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Exploring Pre-Service Mathematics Teachers' Reasoning Skills in Solving Route Travel Problems: A Real-Life Application of Numeracy

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Abstract: This research highlights the importance of numeracy as one of the indicators in assessing a country's progress. Numeracy bridges mathematical theory with practical application and can be used in everyday decision-making, such as financial decisions, health literacy, and risk assessment. However, the Minimum Competency Assessment results show that more than 50% of students still need to be in the low numeracy competency category. This research aims to explore the mathematical reasoning processes of pre-service mathematics teachers in solving travel route problems to understand their analytical skills. This research uses a qualitative descriptive approach with data collected from 30 fifth-semester mathematics education students at the University of Jambi. Data were obtained through numeracy tests, observations, and semi-structured interviews, allowing in-depth analysis of the participants' mathematical reasoning processes in solving contextual problems. Participants were asked to solve problems related to the context of travel routes, focusing on time and cost efficiency in choosing travel routes. The research results show that most participants can understand and model the problem, although there are differences in their approaches to solving it, ranging from very analytical to simple. Some participants initially misunderstood the problem, but after being given the opportunity for reflection, they were able to improve their understanding and the solutions produced. This research concludes that fostering mathematical reasoning in teacher training programs is crucial for improving numeracy skills. Sustained practice, reflection, and a structured problem-solving approach are necessary to help prospective teachers analyze and interpret mathematical problems more effectively.

Keywords: mathematical reasoning, problem-solving, route travel, and pre-service mathematics teachers.

▪ INTRODUCTION

Numeracy skills are one of the indicators used to assess a country's progress. . Numeracy bridges mathematical theory with practical application and can be used in everyday decision-making, such as financial decisions, health literacy, and risk assessment (Bjälkebring & Peters, 2021; Minhat, 2023). Countries such as South Africa, Turkey, and Norway have recognized numeracy's importance and incorporated it into the education curriculum as a fundamental competency relevant to various disciplines (Bruin & Slovic, 2021; Dewayani et al., 2021; Novita et al., 2023).

The Indonesian Government hopes to strengthen numeracy skills in mathematics learning and other subjects. The Minimum Competency Assessment results show that over 50% of students are still in the low numeracy competency category (Kemdikbud, 2023), especially in understanding and interpreting contextual mathematical problems (Adelia, 2024; Astuti, 2024; Purnomo et al., 2022). This condition indicates that students must improve their ability to apply appropriate problem-solving concepts (Juhaevah, 2022). This limitation is caused by the challenges faced by educators in formulating numeracy problems, especially in creating stimuli and question variations (Pratama &

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Retnawati, 2018; Yusoff & Seman, 2018). As a result, professional programs must be developed to improve teacher competence in teaching numeracy (Purnomo et al., 2022).

This challenge is also faced by educators at the Teacher Training Institution in preparing pre-service mathematics teachers to develop and implement numeracy questions in the classroom through professional training. Before training, educators must anticipate the difficulties and learning paths that students may face. This step is essential for designing effective teaching materials. Therefore, researchers must explore pre-service mathematics teachers' reasoning in real-life contexts, such as travel routes. This context is relevant to developing mathematical reasoning because it requires the integration of various concepts that can improve problem-solving skills and mathematical thinking creativity (Dhlamini et al., 2019; Kosyvas, 2015).

Previous studies have examined mathematical reasoning at the secondary school and college levels. In school research, students are generally categorized based on their reasoning ability level (Arifanti, 2020). In college, pre-service mathematics teachers often struggle with reasoning because of its abstract and complex nature (Coşkun & Yüksel, 2018; Urhan, 2020). They usually use routine procedures and imitative reasoning rather than deep mathematical thinking. This shows the importance of learning that emphasizes the development of deeper mathematical reasoning. This kind of learning will help students understand concepts thoroughly, not just follow existing steps.

In addition, research also emphasizes the importance of mathematical reasoning in strengthening pre-service mathematics teachers' numeracy skills. Integrating real-world problems into mathematics learning can increase student engagement and conceptual understanding. For example, Wijaya et al. (2014) found that context-based learning increased student engagement. This aligns with Schoenfeld (2016) view that emphasizes the importance of deep mathematical thinking for pre-service mathematics teachers in conveying complex mathematical concepts. This approach supports conceptual understanding and prepares pre-service mathematics teachers to teach in various environments (Charlo et al., 2021).

Other studies have shown a strong relationship between computational and critical thinking that is important in mathematics learning (Kannadass, 2023), where improving these cognitive skills is essential for the development of critical thinking skills among pre-service mathematics teachers in designing assessment instruments to hone critical thinking skills, mathematical literacy, and problem-solving skills (Kurniati et al., 2022). In addition, using digital technology and innovative strategies such as problem-based learning and gamification are effective in developing logical thinking skills, increasing motivation, and cooperative learning (Aiym et al., 2022; Charlo et al., 2021).

