	High
Devise a Plan	71,8%	Medium
Carry out the Plan	48,2%	Low
Look Back	46,4%	Low

When depicted in graph form, the percentage of students' ability to solve mathematical problems based on Polya's stages is as follows:

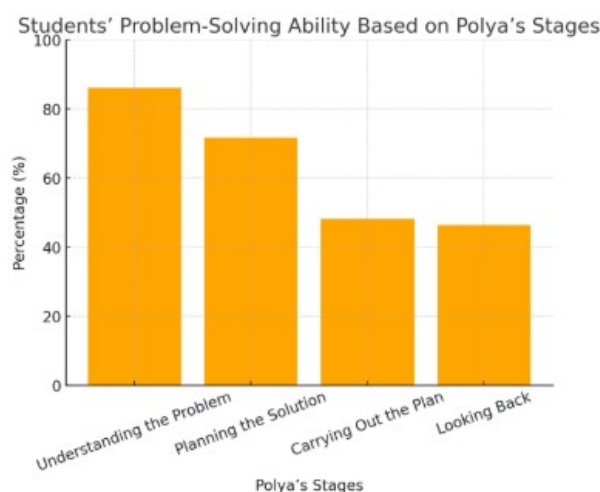


Figure 1. Percentage of Student Ability Based on Polya's Stages

## DISCUSSION

This section focuses on analyzing students' answers using the provided instruments to assess them against Polya's problem-solving stages. In addition, empirical findings in the field are interpreted by linking them to relevant theories and research results to strengthen the analysis. The following description presents the results of the analysis of students' problem-solving abilities using Polya's stages, as described in the research results section.

1. Kelas 5A mengumpulkan uang iuran sebesar Rp. 17.500, kelas 5B Rp. 22.000, kelas 5C Rp. 20.500, dan kelas 5D Rp. 19.000. Jika target iuran sebesar Rp. 85.000, berapa kekurangan iuran yang masih perlu dikumpulkan? Jelaskan

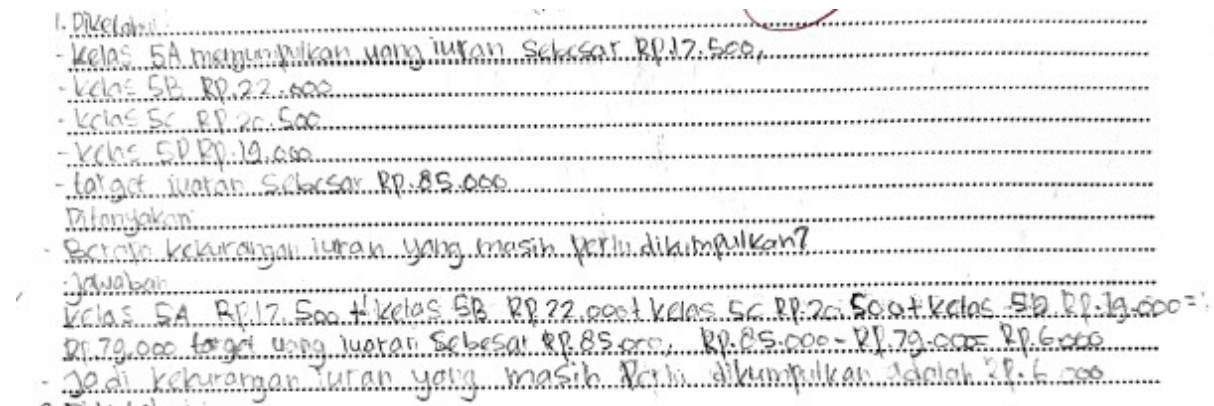


Figure 2. Question No. 1 and One of the Answers from High-Achieving Students

Based on the students' answers in Figure 2, they were able to solve the problem systematically using Polya's steps. In the problem understanding stage, the students successfully identified important information in the question, such as the amount of funds collected by each class and the total cost of the activity, and understood that the question was about the amount of funds needed. In the planning stage, students chose the appropriate strategy by formulating the steps to add up all the funds collected and then comparing them with the total funds needed. Next, in the execution stage, students carried out these steps by performing calculations in a logical and consistent manner until they obtained the difference between the funds collected and the funds needed. Finally, in the rechecking stage, students rewrite the calculation process and results to ensure their accuracy, demonstrating that they not only obtained the final answer but also verified it. Overall, the students' answers demonstrate strong problem-solving skills, as they apply Polya's four stages correctly and present their mathematical thinking process clearly.

The results of the interview with the student are as follows :

T: "When working on the problem earlier, did you know what the question was asking?"

