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POLYA APPROACH IN PRACTICE: ANALYSIS OF PGMI STUDENTS' MATHEMATICS PROBLEM-SOLVING SKILLS

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Abstract
Mathematical problem-solving ability is an important skill that every individual must have in learning mathematics. This research focuses on the practice of problem-solving based on the steps according to Polya. The aim is to describe the problem-solving skills of PGMI students in semester 3 of the 2024/2025 academic year and the obstacles they often face. This research is descriptive qualitative with purposive sampling technique and data collection methods through tests, interviews, observations, and documentation. The data will be analyzed using descriptive statistics, qualitative descriptive analysis, and content analysis. The results showed that the average student's problem-solving ability was 64% (high criteria). In detail, the average understanding of the problem reached 81% (very high), strategy planning 75% (high), plan execution 83% (very high), and re-examination only 0.4% (very low). The main obstacle that students often face is difficulty in understanding the problem, so they often make mistakes in planning and implementing solutions. In addition, students are also less careful in re-examining the answers that have been completed. The results of this study provide significance to improving the quality of mathematics learning in higher education, namely by designing more effective learning methods to improve students' problem-solving skills.
Keywords: *Mathematics; PGMI Students; Polya; Problem-Solving.*

Abstrak
Kemampuan pemecahan masalah matematika adalah keterampilan penting yang harus dimiliki setiap individu dalam pembelajaran matematika. Penelitian ini berfokus pada praktik pemecahan masalah berdasarkan langkah-langkah menurut Polya. Tujuannya yakni untuk mendeskripsikan kemampuan pemecahan masalah mahasiswa PGMI semester 3 tahun akademik 2024/2025 serta kendala yang sering mereka hadapi. Penelitian ini bersifat deskriptif kualitatif dengan teknik pengambilan sampel *purposive sampling* dan metode pengumpulan data melalui proses tes, wawancara, observasi, dan juga dokumentasi. Data akan dianalisis menggunakan statistik deskriptif, analisis deskriptif kualitatif, dan analisis konten. Hasil penelitian menunjukkan rata-rata kemampuan pemecahan masalah mahasiswa sebesar 64% (kriteria tinggi). Secara rinci, rata-rata pemahaman masalah mencapai 81% (sangat tinggi), perencanaan strategi 75% (tinggi), pelaksanaan rencana 83% (sangat tinggi), dan pemeriksaan kembali hanya 0,4% (sangat rendah). Adapun kendala utama yang sering dihadapi mahasiswa adalah kesulitan dalam memahami masalah, sehingga sering keliru dalam merencanakan dan melaksanakan penyelesaian. Selain itu, mahasiswa juga kurang teliti dalam memeriksa kembali jawaban yang telah diselesaikan. Hasil penelitian ini memberikan signifikansi terhadap peningkatan kualitas pembelajaran matematika di perguruan tinggi, yakni dengan merancang metode pembelajaran yang lebih efektif untuk meningkatkan kemampuan pemecahan masalah mahasiswa.
Kata Kunci: Mahasiswa PGMI; Matematika; Pemecahan Masalah; Polya.

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Introduction

Mathematics is often interpreted as an important subject in everyday life (Rosdianah et al., 2019). Talking about math is certainly familiar, mathematics as a subject that is part of the curriculum, (Ahmad et al., 2023) is studied starting from elementary school to college level (Ruqoyyah et al., 2020). Mathematics learning really needs to be given to students as a provision so that they have various abilities (Suanto et al., 2023), such as critical thinking and problem solving skills (Amaliyah, 2020; Rosyada et al., 2019). In learning mathematics, students will be stimulated to understand various concepts by solving various problems according to the context of mathematical material (Ahmad et al., 2023; Atiyah & Nuraeni, 2022; W. Hidayat & Husnussalam, 2019; Lidinillah et al., 2022). The development of mathematics is strongly based on human skills in thinking (Syahriza et al., 2023), because good thinking skills will encourage the ability to solve problems in everyday life (Ulva, 2018). Problem-solving ability is one of the important skills possessed by students (R. Hidayat et al., 2022; Nurmilawati et al., 2021), especially in learning mathematics (Rahman & Setyaningsih, 2022). The National Council of Teachers of Mathematics (NCTM) also emphasizes that problem-solving ability is one of the process skills that must be and is important for students to have through learning mathematics (Febrianti & Wandini, 2024).

Problem-solving skills are the ability to use certain approaches and strategies to find appropriate and meaningful solutions to a problem or situation (Iilonga & Ogbonnaya, 2023). In higher education, mathematics focuses on formal frameworks based on axiomatic systems and verification processes, so students need to have advanced mathematical thinking skills, namely abilities that train them to construct and form a deep understanding of mathematical definitions. These abilities include representation skills, abstraction, creative thinking, and mathematical proof (Kariadinata, 2021). Mathematics learning also requires hands-on experiences that encourage problem-solving skills (Maharani et al., 2019). Problem-solving is a way to overcome various challenges faced (Suryaningtyas & Setyaningrum, 2020). In his book How to Solve It, Polya explained that problem-solving is an effort to find solutions to difficulties that cannot be solved directly (Annisah, 2018; Annizar et al., 2020; Tias & Wutsqa, 2015). This ability can help students develop new ideas, build knowledge, hone their mathematical skills (Cahyani & Setyawati, 2016; Lutfiya et al., 2021), and face and solve increasingly complex problems (Annisah, 2018).