In previous research, few studies have explored how pre-service teachers solve real-world problems such as travel routes. Most studies focus on routine problem-solving rather than in-depth reasoning (Urhan, 2020). This gap is significant because understanding how pre-service teachers process mathematical information in real contexts can support the development of more targeted training programs, helping them design effective numeracy-based learning.

▪ METHOD

Participants

The participants of this study were 30 fifth-semester mathematics education students of class R-001 from Jambi University, batch 2021. This semester's students consisted of 3 classes, namely R-001 30 people, R-002 32 people, and R-003, 33 people, totaling 95 people. The students were selected using a purposive sampling technique, which was selected based on observations during the lecture process for classes whose students had diverse mathematical abilities. Purposive sampling techniques help identify and select cases that are rich in information, which is essential for exploring complex phenomena (Friska, 2023). The purpose of this study is to explore the reasoning of pre-service mathematics teachers in solving problems in the context of travel routes.

Research Design and Procedure

This study used a qualitative descriptive design because it describes the phenomenon in detail (Moser & Korstjens, 2017) and the participants' in-depth experiences (Bradshaw et al., 2017). This design is appropriate for the study's purpose, which is to explore and understand the reasoning process of prospective mathematics teachers when solving mathematical problems in real-life contexts. The research procedure was divided into several steps.

Preparation: Design a numeracy test based on a travel route problem adapted from AKM questions. Data Collection: Participants were given a numeracy test. As participants completed the test, the researcher conducted observations to monitor their problem-solving approaches. After administering the test, the researcher conducted interviews to investigate their reasoning process and explore how they arrived at their solutions. During the interviews, they were allowed to reflect by reviewing and rethinking the solutions they had worked on. Resolution: Data from the numeracy test results, observations, and interviews were collected and analyzed.

Instruments

The instruments used in this study were numeracy tests and interviews. The numeracy test was about the context of travel routes in Jakarta using various transportation methods, namely KRL, MRT, and ojek online. From the travel route data presented, which is equipped with schedules, times, distances, and costs, students were asked three questions:

1. Determine all alternative travel from Rawa Buntu to Fatamawati that can be taken by Adi using the information provided
2. Determine the truth of the statement: Will Adi save more time if he uses an online motorcycle taxi from Rawa Lepas (near Rawa Buntu Station) to Sekolah Swasta Alam (near Fatmawati Station), using the information provided
3. Determine the minimum cost incurred by Adi from various alternative travel routes from Rawa Buntu to Fatmawati using the information provided.

The test instrument can be seen in picture 1 for more details. In the context of this research, solving mathematical problems involves several steps, as shown in Table 1 (Erita et al., 2022; Marasabessy, 2021; Susanto et al., 2021).

The availability of various transportation services, such as K.R.L. (Electric Rail Train), M.R.T. Jakarta (Jakarta Mass Rapid Transit), and online transportation, has facilitated the public's travel. The fees charged are adjusted to the distance travelled by the service user. Through the map search engine, someone can see various options to get to a place, like the table below.

K.R.L.
(Of the seven Rawa Buntu – Tanah Abang K.R.L. stop stations, four are shown)

Rawa Buntu → Tanah Abang (21 km)

Stasiun	Time
Rawa Buntu	11: 39
Jurang Mangu	11: 48
Kebayoran	12: 00
Tanah Abang	12: 12

Tanah Abang → Sudirman (2,8 km)

Stasiun	Time
Tanah Abang	12: 21
Karet	12: 25
Sudirman	12: 28

The K.R.L. fare for the first 1 – 25 km is IDR 3,000.00 and + IDR 1,000.00 for every subsequent 10 km.

MRT
(Of the 11 stops, six are shown)

Stasiun	Waktu
Sudirman	12: 32
Bendungan Hilir	12: 36
Senayan	12: 40
Blok M	12: 45
Haji Nawi	12: 50
Fatmawati	12: 55

Ojek Online

Tanah abang → Fatmawati (15 km)

Kebayoran → Fatmawati (13 km)

Rawa Buntu → Fatmawati (22 km)

The online ojek rate is IDR 2000.00 per km, with an average travel time of 1 km being 3 minutes.

1. Adi will travel from Rawa Buntu to Fatamawati. Based on the information given in the table, determine all alternative trips that Adi can take!
2. Adi will save more time using an ojek online from Rawa Lepas (near Rawa Buntu Station) to Sekolah Swasta Alam (near Fatmawati Station). Is the statement true? Explain your opinion!
3. Adi travels from Rawa Buntu to Fatmawati. What is the minimum cost that Adi must spend on the various available alternative routes?