S: "Yes, sir, because I read it slowly and then looked for what was missing."

T: "How did you determine the steps to solve it?"

S: "I calculated the money from all the classes first, then I compared it with the money that had to be collected. So I knew how much was missing."

T: "When calculating, did you follow the steps you had planned?"

S: "Yes, sir, I calculated one by one so I wouldn't make a mistake. Because if I did it all at once,

I would get confused."

T: "After getting the answer, do you check it again or just finish?"

S: "I check it again, sir. I'm afraid of making a mistake. But if time is tight, I don't have time to check it."

During the interview stage, students provided explanations consistent with their written-test answers, thereby reinforcing that the steps they took to solve the problems were in line with the problem-solving process demonstrated in their work.

Research on students' mathematical problem-solving abilities based on Polya's theory shows that students with high abilities can effectively follow the four stages of problem-solving. According to Raudho et al. (2020), students with high abilities succeed in understanding problems, planning solutions, implementing solutions, and checking the results. Another study by Hidayah Hidayah (2021) also supports these findings, showing that students in the high mathematical ability category performed well at each stage of the problem-solving thinking process. Similar results were reported by Guntari et al. (Gumanti et al., 2022), who found that highly capable students achieved high average scores in mathematical problem-solving.

2. Sebuah toko memiliki 950 bungkus permen. Hari pertama terjual 175 bungkus, hari kedua 220 bungkus, dan hari ketiga 195 bungkus. Berapa bungkus permen yang masih tersisa di toko? Jelaskan langkah perhitungannya!

① di ketahui:  
 - sebuah toko memiliki 950 permen.  
 - hari pertama terjual 175 permen. 175  
 - hari kedua terjual 220 permen. 220  
 - hari ketiga terjual 195 permen.  
 ② ditanyakan:  
 berapa bungkus permen yang masih tersisa di toko?  
 ③ jawaban:  
 $950 \text{ permen} - 175 \text{ permen} - 220 \text{ permen} - 195 \text{ permen} = 260$   
 ④ jadi sisa permen seluruhnya di toko adalah 260 permen.

Figure 3. Question No. 2 and One of the Answers from Students in the Intermediate Category

Based on the students' answers in Figure 3, they understood the question and identified the key information needed to solve the problem. In the problem comprehension stage, the students wrote down all the data provided: the initial number of candies in the store and the number sold on the first, second, and third days. The students also knew that the main question was to calculate the remaining candies in the store. In the planning stage, students chose the appropriate strategy: first add up all the candy wrappers sold, then subtract that number from the initial number of candies available in the store. This shows that students have a strong conceptual understanding of how to organize problem-solving steps.

However, during implementation, the student made an error in calculating the total number of candies sold, resulting in an inaccurate final count of the remaining candies. This mistake shows that the student was inconsistent and did not perform the calculation thoroughly. In addition, during the review stage, the student did not check their calculations, so they did not realize the mistake. Thus, this student is classified as average because they understood the problem and planned the solution correctly, but still had difficulty with the calculation stage and did not verify their answer. This shows the need to strengthen their calculation skills and get them into the habit of reviewing their work.

The following is a transcript of an interview with students who answered the question.

T: "Earlier, when you were working on the candy problem, did you understand what the question was about?"

S: "Yes, sir. At first there were 950 pieces of candy, then 175, 220, and 195 pieces were sold."

T: "Do you know what the question is asking?"

S: "The remaining candy, sir. How many are still in the store?"

T: "What steps did you take to solve it?"

S: "I added up all the candies that were sold, then subtracted that from 950, sir."

T: "When you added up the candies that were sold, were you sure of the result?"

S: "I thought it was correct, sir. So I just subtracted it."

T: "Did you double-check the final result?"

S: "No, sir, because I thought it was correct. So I just wrote it down."

T: "If you had double-checked, would you have noticed the mistake?"

S: "I think so, sir... because I wasn't careful enough earlier."

Based on the written answers and interview results, it can be concluded that the students who worked on question 2 understood the main information in the problem and determined the appropriate strategy to solve it. Students were able to identify the initial data —namely, the

number of candies available and the number sold each day—and understand that the steps were to add up all the candies sold and then subtract them from the initial total. However, during implementation, the student made an addition error, resulting in an incorrect final answer. In addition, the student did not double-check the calculation, so the mistake went undetected. Thus, the student demonstrated a good ability to understand the problem and choose a strategy, but their calculation accuracy and habit of double-checking results still need improvement. Overall, this student's ability is in the medium category.