In Indonesia, math problem-solving skills are still a challenge in education. This is reflected in the results of various studies and evaluations, such as the Program for International Student Assessment (PISA), which show that Indonesian students often rank low in terms of mathematical problem-solving skills (Hayati et al., 2025). Where many educators are still only focused on procedural teaching rather than concept understanding and contextual problem-solving. Globally, problem-solving skills in mathematics education are recognized as an important ability to prepare learners for the challenges of an increasingly complex real world. In addition, mathematical problem-solving is a major focus in the development of educational curricula in many developed countries, such as Finland, Singapore, Japan, and South Korea. These countries apply a problem-based learning approach and Polya's method has been systematically integrated into the curriculum. The focus is not only on the end result but also on the critical, reflective, and collaborative thinking process in finding solutions. However, both in Indonesia and around the world, Polya's approach with its four problem-solving steps of understanding the problem, planning the solution, executing the plan, and re-examining the answer (Hayati et al., 2025), remains a reliable framework for improving problem-solving skills.

The development of mathematical problem-solving skills in students is strongly influenced by the ability of educators, so the ability of educators to solve mathematics problems also has a very important role (Annisah, 2018). Moreover, with the development of the 21st century, the world of education is expected to be able to prepare students who have various qualified abilities (Kalaka et al., 2024) one of which is problem-solving ability (Waluyo et al., 2020). Therefore, according to Lidinillah, educators or prospective educators as those who have a major role in the learning process, need to master problem-solving not only conceptually, but also in its implementation in the classroom (Annisah, 2018). The Madrasah Ibtidaiyah Teacher Education (PGMI) study program as one of the educator training institutions is expected to be able to produce prospective educators who have the competence to empower students with various abilities, one of which is problem-solving ability. PGMI students as prospective educators in elementary schools or madrasah ibtidaiyah are very important to have strong problem-solving skills because as future educators, they are expected to be able to effectively convey mathematical knowledge to students. Moreover, as the spearhead of education, educators have an important role in planning, implementing, and guiding students to achieve learning goals.

Research related to math problem-solving skills is not something new, both at the elementary school and college levels. As in research (Annisah, 2018), revealed that the results of the value of the SD / MI mathematics concept course in odd-semester PGMI students were still relatively low. This can be seen from the difficulty of students in solving problems, especially non-routine story problems or problem-solving. These findings indicate that the ability of students to solve mathematical problems, especially story problems or problem-solving, still needs to be improved, so in the study, researchers tried to develop teaching materials on geometry material. Another study conducted (Samo, 2017), revealed that the ability of students to solve problems of geometry material with cultural context tends to vary. Students with high ability showed better problem-solving skills than those with medium or low ability. The main problem found in this study is the lack of student understanding of the problems presented and the difficulty in making problem-solving strategies or mathematical modeling. Similar research was also conducted by (Lutfiya et al., 2021) which describes the results of analyzing problem-solving in junior high school students with Polya's solution. The results showed that the average student's problem-solving ability was classified as sufficient, but the ability to solve problems was not sufficient.

There have been many studies on mathematics problem-solving skills, especially in higher education, but there are still gaps in understanding the specific obstacles faced by students in solving story problems and problem-solving. Thus, this study will focus on a more in-depth analysis of the abilities and obstacles faced by students in solving mathematical problems at the university level. This study will use five description questions in the form of story problems or problem-solving to evaluate the extent of students' ability to understand and solve mathematical problems. It is hoped that the results of this study can provide new insights that can be used as a basis for improving mathematics learning methods that are more effective and relevant to the needs of students, especially in an effort to improve better problem-solving skills.

Mathematical problem-solving ability is an important skill that students need to master, especially in facing future academic and professional challenges. To assess this ability, NCTM provides indicators that can be used to measure the extent to which students can solve problems effectively. These indicators include the ability to build new knowledge through problem-solving, relate mathematics to other contexts, apply various appropriate strategies,

and reflect on the steps taken in the problem-solving process (Lutfiya et al., 2021). Meanwhile, according to Polya, there are four main steps in solving math problems, namely: (1) understanding the problem, (2) planning a solution strategy, (3) implementing the solution plan, and (4) checking back or making conclusions (Febrianti & Wandini, 2024; Lee, 2017; Muslim et al., 2024; Nurfitriyanti, 2016; Sam & Qohar, 2016). In this study, students' mathematical problem-solving skills will be analyzed using Polya's solution steps. These stages provide a systematic and effective framework for solving mathematical problems. The framework emphasizes the importance of deep understanding, careful planning, precise execution, and critical review as fundamental principles in problem-solving (Chacon-Castro et al., 2023). In this study, students' mathematical problem-solving skills will be analyzed through the application of Polya's solution steps.

Polya's solution step is one of the solution steps that can be used in developing or assessing students' abilities in problem-solving (Lutfiya et al., 2021). Polya has determined four problem-solving steps that can be done so that problem-solving can be more focused. Polya's problem-solving steps are more popular and widely used than other steps. In addition, this strategy is recognized by many researchers as a stage in problem-solving (Muslim et al., 2024). This is because the procedure in problem solving according to Polya is simpler and each step in the solution is quite clear. Among the many theories proposed regarding problem-solving strategies, the problem-solving method proposed by Polya in 1957 is the most comprehensive (Lee, 2017). Thus students' mathematical problem-solving ability in this study will refer to Polya's problem-solving practice. It is hoped that through the application of the procedures of this approach, students can be better trained in critical and reflective thinking, which is essential in dealing with more complex mathematical problems. In addition, these structured steps support the development of problem-solving skills that are not only relevant for mathematics but also for real-world challenges that require systematic problem-solving.