Figure 1. Instrument test related to travel routes

Table 1. Mathematical reasoning in the problem-solving process

Problem-Solving Process	Description of Students' Mathematical Reasoning
Understanding the Problem	Students fully grasp the problem, identify known variables and inquiries, and establish connections.
Streamlining the problem	Students analyze the situation, identify essential and non-essential variables, and make realistic assumptions.
Modeling Problems Mathematically	Students correctly create the required mathematical models according to realistic assumptions, explain the models, and relate them to each other.

Problem-Solving Process	Description of Students' Mathematical Reasoning
Solving Math Problems	Students derive accurate solutions from appropriately constructed mathematical models.
Interpreting Problem Solutions	Students interpret mathematical solutions accurately and comprehensively in real-life contexts.
Verifying the Solution's Validity	Students thoroughly verify and correct identified inaccuracies.

Researchers adapted this test from Minimum Competency Assessment questions and validated it by two mathematics education lecturers to ensure its content and construct validity. The semi-structured interview aims to explore the reasoning process of pre-service mathematics teachers in depth. The interview focuses on the following indicators:

Indicator 1: Students' thinking process during understanding the problem by identifying known and asked problems
Indicator 2: Strategies used to simplify and model problems
Indicator 3: Reflection on the problem-solving process

Data Analysis

Data analysis followed Miles & Huberman (1994) interactive model, which focused on understanding participants' reasoning processes. The analysis was divided into three stages: ***Data Condensation:*** Data from the tests, observations, and interviews were summarized and organized. Key reasoning steps and errors were identified for each participant. ***Data Display:*** Data were presented in tables and charts, showing the frequency of reasoning patterns, standard errors, and successful problem-solving strategies. ***Conclusion Drawing and Verification:*** Conclusions were drawn from the data, focusing on reasoning patterns, the influence of reflection on problem-solving, and participants' overall performance. Conclusions were verified by re-examining the test data, observations, and interviews.

▪ RESULT AND DISSCUSSION

Based on the results of the test answers and observations during the test process related to the travel route, pre-service mathematics teachers showed the ability to understand the questions given. However, observations also revealed that they took about 8 to 10 minutes to understand the problem. Although they could create a mathematical model of the problem, there was variation in their thinking process when solving the problem and interpreting the solution. Table 2 shows the mathematical reasoning process of pre-service teachers when solving all questions related to travel routes. The reasoning process of pre-service mathematics teachers in solving each question related to the travel route problem is explained as follows.

Results of the Travel Route Context Test on Question No. 1 Alternative Travel Routes

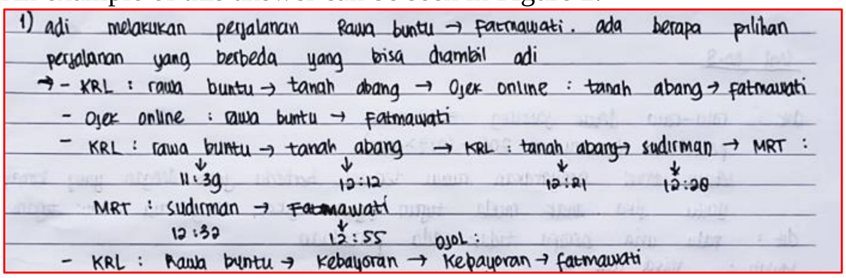
The first analysis focused on the reasoning process of pre-service mathematics teachers in answering question No. 1. In this question, they were asked to determine all

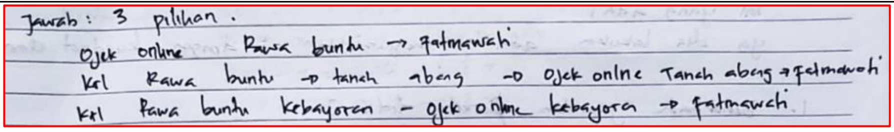
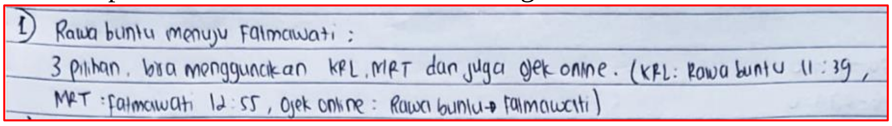
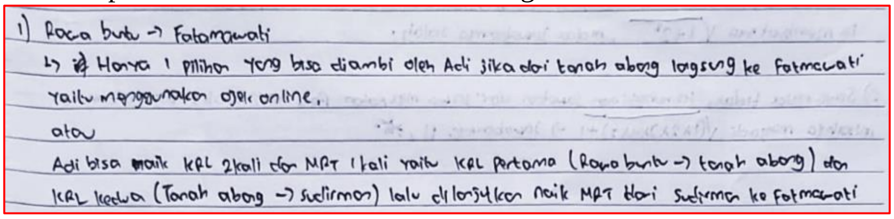
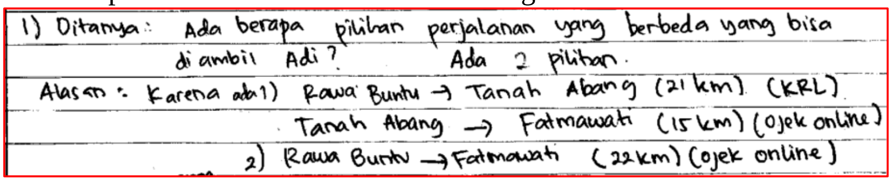
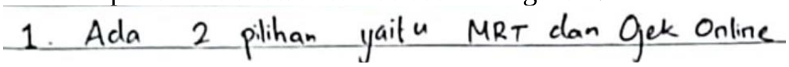
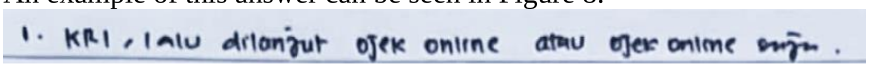
Table. 2 Reasoning process of pre-service mathematics teachers on all questions related to travel routes