A deeper analysis of Polya's steps shows that students who complete all stages—understanding the problem, planning the solution, implementing the plan, and reviewing—have a significant advantage in problem-solving. Students with high abilities consistently meet all four indicators, while students with medium abilities show difficulties in the implementation and review stages (Mitasari & Murtiyasa, 2023).

Students with lower problem-solving abilities often do not fully realize the importance of the review stage. A study found that students with low reasoning abilities are unable to understand problems and plan solutions effectively, which in turn leads them to fail to complete the review stage (Irianti, 2020; Taqiyudin et al., 2024). In addition, students with very low reasoning skills often do not perform this stage, indicating that they are usually unsure of the results achieved, even though they may have carried out the plan with some truth in their exploration and problem-solving (Irianti, 2020).

3. Sebuah pabrik roti memiliki 3 mesin pembuat roti. Mesin pertama dapat menghasilkan 125 roti per jam, mesin kedua 115 roti per jam, dan mesin ketiga 135 roti per jam. Jika ketiga mesin tersebut bekerja selama 8 jam, berapa jumlah seluruh roti yang dihasilkan pabrik tersebut? Jelaskan langkah-langkah perhitungannya!

<p>No 3</p> <p>Diketahui</p> <p>- Sebuah pabrik roti memiliki 3 mesin roti</p> <p>- Mesin pertama dapat menghasilkan 125 roti per jam</p> <p>- Mesin ke 2 115 roti per jam</p> <p>- Mesin ke 3 135 roti per jam</p> <p>- Jika ketiga mesin tersebut bekerja selama 8 jam</p>	<p>Ditanyakan</p> <p>- Berapa jumlah seluruh roti yang dihasilkan pabrik tersebut?</p> <p>Jawaban</p> <p><math>125 \times 8 = 1000</math> <math>115 \times 8 = 920</math> <math>135 = 1080</math></p> <p><math>1000 + 920 + 1080 =</math></p>
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Figure 4. Question No. 3 and One of the Answers from Low-Achieving Students

Based on the students' answers in Figure 4, they demonstrated a good initial understanding, as they successfully wrote down important information from the question, such as the number

of machines and the number of loaves of bread produced by each machine per hour. This shows that the students correctly completed the problem-understanding stage. However, in the next stages —planning the solution, implementing the plan, and double-checking —the students did not apply the appropriate strategies. It appears that the students did not multiply the hourly production by 8 hours for each machine, and they made calculation errors, resulting in an inaccurate final answer. In addition, there was no attempt to review the calculation results, so the errors went undetected. Thus, these students were able to complete only the first stage of Polya's problem-solving, while the remaining three stages were not carried out correctly. This shows that these students are in the low-ability category in mathematical problem-solving.

The following interview dialogue shows that the student's answer was consistent with the steps listed on the answer sheet.

T: "When working on the bread factory problem earlier, did you know what information was in the question?"

S: "Yes, sir, there are three machines. The first one makes 125 loaves of bread per hour, the second one makes 115, and the third one makes 135 loaves of bread per hour."

T: "What does the problem ask for?"

S: "The total number of loaves produced if the machines run for 8 hours, sir."

T: "How did you solve it?"

S: "I multiplied 125 by 115 and 135 by 115, sir, because they all run for 8 hours."

T: "I see you've multiplied everything, but why haven't you written down the result of the third machine's multiplication?"

S: "I was going to write it down, sir, but I got confused and just added them up, so I haven't finished it yet."

T: "Did you check the result again before submitting it?"

S: "No, sir. I thought it was correct because I had already multiplied them."

From the written work and interviews, it appears that the student understood the main information in the question and knew that the three machines operated for 8 hours. This is reflected in his ability to record the data and perform multiplication for each machine. However, even though the student reached that stage, he did not complete the process because he did not record the final result of the third machine's multiplication and immediately added the results without checking that they were correct. The student's statements in the interview indicate that he understood the steps to be taken, but was careless and hasty in recording the

final result. The consistency between the written answers and the verbal explanation confirms that the student's mistake was due to a lack of thoroughness in carrying out the steps and not checking the results, rather than a lack of understanding of the problem or the solution strategy.

When students successfully understand the problem, the next step is to plan a solution. Here, it is important for students to be able to formulate appropriate mathematical models or problem-solving strategies. As Rahmah and Darsikin stated, success in planning is closely related to students' ability to explore various solution methods based on their understanding of the problem (Rahmah & Darsikin, 2021). Implementing the plan is also important, where students must actively apply the planned strategies. According to Pradana's research, this stage requires students not only to follow the set steps but also to reflect on the process they are undergoing, ensuring that every action taken is in accordance with the plan (Pradana, 2024).