Based on the background of the problem, this study aims to describe the mathematical problem-solving ability of PGMI students based on Polya's approach. In connection with this, the results of this study answer two questions, namely (1) how is the mathematical problem-solving ability of PGMI students based on Polya's approach, and (2) what obstacles are often experienced by students in solving math problems. The results of this study can be used as data or information to carry out learning evaluations or further research in an effort to improve the problem-solving skills of PGMI students.

Research Methods

This research uses descriptive qualitative research. Some important steps in this research include the process of asking questions, applying procedures, the process of collecting data from participants, inductive data analysis, and interpretation of meaning (Creswell & Creswell, 2017). This research will describe the results of analyzing the problem-solving abilities of PGMI students and what obstacles students often experience in the problem-solving process. This research was conducted at the Madrasah Ibtidaiyah Teacher Education (PGMI) Study Program of the Metro State Islamic Religious Institute for 3rd-semester students in the 2024/2025 academic year. The sampling technique used purposive sampling with the consideration that students in semester 3 (three) of the 2024/2025 academic year were taking the SD/MI Mathematics Concepts course. The subjects in this study involved 110 (one hundred and ten) 3rd semester students, namely classes A, B, C, and D.

The data collection process was carried out in this study using multiple sources of evidence which include: test results, interviews, observations, documentation, notes,

documents, and other visual sources. This research was carried out through a series of processes which included: (1) implementation of tests used to assess students' mathematical problem-solving skills, the tests used are story or problem-solving questions totaling five description questions that have been developed previously and then modified the numbers, (2) asking questions to respondents used to obtain data on the obstacles that students often experience in problem-solving, and (3) observations made observing the subject directly and documentation used to obtain data on the phenomenon under study.

After all the data has been collected, the data analysis process is then carried out using an interactive data analysis model which includes a series of processes, namely data condensation, data presentation, and conclusion drawing (Cahyono, 2021; Miles et al., 2014). The data analysis process as an interactive cycle can be seen in the following figure:

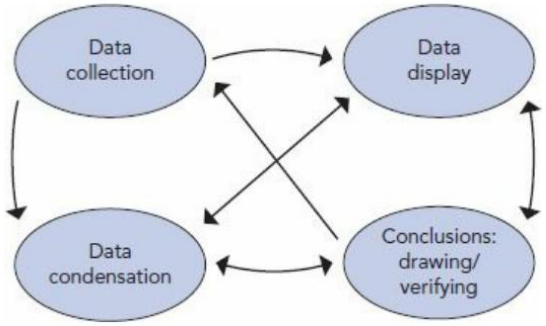

Figure 1. Interactive Data Analysis

Figure 1 shows a series of processes carried out after the necessary data has been collected by the researcher. This step is an interactive data analysis process. The process includes data condensation, data presentation, and finally conclusion drawing/verification. Then the research data processed through these 3 (three) stages will be analyzed using descriptive statistics for test results qualitative descriptive methods and content analysis for the results of interviews and observations. The results of these stages and analysis will be used to formulate conclusions about the ability of students in problem-solving.

Furthermore, to assess students' mathematical problem-solving ability, it will be analyzed based on indicators of the stages of problem-solving according to Polya as in the following modified assessment rubric.

Table 1. Polya's Problem-Solving Assessment Rubric

No	Polya's Stages of Problem Solving	Students Assessment/Score				
		0	**1**	**2**	**3**	**4**
1.	*Understanding the Problem*	No answer at all	Writing known and asked but wrong/incomplete/incorrect	Understanding and writing information thoroughly		
2.	*Devising Plan*	No strategy	Create a strategy but irrelevant/unclear	Present the steps/strategy of the solution correctly		
3.	*Carrying Out the Plan*	No problem-solving at all	There is a solution but it is unclear or	There is a solution procedure but the	There is a correct solution but	There is a solution with the right

			wrong	steps are wrong/ incomplete	the answer is not correct	procedure and correct
4.	*Looking Back*	Did not check the answer	Checking but not correct	Checking the result correctly		

Source (Suryani et al., 2020) and Reseacher Modifications.

The achievement of the results of the problem-solving ability test scores of each student will be calculated using the formula (Prayitno, 2019) as follows.

$$\text{Final Score} = \frac{\text{Acquisition Score}}{\text{Maximum Score}} \; x \; 100$$

Source: (Prayitno, 2019)

Description:
Acquisition score = number of scores obtained by students
Maximum score = total score of all questions.

In addition, the average analysis of students' problem-solving ability will be calculated using the following formula as follows.

$$\bar{x} = \frac{\sum x_i}{n}$$

Source: Sudjana (in Lutfiya et al., 2021)

Description:
$\bar{x}$ = average score
$\sum x_i$ = number of marks obtained by an individual
n = number of students

Furthermore, the percentage analysis of the level of students' problem-solving ability based on Polya's steps will be calculated using the formula as follows.

$$P_i = \frac{n_i}{N} \text{ x } 100\%$$

Source: Ninik et al (in Lutfiya et al., 2021)

Description:
P_i = percentage of students in each ability level
n_i = number of students in each ability level
N = number of students who took the test

The criteria for determining the criteria for classifying students' mathematical problem-solving abilities are as follows.