Problem Solving Process	The Reasoning Process of Pre-Service Mathematics Teachers in Solving Problems Related to Travel Routes
Understanding the Problem	All pre-service mathematics teachers understood the issue of the travel route context, although it took them about 8 to 10 minutes to understand it.
Streamlining the problem	All pre-service mathematics teachers can identify known and asked information and model the problem mathematically. However, some students still misunderstand what is being asked in the questions.
Modeling Problems Mathematically	All pre-service mathematics teachers can solve problems, but they use various solution methods.
Solving Math Problems	The various problem-solving processes lead to variations in their interpretations.
Interpreting Problem Solutions	All pre-service mathematics teachers reviewed their solution process and felt confident in the steps taken, even though the final result still needed to be corrected.

alternative travel routes that Adi could take from Rawa Buntu to Fatmawati, using the information provided in Figure 1. The student's reasoning process for solving this problem is presented in Table 3.

Table 3. Reasoning process of pre-service mathematics teachers in solving problem no. 1

No	Thinking Process (Reasoning)	Many Students
1	Students answer four choices of travel routes. "Indonesia's online motorcycle taxi service (ojek online)" 1. Ojek online (Rawa Buntu → Fatmawati) 2. K.R.L. (Rawa Buntu → Tanah Abang) to be continued ojek online (Tanah Abang → Fatmawati) 3. K.R.L. (Rawa Buntu → Kebayoran) to be continued ojek online Kebayoran → Fatmawati 4. K.R.L. (Rawa Buntu → Tanah Abang), to be continued K.R.L. (Tanah Abang → Sudirman), and to be continued M.R.T. (Sudirman → Fatmawati) An example of this answer can be seen in Figure 2.  **Figure 2.** Example of the First Alternative Answer to Question Number 1	**12**
2	Students answered three choices of alternative travel routes because they did not find the fourth choice in the first alternative answer. An example of this answer can be seen in Figure 3.	**5**

No	Thinking Process (Reasoning)	Many Students
	 **Figure 3.** Example of the Second Alternative Answer to Question Number 1	
3	Students answered three alternative travel routes using three types of transportation for the trip from Rawa Buntu to Fatmawati: KRL, MRT, and ojek. An example of this answer can be seen in Figure 4.  **Figure 4.** Example of the Third Alternative Answer to Question Number 1	**2**
4	Students answered two choices of travel routes because they did not find the second and third choices in the first alternative answer. An example of this answer can be seen in Figure 5.  **Figure 5.** Example of the Fourth Alternative Answer to Question Number 1	**4**
5	Students answered two choices of travel routes because they could not find the third and fourth choices in the first alternative answer. An example of this answer can be seen in Figure 6.  **Figure 6.** Example of the Fifth Alternative Answer to question number 1	**3**
6	Students answered that there were two options: MRT and ojek online. An example of this answer can be seen in Figure 7.  **Figure 7.** Example of the Sixth Alternative Answer To Question Number 1	**2**
7	They only mention the type of transportation without including the name of the destination. An example of this answer can be seen in Figure 8.  **Figure 8.** Example of the Seventh Alternative Answer to Question Number 1	**2**

The data presented in Table 3 shows significant variation in students' ability to process information and answer questions related to travel routes. The main findings show that most students (12) provided comprehensive answers, covering a combination of transportation modes and appropriate routes. This reflects a strong understanding of analyzing various alternatives based on the information provided. Research supports that this comprehensive processing indicates increased critical thinking skills and deep understanding, in line with the principles of holistic education that emphasize the interconnectedness of knowledge and skills (Mahmoudi et al., 2012; Rianawaty et al., 2021).