After completing the solution, the final step is to reevaluate the results. The review process is very important for identifying errors that may have occurred during problem-solving and for assessing whether the strategies used have been effective. Research by Maharani et al. highlights that students who reflect on their problem-solving results tend to show improvement in problem-solving in subsequent stages (Maharani et al., 2019). This shows that the ability to review results and reflect on the process is an important indicator of good mathematical problem-solving skills.

The results of the study show that students are generally able to understand problems well, as indicated by an 86.2% achievement rate in the problem understanding stage. At this stage, most students are able to write down the information they know and are asked correctly. This aligns with the interview results, which show that students find it easier to identify the initial information in the question.

At the planning stage, students achieved a 71.8% score, which is in the moderate category. Although students were able to determine some initial steps for solving the problem, some were still not accurate in choosing the appropriate strategy or in writing their plan in a coherent manner. This shows that students' strategic thinking skills still need improvement.

During the implementation stage, the achievement rate dropped to 48.2% and was categorized as low. Many students made calculation errors or did not consistently follow the plan. This finding was supported by interview results indicating that students were often

confused when performing calculations or were not thorough in following the steps to solve the problem.

The final stage, rechecking, had the lowest achievement percentage at 46.4%. The majority of students did not recheck their calculations, even writing down the final answer without ensuring its correctness. This aligns with previous research findings that elementary school students generally lack the final reflection stage in problem-solving.

Overall, the results of this study indicate that students' problem-solving skills still need improvement, particularly in the stages of implementing plans and reflecting on results. Mathematics learning needs to place greater emphasis on systematic practice based on Polya's steps, the explicit application of problem-solving strategies, and the habit of checking work results.

## **CONCLUSION**

The results show that fifth-grade students' mathematical problem-solving abilities in whole-number operations, as outlined by Polya's stages, vary. Students achieved the highest score in the understanding stage at 86.2% (high category), followed by the planning stage at 71.8% (medium category). However, students' abilities declined significantly in the executing a plan stage (48.2%) and the checking the solution stage (46.4%), both of which were in the low category. These findings indicate that most students can understand the information in the problem and determine the appropriate solution strategy, but still experience difficulties executing the calculation steps and do not sufficiently check the results.

This study makes an important contribution to a deeper understanding of elementary school students' thinking processes in solving mathematical problems based on Polya's stages. The implications of this study emphasize the need to apply learning that emphasizes systematic, explicit practice in Polya's four stages, especially in the implementation of plans and in checking results. Teachers are expected to develop learning strategies that foster accuracy, reflection, and the habit of checking students' work.

Therefore, improving procedural and reflective abilities at each stage of Polya's model is an important factor in optimizing elementary school students' mathematical problem-solving abilities. The findings of this study can also serve as a basis for designing more innovative and effective learning models to foster students' critical and creative thinking skills when confronting complex mathematical problems.

## REFERENCES

- Arifin, Z. and Janan, T. (2023). Analisis kesalahan siswa dalam pemecahan soal asesmen kompetensi minimum numerasi berdasarkan teori polya. *Al Jabar Jurnal Pendidikan Dan Pembelajaran Matematika*, 2(2), 52-59. <https://doi.org/10.46773/aljabar.v2i2.702>
- Gumanti, G., Maimunah, M., & Roza, Y. (2022). Kemampuan pemecahan masalah matematis siswa smp kecamatan bantan. *Prisma*, 11(2), 310. <https://doi.org/10.35194/jp.v11i2.2301>
- Hasanah, A. and Imami, A. (2022). Kemampuan pemecahan masalah matematis siswa kelas ix smp ditinjau dari kemandirian belajar siswa. *Jurnal Educatio Fkip Unma*, 8(1), 290-302. <https://doi.org/10.31949/educatio.v8i1.1981>
- Hidayah, A. R. (2021). Proses berpikir siswa dalam memecahkan masalah matematika kontekstual ditinjau dari kemampuan matematika dan jenis kelamin. *MATHEdunesa*, 10(1), 121-136. <https://doi.org/10.26740/mathedunesa.v10n1.p121-136>
- Irianti, N. P. (2020). Analisis kemampuan penalaran siswa dalam memecahkan masalah matematika berdasarkan langkah-langkah polya. *MUST: Journal of Mathematics Education, Science and Technology*, 5(1), 80. <https://doi.org/10.30651/must.v5i1.3622>
- Jangu, E., Taga, G., & Mei, A. (2023). Proses berpikir dalam memecahkan masalah berdasarkan tingkat kemampuan matematika pada siswa kelas viii smp. *Jupika Jurnal Pendidikan Matematika*, 6(1), 58-74. <https://doi.org/10.37478/jupika.v6i1.2026>
- Jannah, M., Hilyana, F., & Purwaningrum, J. (2023). Penggunaan model contextual teaching and learning untuk meningkatkan kemampuan pemecahan masalah matematis siswa sekolah dasar. *Jp2m (Jurnal Pendidikan Dan Pembelajaran Matematika)*, 9(2), 239-244. <https://doi.org/10.29100/jp2m.v9i2.4484>
- Jedaus, M. D., Farida, N., & Suwanti, V. (2019). Analisis Kesalahan Siswa dalam Menyelesaikan Soal Cerita Pokok Bahasan Perbandingan Tahapan Polya. 2, 306–315
- Maharani, S., Kholid, M. N., Pradana, L. N., & Nusantara, T. (2019). Problem solving in the context of computational thinking. *Infinity Journal*, 8(2), 109. <https://doi.org/10.22460/infinity.v8i2.p109-116>
- Maulana, H., Muzdalipah, I., Setialesmana, D., Musannadah, R., & Wali, L. (2023). Students error description and contributing factor in solving timss geometry content domain problems based on their learning style. *Jurnal Cendekia Jurnal Pendidikan Matematika*, 7(2), 1558-1570. <https://doi.org/10.31004/cendekia.v7i2.2326>
- Mitasari, D. and Murtiyasa, B. (2023). Analisis kemampuan pemecahan masalah matematis siswa dalam menyelesaikan soal cerita pada materi aritmatika sosial berdasarkan langkah polya. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, 7(2), 1759-1772. <https://doi.org/10.31004/cendekia.v7i2.2399>
- Murni, A. (2019). Metakognisi dalam pembelajaran matematika. *Jurnal Prinsip Pendidikan Matematika*, 1(2), 1-14. <https://doi.org/10.33578/prinsip.v1i2.23>