Table 2. Criteria for Clarifying the Percentage of Problem-Solving Ability

Percentage	Criteria
0 % ≤ $\boldsymbol{P_i}$ ≤ 20 %	Very Low
20 % < $\boldsymbol{P_i}$ ≤ 40 %	Low
40 % < $\boldsymbol{P_i}$ ≤ 60%	Medium
60 % < $\boldsymbol{P_i}$ ≤ 80 %	High
80 % < $\boldsymbol{P_i}$ ≤ 100 %	Very High

Source: Romika and Amalia (dalam Lutfiya et al., 2021)

Based on table 2 on the classification criteria for the percentage of problem-solving ability, information can be obtained that if the P_i value is more than 60% then the percentage of problem-solving ability is declared high, if P_i is less than or equal to 40% then the percentage of problem-solving ability is declared quite low.

Result and Discussion

This study was conducted to determine the distribution of the level of students' mathematical problem-solving ability based on Polya's solving practices. The indicators discussed in this study are the ability of students to understand the problem, the ability of students to plan problem-solving strategies, the ability of students to solve problems, and the ability of students to re-examine answers or draw conclusions from answers. As for assessing the mathematical problem-solving ability of PGMI students in semester 3 of the 2024/2025 academic year, researchers developed questions which were descriptive questions related to problem-solving totaling 5 (five), then the questions were given to all PGMI students in semester 3, namely classes A, B, C, and D, totaling 110 students.

The assessment of the mathematical problem-solving ability of PGMI students in semester 3 (three) of the 2024/2025 academic year is reviewed from the subject matter and sub-subject matter, Course Learning Outcomes (CPMK), Sub-Course Learning Outcomes (Sub-CPMK), and learning indicators. In this study, the things that were done in the preparation of the questions were (1) designing questions related to problem-solving or problem-solving skills based on the subject matter in the odd semester SD / MI Mathematics Concepts course is the concept material of Numbers, KPK & FPB, and Fractions, (2) Sub-CPMK contained in the questions are Sub-CPMK 1. 2. 3. and 4. namely solving problems in everyday life related to the concepts of numbers, KPK & FPB, and fractions, and (3) making assessment rubrics and assessment criteria. Furthermore, the validated problems were given to students to solve.

The results of the value of the mathematical problem-solving ability of PGMI students in semester 3 of the 2024/2025 academic year showed that the minimum value of the 110 PGMI students after working on problem-solving problems is 26 while the maximum value is 84. Based on the results of the student math problem-solving ability test based on Polya's solution steps, it can be concluded that the test results are not the same. This is because the research subjects have different abilities. The test results related to the ability to solve math problems that have been carried out are as follows.

Table 3. List of Student Problem-Solving Results

No	Students	Score	Criteria	No.	Students	Score	Criteria
1.	ADF	74	High	56.	SLI	70	High
2.	ANW	74	High	57.	VAR	68	High
3.	ANI	80	High	58.	VIS	74	High
4.	AL	70	High	59.	WRN	60	Medium

5.	AY	72	High	60.	WA	74	High
6.	DH	66	High	61.	AH	64	High
7.	DZ	60	Medium	62.	ATA	74	High
8.	DA	64	High	63.	AJP	54	Medium
9.	DNS	64	High	64.	AW	54	Medium
10.	DYA	68	High	65.	AMP	32	Low
11.	HUN	70	High	66.	DR	54	Medium
12.	IKS	64	High	67.	ESW	44	Medium
13.	JLS	76	High	68.	FNR	78	High
14.	KHK	48	Medium	69.	FBH	40	Low
15.	LAM	38	Low	70.	HRI	70	High
16.	MA	70	High	71.	HWM	72	High
17.	MS	60	Medium	72.	ISA	74	High
18.	MI	54	Medium	73.	LAH	54	Medium
19.	NR	56	Medium	74.	MYA	70	High
20.	NDR	78	High	75.	MMA	60	Medium
21.	NK	62	High	76.	MDR	26	Low
22.	NS	68	High	77.	NDJ	74	High
23.	PR	70	High	78.	NNA	58	Medium
24.	REIP	62	High	79.	ORI	36	Low
25.	RK	68	High	80.	RMN	34	Low
26.	RAK	68	High	81.	SSA	74	High
27.	SFK	46	Medium	82.	SK	74	High
28.	TSR	84	Very High	83.	SMH	48	Medium
29.	TKC	68	High	84.	SFY	56	Medium
30.	TW	52	Medium	85.	TNY	68	High
31.	AJML	72	High	86.	YAF	64	High
32.	CSI	80	High	87.	ANKD	60	Medium
33.	DKAF	68	High	88.	AR	64	High
34.	DRI	64	High	89.	AA	70	High
35.	DSI	64	High	90.	BNFY	66	High
36.	DPA	66	High	91.	DKI	64	High
37.	DDPR	66	High	92.	DT	56	Medium
38.	EPF	74	High	93.	ELY	74	High
39.	ET	68	High	94.	GDF	60	Medium
40.	EMA	74	High	95.	HAA	56	Medium
41.	HLS	60	Medium	96.	IS	70	High
42.	HP	78	High	97.	IAI	74	High
43.	JAI	70	High	98.	LRH	56	Medium
44.	LHA	74	High	99.	MNA	70	High
45	MDA	74	High	100.	NRH	54	Medium
46.	MF	68	High	101.	HH	66	High
47.	NOS	72	High	102.	OKP	68	High
48.	NNA	72	High	103.	PWI	74	High
49.	NDS	62	High	104.	PHI	74	High
50.	NRA	64	High	105.	RRN	66	High
51.	NRA	60	Medium	106.	RLM	68	High
52.	ODA	58	Medium	107.	RSA	56	Medium
53.	PAL	72	High	108.	TRS	76	High
54.	SHI	64	High	109.	US	66	High
55.	SA	64	High	110.	VAC	62	High
Minimum Score					**26**	**Low**	
Maximum Score					**84**	**Very High**	
Mean Score					**64,4**	**High**	