In contrast, students who provided limited responses only mentioned the mode of transportation without specifying the route, requiring assistance in understanding the context of the question. Interviews revealed that the students initially misinterpreted the question, thinking that only the mode of transportation was being asked without realizing that alternative routes were also being asked. This shows their need for more understanding of the process. We recognize the importance of encouraging students to reflect on and deepen their understanding of the instructions given. Research shows that students' understanding often increases when they reflect on their knowledge. This emphasizes the importance of time and reflection in effective learning (Pan et al., 2010; Renshaw & Wood, 2011).

Two main aspects emerged from the pre-service mathematics teachers' test answers. First, the ability to process information holistically was seen in students with complete answers and good critical thinking skills. Second, the level of reflection and understanding of instructions, where students who initially misinterpreted the question improved their understanding after reflecting on the information. These findings are consistent with holistic education research, which states that a comprehensive learning approach increases student engagement and understanding (Akmençe et al., 2017; Ojha, 2020). The implications of these findings emphasize the importance of deep understanding and a focus on problem-solving, as students who can identify and analyze information comprehensively tend to provide more accurate and complete answers.

Results of the Travel Route Context Test on Question No. 2 about Efficient Time

The second analysis focused on the reasoning process of pre-service mathematics teachers in answering question No. 2. In this question, they were asked to determine the truth of the statement: Will Adi save more time if he uses an online motorcycle taxi from Rawa Lepas (near Rawa Buntu Station) to Sekolah Swasta Alam (near Fatmawati Station), using the information provided in Figure 1. The student's reasoning process in solving this problem is presented in Table 4.

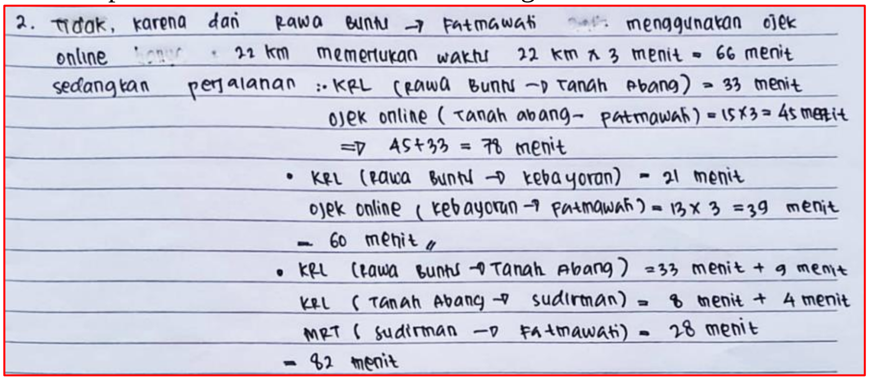
Table 4. Reasoning process of pre-service mathematics teachers in solving problem no. 2

No	Thinking Process (Reasoning)	Many Students
1.	Students can determine four alternative travel routes in No. 1 and choose one of the existing ones: KRL (Rawa Buntu → Kebayoran) followed by an ojek online (Kebayoran → Fatmawati). They calculate the travel time for each route option. From these calculations, they conclude that they do not agree with the statement. According to them, Adi will not save time using an ojek online directly from Rawa Lepas (near Rawa Buntu Station) to Sekolah Swasta Alam (near Fatmawati Station). The most time-saving route is KRL (Rawa Buntu → Kebayoran), followed by an ojek online (Kebayoran → Fatmawati).	**8**

<table>
<tr><th>No</th><th>Thinking Process (Reasoning)</th><th>Many Students</th></tr>
<tr><td></td><td>

1. Ojek online (Rawa Buntu → Fatmawati) = 1 km 3 minutes, 22 km = 22 × 3 minutes = **66 minutes**
2. KRL (Rawa Buntu → Tanah Abang) = 33 minutes, to be continued online (Tanah Abang → Fatmawati) = (15 ×3 minutes = 34 minutes), Total = 33 minutes + 45 minutes = **78 minutes**
3. KRL (Rawa Buntu → Kebayoran) = 21 minutes, to be continued ojek online (Kebayoran → Fatmawati) = (13 × 3 = 39 menit), Total 21 minutes + 39 minutes = **60 minutes**
4. KRL (Rawa Buntu → Tanah Abang) = 33 minutes, to be continued KRL (Tanah Abang → Sudirman) = 16 minutes, MRT (Sudirman → Fatmawati) = 33 minutes, Total= 33 minutes + 16 minutes + 27 minutes = 76 **minutes**

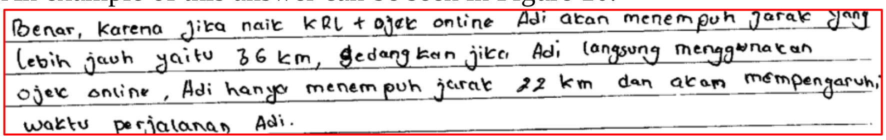
An example of this answer can be seen in Figure 9.