- Pixyoriza, P., Nurhanurawati, N., & Rosidin, U. (2022). Pengembangan modul digital berbasis stem untuk mengembangkan kemampuan pemecahan masalah. *Edumatica | Jurnal Pendidikan Matematika*, 12(01), 76-87. <https://doi.org/10.22437/edumatica.v12i01.17541>
- Popon, P., Apriani, I., Karlimah, K., & Wijaya, T. (2024). Analisis kemampuan pemecahan masalah soal cerita operasi hitung campuran bilangan cacah di kelas iv. *Dwija Cendekia Jurnal Riset Pedagogik*, 8(1), 101. <https://doi.org/10.20961/jdc.v8i1.85093>
- Pradana, L. N. (2024). Problem-solving strategy: mathematical problem-solving model within the polya' framework. *KnE Social Sciences*. <https://doi.org/10.18502/kss.v9i6.15327>
- Rahmah, N. A. E. and Darsikin, D. (2021). Student's problem-solving skills in thermodynamics at dampelas 1 senior high school. *Jurnal Ilmiah Pendidikan Fisika*, 5(2), 258. <https://doi.org/10.20527/jjpf.v5i2.2797>
- Ramadhana, O., 'Ariikah, N., & Hidayah, N. (2024). Analisis kemampuan penalaran siswa kelas vi di sd 06 bulungkulon dalam menyelesaikan masalah matematika berdasarkan langkah-langkah polya. *E-GOV*, 2(3), 299-306. <https://doi.org/10.71128/e-gov.v2i3.117>
- Raudho, Z., Handayani, T., & Syutaridho, S. (2020). Analisis kemampuan pemecahan masalah soal pythagoras berdasarkan langkah-langkah polya. *Suska Journal of Mathematics Education*, 6(2), 101. <https://doi.org/10.24014/sjme.v6i2.9061>
- Saparwadi, L. and Cahyowatin, C. (2018). Proses pemecahan masalah matematika siswa berkemampuan tinggi berdasarkan langkah polya. *Union Jurnal Ilmiah Pendidikan Matematika*, 6(1). <https://doi.org/10.30738/.v6i1.2111>
- Taqiyudin, M., Fasya, R. I., Sholahuddin, D. F., Herman, T., & Hasanah, A. (2024). Analisis kesulitan siswa dalam proses pemecahan masalah matematis pada materi spldv berdasarkan langkah polya. *AL KHAWARIZMI: Jurnal Pendidikan Matematika*, 4(2), 68-72. <https://doi.org/10.46368/kjpm.v4i1.1767>
- Widyastuti, R. and Airlanda, G. (2021). Efektivitas model problem based learning terhadap kemampuan pemecahan masalah matematika siswa sekolah dasar. *Jurnal Basicedu*, 5(3), 1120-1129. <https://doi.org/10.31004/basicedu.v5i3.896>