Based on Table 3, it is obtained that the results of the test scores of mathematical problem-solving skills of PGMI students in semester 3 (three) of the 2024/2025 academic year, who have solved the five problem-solving problems in everyday life about the concept of

numbers, KPK & FPB, fractions, namely obtained a minimum score of 26 with the category "low" and a maximum score of 84 with the category "very high" and obtained an average score of 64.4 with the category "high". Based on these results it can be concluded that the results of student achievement or the ability of students to solve mathematical problems are quite high, but there are still students with low achievement and very high criteria are still very, namely only one student. So the learning approach used at this time is appropriate but there is a need for evaluation to improve learning. Through evaluation of the shortcomings or mistakes that are often made by students in problem-solving, it is hoped that it can improve students' mathematical problem-solving skills.

The results of the value of the mathematical problem-solving ability of PGMI students in semester 3 (three) of the 2024/2025 academic year can be further classified according to the criteria for the mathematical problem-solving ability of PGMI students. Based on table 3, it can be seen that the average score of PGMI students' mathematical problem-solving ability is 64.4 in the high category. Furthermore, researchers present the percentage of classification results based on the interval of students' mathematical problem-solving ability. This is presented in table 4 below.

Table 4. Results of Problem-Solving Ability Clarification Criteria

Interval KPMM	Number of Students	Persetase	Criteria
0% $\leq P_i \leq$ 20%	0	0%	Very Low
20% $< P_i \leq$ 40 %	6	5,45%	Low
40% $< P_i \leq$ 60%	27	24,54%	Medium
60% $< P_i \leq$ 80%	76	69,09%	High
80% $< P_i \leq$ 100%	1	0,91%	Very High

Based on table 4, it can be obtained information that the achievement of PGMI students in semester 3 of the 2024/2025 academic year in solving mathematical problems, the highest percentage is in the high criteria, namely 69.09%, of which 76 students out of 110 students are in the high category. This shows that the overall ability of PGMI students to master the material of number concepts, KPK & FFPB, and fractions has met the high criteria. On the other hand, there are still students who are in the low criteria, namely 5.45% or around 6 students, medium criteria, namely 24.54% or around 27 students and students in very high criteria, namely 0.91% or out of 110 students there is only 1 student who gets very high criteria.

As for the recapitulation of the results of the achievement of students' mathematical problem-solving skills based on the criteria or indicators of problem-solving skills according to Polya's steps, namely in problem number one as follows.

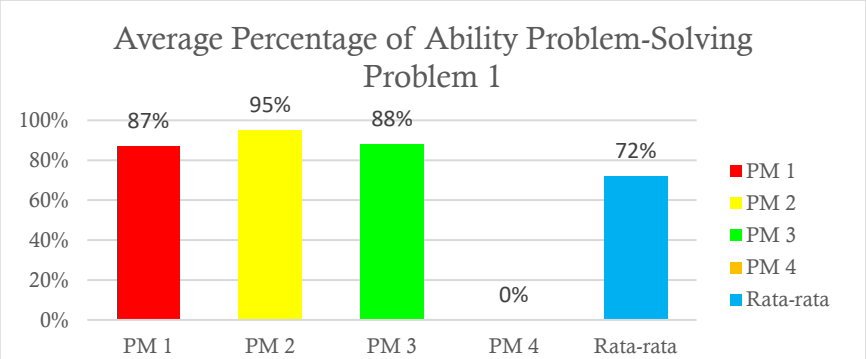

Figure 2. Average Percentage of Problem-Solving Ability Problem 1

Based on Figure 2, information can be obtained that in solving problem number one, it can be seen that the average percentage of students' problem-solving ability on KPK material is 72%, this percentage meets the "high" criteria. The distribution of students' mathematical problem-solving ability on the indicator of understanding the problem is 87% with very high criteria. Furthermore, the indicator of planning the strategy is 95% at very high criteria, the indicator of implementing the solution is 88% at very high criteria and the indicator of checking back is 0% at very low criteria. This shows that the indicators of understanding the problem, planning strategies, and carrying out solutions are the stages most mastered by students, while the stage of re-examining students is still lacking in mastery or the ability of students at the stage of re-examining is still very low.