2. Tidak, karena dari Rawa Buntu → Fatmawati menggunakan ojek online 22 km memerlukan waktu 22 km x 3 menit = 66 menit
sedangkan perjalanan :. KRL (Rawa Buntu → Tanah Abang) = 33 menit
ojek online (Tanah abang – Fatmawati) = 15x3 = 45 menit
=> 45+33 = 78 menit
• KRL (Rawa Buntu → Kebayoran) = 21 menit
ojek online (Kebayoran → Fatmawati) = 13 x 3 = 39 menit
= 60 menit
• KRL (Rawa Buntu → Tanah Abang) = 33 menit + 9 menit
KRL (Tanah Abang → Sudirman) = 8 menit + 4 menit
MRT (Sudirman → Fatmawati) = 28 menit
= 82 menit

Figure 9. Example of the First Alternative Answer to Question Number 2
</td><td></td></tr>
<tr><td>2</td><td>

Students stated that ojek online was the most time-saving mode of transportation because the distance between Rawa Buntu and Fatmawati was only 22 km. On the other hand, using the KRL from Rawa Buntu to Tanah Abang, then continuing with an ojek online to Fatmawati, required a travel distance of 36 km. Based on this, they concluded that the shortest distance was the fastest. However, when interviewed, students remained confident that their answers were correct, so they were asked to detail the travel time for each route. After calculating the time, they realized the error in their calculations. This can be seen by comparing the distance and time required for each mode of transportation.
An example of this answer can be seen in Figure 10.



Benar, karena jika naik KRL + ojek online Adi akan menempuh jarak yang lebih jauh yaitu 36 km, sedangkan jika Adi langsung menggunakan ojek online, Adi hanya menempuh jarak 22 km dan akan mempengaruhi waktu perjalanan Adi.

Figure 10. Example of the Second Alternative answer to Question Number 2
</td><td>11</td></tr>
<tr><td>3</td><td>

Students stated that Ojek online is the most economical option. When answering question No. 1, they did not find an alternative route using KRL from Rawa Buntu to Kebayoran, which was continued by ojek online from Kebayoran to Fatmawati.
An example of this answer can be seen in Figure 11.
</td><td>11</td></tr>
</table>

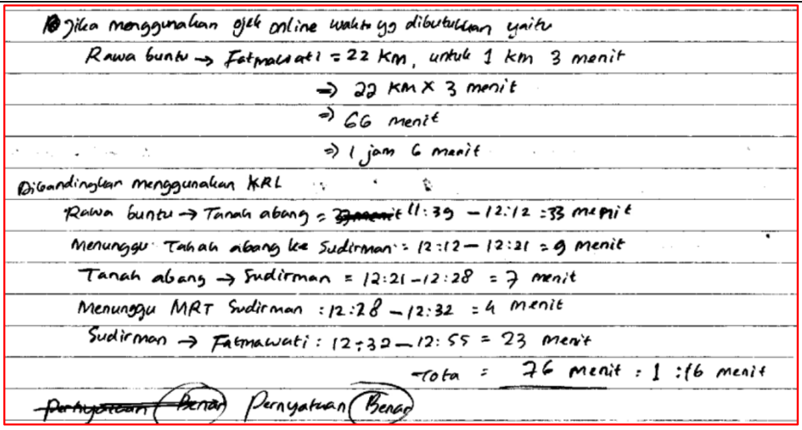
No	Thinking Process (Reasoning)	Many Students
		

Figure 11. Example of the Third Alternative Answer to Question Number 2

Based on Table 4, the analysis of students' reasoning processes in solving travel route problems shows significant variations in their ability to analyze and understand the context of the problem. Some students use a comprehensive approach by evaluating various transportation options, such as combining KRL and ojek online. Their results show that relying on ojek online alone from Rawa Buntu to Fatmawati does not save time compared to routes involving KRL. This supports the idea that solving practical problems in mathematics requires students to consider many variables, not just distance (Kabael & Yayan, 2014).

In addition, students' experiences highlight a common misconception that online motorcycle taxi efficiency is only based on distance without considering travel time, which is affected by speed and mode of transportation. This finding indicates that students often consider several alternatives in decision-making (Rodríguez et al., 2014). Therefore, the role of teachers is important in helping students structure and associate quantities in problem situations, which can improve their problem-solving skills (Kabael & Yayan, 2014).