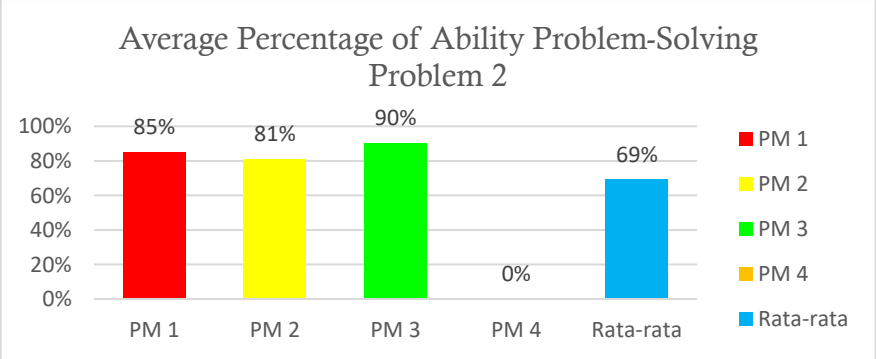

Figure 3. Average Percentage of Problem-Solving Ability Problem 2

Based on Figure 3, information can be obtained that in solving problem number two, it can be seen that the average percentage of students' problem-solving ability in Comparison material is 69%, this percentage meets the "high" criteria. The distribution of students' mathematical problem-solving ability on the indicator of understanding the problem is 85% with very high criteria. Furthermore, the indicator of planning the strategy is 81% with very high criteria, the indicator of implementing the solution is 90% with very high criteria and the indicator of checking back is 0%, this percentage is at a very low criterion. This can be interpreted that in problem number two the indicators in understanding the problem, planning the strategy, and carrying out the solution are the stages that students master the most, especially the completion stage, while in the stage of checking back students still lack mastery or the ability of students at the stage of checking back is still very low.

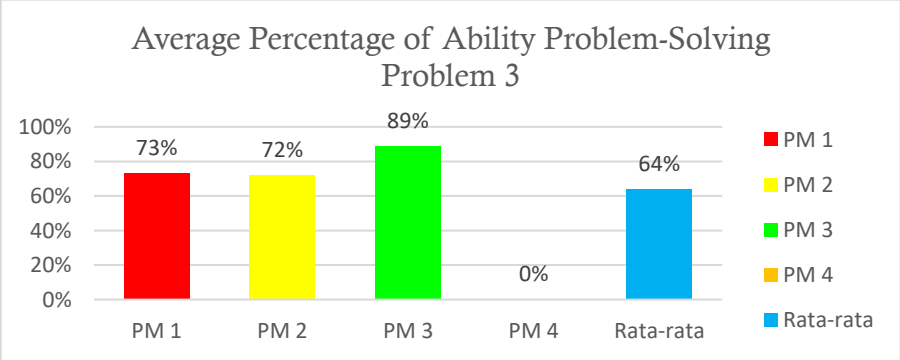

Figure 4. Average Percentage of Problem-Solving Ability

Based on Figure 4, information can be obtained that in solving problem number three, it can be seen that the average percentage of students' problem-solving ability in Comparison material is 64%, this percentage meets the "high" criteria. The distribution of students' mathematical problem-solving ability on the indicator of understanding the problem is 73% with high criteria. Furthermore, the indicator of planning the strategy is 72% with high criteria, and the indicator of implementing the solution is 89% which is at a very high criterion and the indicator of checking back is 0%, this percentage is at a very low criterion. Based on this, it can be interpreted that in problem number three the indicators of understanding the problem and planning the strategy of students have been mastered enough. The stage of doing the solution is the stage that students master the most. However, at the stage of re-examining the answers, students lack mastery or the ability of students at the stage of re-examining is still very low.

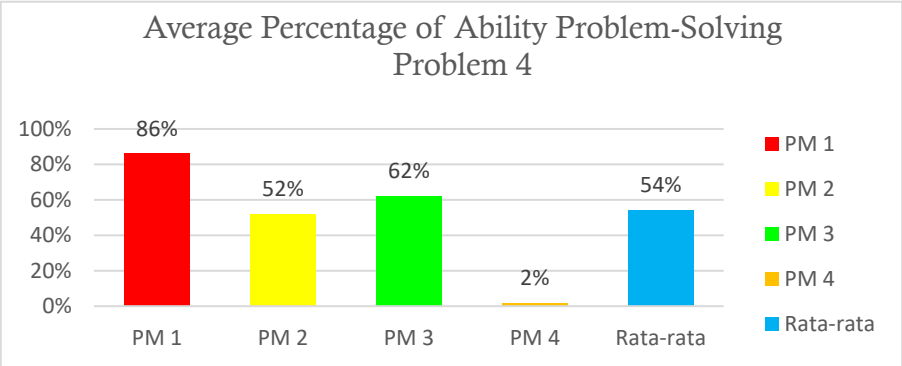

Figure 5. Average Percentage of Problem-Solving Ability Problem 4

Based on Figure 5, information can be obtained that in solving problem number four, it can be seen that the average percentage of students' problem-solving ability in Comparison material is 54%, this percentage meets the "medium" criteria. The distribution of students' mathematical problem-solving abilities on the indicator of understanding the problem is 86% with very high criteria. Furthermore, the indicator of planning the strategy is 52% on medium criteria, the indicator of implementing the solution is 62% on high criteria and the indicator of checking back is 1.8%, this percentage is on very low criteria. This can be interpreted that in problem number four the indicator of understanding the problem is the stage that students master the most, while in the indicators of planning strategies and performing solutions, students have understood enough and can solve the problems presented even though they are less precise and incomplete. Finally, at the stage of checking back students still lack mastery or the ability of students at the stage of checking back is still very low.

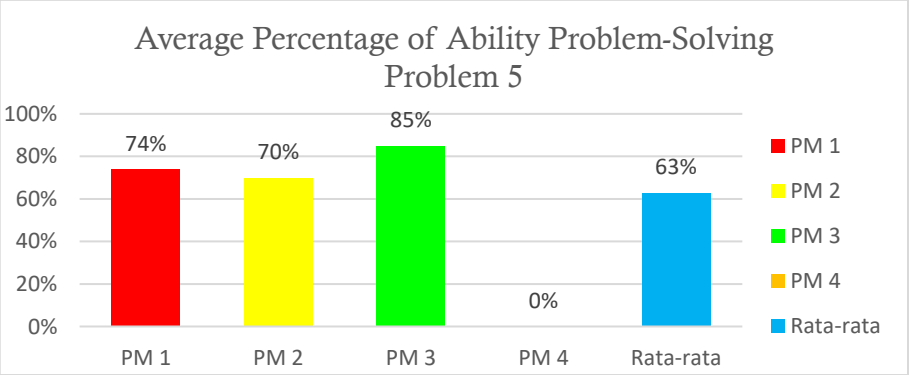

Figure 6. Average Percentage of Problem-Solving Ability Problem 5

Based on Figure 6, information can be obtained that in solving problem number five, it can be seen that the average percentage of students' problem-solving ability in Comparison material is 63%, this percentage meets the "high" criteria. The distribution of students' mathematical problem-solving abilities on the indicator of understanding the problem is 74% with high criteria. Furthermore, the indicator of planning a strategy is 70% with high criteria, and the indicator of carrying out the solution is 85% which is at very high criteria and the indicator of checking back is 0%, this percentage is at very low criteria. This can be interpreted that in problem number five, the indicators of understanding the problem and planning the strategy, students have understood enough and can determine the strategy to be used even though some are still inaccurate and incomplete, while the indicator of solving is the stage that students master the most. In this case, students can solve problems with various strategies. Finally, at the stage of checking back students still lack mastery or the ability of students at the stage of checking back is still very low.

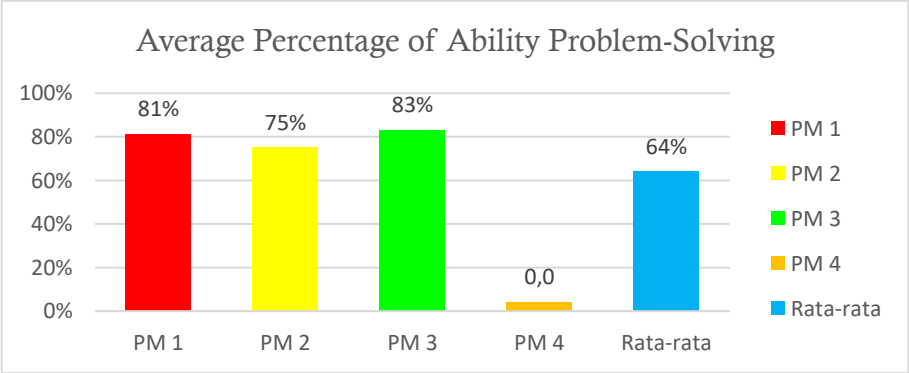

Figure 7. Average Percentage of Problem-Solving Ability

Based on Figure 7, it can be obtained information that the average value of the mathematical problem-solving ability of PGMI students in semester 3 of the 2024/2025 academic year on Numbers, KPK & FFPB, and Fractions material is 64%, this percentage meets the "high" criteria. The distribution of students' mathematical problem-solving ability on the indicator of understanding the problem is 81% where the percentage meets the criteria very high so that the indicators of understanding the problem in questions 1-5 have been mastered by students. Students have been able to understand and find the information presented and understand what the question is asking. In the indicator of planning strategies, the average percentage of students is 75% with high criteria, meaning that students are quite capable of making strategies or plans for solving the problems presented and understanding the formulas used. Then on the indicator of carrying out the completion of the average percentage of 83% with very high criteria, it can be interpreted that students are quite capable

of solving problems, answering questions, and getting answers to the problems presented. Finally, the indicator of checking back the average percentage of students' problem-solving ability is 0.4% with very low criteria, meaning that in the indicator of checking back answers, students are not capable enough or students' ability to check back answers is still very low.

On the results of the analysis of student achievement in solving mathematics problems, it can be concluded that several important things are related to problem-solving indicators, (1) understanding the problem, it is important for students to understand the information from the problem correctly, including knowing what information is given and what is asked. This is in line with the opinion of Roebyanto and Harmini, who stated that at the stage of understanding the problem, students must be able to clearly identify known and unknown information (Hermawati et al., 2021). (2) making a strategy plan, at this stage, students are expected to be able to design a relationship between known and unknown information to determine the right solution strategy. According to Soesanto and Dirgantoro, the ability to plan effective strategies depends on strong prior knowledge. This knowledge will encourage designing the right strategy when facing math problems (Soesanto & Dirgantoro, 2021). (3) By implementing the solution, students are expected to be able to choose and develop appropriate problem-solving strategies and use appropriate concepts and formulas to perform calculations. Roebyanto and Harmini stated that a good problem-solving strategy is to use the right technique so that it helps facilitate the calculation steps in finding a solution (Hermawati et al., 2021). and (4) re-examining the answer, At this stage, students are expected to be able to re-examine the answers obtained, ensuring whether the steps taken are correct and the final result is as expected. By understanding and applying these four indicators, it is hoped that student's ability to solve mathematical problems can improve significantly.