Furthermore, the limitations of the analysis found in some students, where they did not explore all available travel routes, underscore the variation in analytical skills. Although some of them provide detailed travel time calculations, their conclusions remain inaccurate as they ignore alternative modes of transportation. This situation aligns with travelers' behavior that responds to travel time variability and the importance of considering multiple routes in decision-making (Xu et al., 2012). The complexity of urban travel decisions suggests that an excessive focus on travel time may overlook other important factors that influence route choice (Anastasopoulos et al., 2012).

Overall, the data collected from students showed a spectrum of analytical abilities, with some students considering travel time factors comprehensively, while others focused only on aspects such as distance. This variation in reasoning emphasizes the need for educational strategies that support a holistic problem-solving approach in the context of transportation (Andriyani et al., 2020; Seepiwsiw, 2023).

Results of the Travel Route Context Test on Question No. 3 about Minimum Cost

The third analysis focused on the reasoning process of pre-service mathematics teachers in answering question No. 3. In this question, they were asked to determine the minimum cost incurred by Adi from various alternative travel routes from Rawa Buntu to Fatmawati, using the information provided in Figure 1. The student's reasoning process in solving this problem is presented in Table 5.

Table 5. Reasoning process of pre-service mathematics teachers in solving problem no. 3

<table>
<tr><th>No</th><th>Thinking Process (Reasoning)</th><th>Many Students</th></tr>
<tr><td>1.</td><td>Students calculate the cost of each alternative travel route they choose. In solving problem number 3, there was an increase in the number of students who successfully solved the problem correctly compared to when working on problem number 1. Based on the interview results, they stated that in solving problem number 3, they reread the problem so that they could find additional alternative travel routes. This allowed them to detail the costs for each alternative to accurately determine the minimum price that Adi had to spend for the trip from Rawa Buntu to Fatmawati.

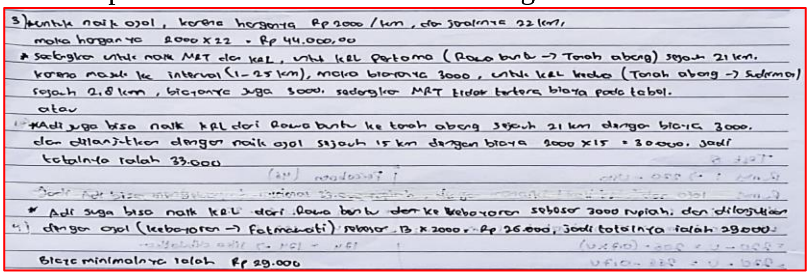
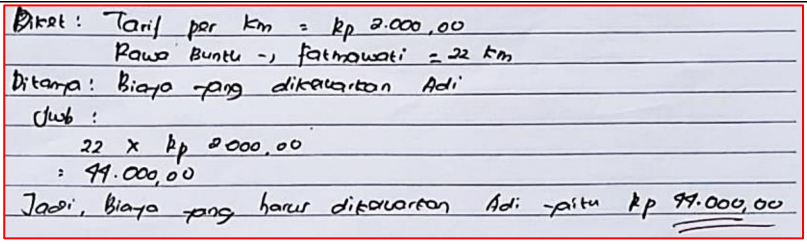
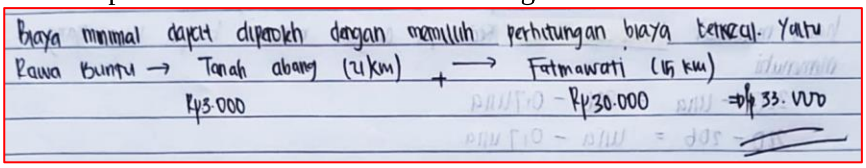
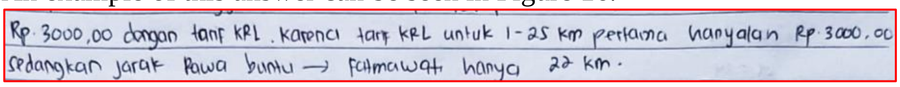
1. Ojek online (Rawa Buntu → Fatmawati) = 1 km = Rp 2.000, 22 km = 22 × Rp 2.000 = **Rp 44.000**
2. KRL (Rawa Buntu → Tanah Abang) = (21 km), 1- 25 km = Rp 3.000, jadi KRL Rp 3.000, to be continued Ojek online (Tanah Abang → Fatmawati) = (15 ×Rp 2.000 = Rp 30.000), Total = Rp 3.000 + Rp 30.000 = **Rp 33.000**
3. KRL (Rawa Buntu → Kebayoran) = < 21 km, 1- 25 km = Rp. 3000, to be continued Ojek online (Kebayoran → Fatmawati) = (13×Rp 2.000 = Rp 26.000), Total Rp 3.000 + Rp 26.000 = **Rp 29.000**
4. KRL (Rawa Buntu → Tanah Abang) to be continued KRL (Tanah Abang → Sudirman) = 23,8 km, 1- 25 km = Rp. 3000, MRT Sudirman → Fatmawati, There are no rates, so prices cannot be determined.
An example of this answer can be seen in Figure 13.