Of the four indicators, students are quite good at solving math problems. However, in the fourth indicator (checking the answer again), there are still many students who have not fully mastered it. This can be an evaluation material to improve the quality of learning, for example through the application of a more effective learning process and providing training that focuses on improving students' reflective abilities. In addition, educators also need to facilitate students to be able to develop problem-solving skills optimally. This is in line with the opinion of Setiawan et al., who stated that problem-solving skills can be trained formally through the learning and assessment process. Educators are expected to create a conducive learning climate and support the development of students' problem-solving skills (Widana, 2021). These findings emphasize the importance of a pedagogical approach that focuses not only on delivering material but also on strengthening students' critical and reflective thinking skills. Interactive approaches such as problem-based learning and collaboration between educators, institutions, and students can create a learning environment that is more supportive of the development of these skills. In addition, curricula and teaching methods need to systematically integrate reflective practice to improve academic outcomes and better prepare students for real-world challenge.

Furthermore, based on the results of interviews related to the obstacles that are often experienced by students in solving mathematical problems, including, (1) some students sometimes find it difficult to understand what information is presented in the problem, so to determine the next step they find it difficult and sometimes also choose the wrong strategy because they misunderstand the information presented. In this case, Polya highlights the importance of success in each stage of problem-solving, so the first step that needs to be done in problem-solving is to understand the problem and see clearly what is needed (Turkoglu & Yalcınalp, 2024), (2) students have difficulty in determining the strategy to be used in problem-

solving when it is difficult to understand the problem, (3) at the completion stage, students have been able to use various strategies and methods, but the methods used are sometimes less precise so that the answers presented are less precise, and (4) checking back, this stage is the most that students do not do, students only focus on the completion stage without checking back the answers and making conclusions. This is in line with the results of research (Yuwono et al., 2018) which states that the mistakes that are often made include not writing conclusions on problem-solving, not re-examining answers, and not carrying out the stages of checking back. The results of research by (Isnaini et al., 2021) show that in solving problem solving problems with Polya's solution steps, students often forget the checking back stage so that there are no students who answer completely according to Polya's 4 indicators on all problem numbers.

Based on the obstacles that students often face in solving math problems, there are several strategic steps that can be applied to overcome these problems. The steps include; (1) evaluation of learning, educators need to evaluate the flow and results of learning that has been carried out to identify the obstacles faced by students, (2) use of effective methods, to improve mathematical problem solving skills, educators can apply a variety of more effective learning methods such as the Creative Problem-Solving (CPS) learning model (Satriani & Wahyuddin, 2018), the Problem-Based Learning (PBL) approach (Febriana et al., 2020; Oktaviana & Haryadi, 2020) and other methods, (3) practice problems, educators should increase the provision of practice problems to students, because the more often they practice, the better student understanding will be (Arrosyad et al., 2023), and (4) the use of appropriate teaching materials, educators can use teaching materials that are in accordance with the level of student understanding (Dewi et al., 2024), to help improve deficiencies in understanding and solving mathematical problems. With the implementation of these steps, it is expected that the obstacles faced by students in solving mathematical problems can be overcome and their ability to solve mathematical problems will increase. Because it cannot be denied that one of the most crucial aspects in the world of education is the application of effective teaching methods (Suparatulatorn et al., 2023)

Conclusion

The results of the analysis of the mathematical problem-solving ability of PGMI students show that the total average mathematical problem-solving ability of PGMI students in semester 3 (three) of the 2024/2025 academic year is 64.4 on high criteria or an average percentage of 64% on high criteria. The distribution of the average percentage of the results of the mathematical problem-solving ability of PGMI students in semester 3 (three) of the 2024/2025 academic year, namely the average percentage of the ability to understand the problem is 81% meeting the criteria of "very high", making a strategy or planning a solution strategy is 75%, this percentage meets the criteria of "high", and implementing problem solving is 83% meeting the criteria of "very high" and the ability to check back or conclude is 0.4% in the criteria of "very low". These results are in line with the obstacles often experienced by students in solving mathematical problems including a lack of understanding of the problem or information presented so that students sometimes incorrectly determine the strategy or problem-solving and often students are less careful to re-examine the answers that have been completed and only focus on the final answer.

The results of this study indicate that the learning methods used by lecturers to support the problem-solving skills of PGMI students are very good, but further evaluation is needed to improve students' ability to solve math problems, especially in re-examining the answers that

have been completed. However, this research is only limited and focused on the analysis process of students' mathematical problem-solving skills, so that the results of this study can be used as evaluation material to improve students' mathematical problem-solving skills better. Thus, future researchers can develop various approaches, models, methods, or learning paths that are more effective so that each step of problem-solving can be completed appropriately.

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