Figure 13. Example of the First Alternative Answer to Question Number 3</td><td>**16**</td></tr>
<tr><td>2</td><td>Students only calculate the cost of ojek online based on the interview results. When answering question No. 2, they assume that ojek online can reach the closest distance. Therefore, to calculate the minimum cost, they only consider the cost of traveling using ojek online.
An example of this answer can be seen in Figure 14.</td><td>**3**</td></tr>
</table>

No	Thinking Process (Reasoning)	Many Students
	 Diket : Tarif per km = Rp 2.000,00 Rawa Buntu -> Fatmawati = 22 km Ditanya : Biaya yang dikeluarkan Adi Jwb : 22 x Rp 2.000,00 = 44.000,00 Jadi, Biaya yang harus dikeluarkan Adi yaitu Rp 44.000,00 **Figure 14.** Example of the Second Alternative Answer to Question Number 3	
3.	Students immediately answered the minimum cost for one route without comparing it with the cost of other routes, so their answers needed to be corrected. When interviewed, they admitted that their answers were based on guesses from several existing alternatives. They gave quick answers because they felt they did not have enough time to calculate the cost of each alternative route. An example of this answer can be seen in Figure 15.  Biaya minimal dapat diperoleh dengan memilih perhitungan biaya terkecil. Yaitu Rawa buntu → Tanah abang (21 km) + → Fatmawati (15 km) Rp3.000 Rp30.000 =Rp 33.000 **Figure 15.** Example of the Third Alternative Answer to Question Number 3	**5**
4.	Students gave the wrong answer because they calculated the distance for ojek online but used the KRL fare. This shows that they need to be more careful when adjusting the type of transportation to the appropriate fare. An example of this answer can be seen in Figure 16.  Rp 3000,00 dengan tarif KRL. karena tarif KRL untuk 1-25 km pertama hanyalah Rp 3000,00 sedangkan jarak Rawa buntu → Fatmawati hanya 22 km. **Figure 16.** Example of the Fourth Alternative Answer to Question Number 3	**3**
5.	There is no answer for question No. 3 because they are still completing questions No. 1 and No. 2 and have not had time to complete question No. 3.	**3**

Based on Table 5, the study shows a significant increase in students' problem-solving abilities, especially in their approach to question No. 3 compared to question No. 1. This increase is related to students' practice of rereading the questions, which allows them to identify alternative travel routes and perform detailed cost calculations for each mode of transportation. This practice aligns with educational theory emphasizing the importance of repeated learning and problem-solving skills in improving student performance (Kónya & Kovács, 2021).

Interviews with students revealed that they felt better prepared to determine the minimum cost for a trip, indicating a relationship between their reasoning process and their ability to effectively analyze transportation options (Ševrović et al., 2015). Despite the overall improvement, some students faced challenges in calculations. Mistakes often occur when students focus only on one mode of transportation, such as ojek online, and ignore alternatives that could result in lower costs. This suggests a cognitive bias, where students assume that the shortest distance will always be associated with the lowest cost, which can lead to suboptimal transportation decisions (Fadyushin & Zakharov, 2022).

In addition, time management issues contributed to incomplete answers, indicating the need for strategies that develop analytical skills and effective time allocation in problem-solving tasks (Wang, 2021). These findings emphasize the importance of comprehensive understanding and detailed calculations in obtaining accurate answers. Students' ability to compare different transportation routes and associated costs reflects the benefits of a structured problem-solving framework in an educational setting.

Such a framework can help students make informed decisions in complex situations, such as urban transportation involving multiple variables (Šipuš et al., 2022). Although students showed significant progress in analytical skills, continued support in time management and critical thinking in comparing alternatives is essential for further improvement in their problem-solving skills (Ali et al., 2021).

▪ CONCLUSION

This study shows that pre-service mathematics teachers can understand and solve contextual problems like travel routes. Although they took time to understand the problems, the findings show variation in students' approaches. Some students demonstrated comprehensive analytical skills, while others struggled with incomplete or imprecise solutions. Most students could model and solve the problems, but many initially misinterpreted the questions and relied on shallow reasoning. However, through repeated reflection and re-evaluation, they produced better solutions. This research highlights the importance of structured mathematical reasoning in teacher training programs and the need for continued practice, reflection, and the development of greater problem-solving skills to strengthen numeracy education.

This study has implications for education by emphasizing the importance of integrating real-world problems into the mathematics curriculum so prospective teachers can develop more applicable and relevant skills. However, this study has limitations, such as a limited sample size for one educational institution and a focus on only one problem context. These limitations may affect the generalizability of the findings, so further research with larger samples and more diverse contexts is needed to obtain more comprehensive results.

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