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Exploring the Decision-Making Process of Pre-Service Teachers in Solving Mathematics Literacy Problems

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Abstract

Students' lack of mathematical literacy skills is also accompanied by the lack of mathematical literacy skills of most pre-service teachers. The purpose of this study is to investigate the decision-making process conducted by pre-service teachers in solving mathematical literacy problems. This qualitative descriptive study involved two subjects taken from 42 pre-service mathematics teacher students. Each subject was identified based on their pattern in solving mathematical literacy problems correctly and inappropriately. Data were collected through tests of mathematical literacy problems and test-based interviews. The results showed that there were differences in the decision-making process done by the students with correct and incorrect problem solving, namely: (1) building ideas, having three vs. two solution ideas, formulating and employing correctly vs. formulating correctly and employing inappropriately; (2) clarifying ideas, giving reasons for each idea vs. having wrong reasons due to calculation errors, interpreting correctly vs. interpreting incorrectly; and (3) assessing the reasonableness of an idea, providing logical reasons with one choice vs. logical reasons with one choice but less sure. Based on the findings, it can be concluded that the creativity of prospective teacher students in building ideas is still low and reasoning in expressing and choosing ideas is still weak, causing immature decision making. The finding of this study provides suggestions for educators to provide structured assignments and for other researchers to find factors influencing pre-service teachers' decision-making in mathematics problem-solving to improve pre-service teachers' decision-making skills.

Keywords: Decision Making, Mathematical Literacy, Problem Solving

Abstrak

Masih rendahnya kemampuan literasi matematis siswa juga diringi dengan kemampuan literasi matematis sebagian besar mahasiswa calon guru yang masih rendah. Tujuan dari penelitian ini mengungkap proses pengambilan keputusan yang dilakukan oleh calon guru dalam menyelesaikan masalah literasi matematis. Penelitian ini merupakan penelitian deskriptif kualitatif dengan dua subjek yang diambil dari 42 mahasiswa calon guru matematika. Masing-masing subjek teridentifikasi menyelesaikan masalah literasi matematis dengan benar dan kurang tepat. Pengambilan data dilakukan melalui tes masalah literasi matematis dan wawancara berbasis tes. Hasil penelitian menunjukkan bahwa terdapat perbedaan proses pengambilan keputusan yang dilakukan oleh mahasiswa dengan penyelesaian masalah benar dan kurang benar yaitu: (1) membangun ide, memiliki tiga vs dua ide penyelesaian, melakukan formulate dan employ dengan benar vs formulate benar dan employ kurang tepat; (2) mengklarifikasi ide, memberikan alasan masing-masing ide vs memiliki alasan yang salah karena kesalahan penghitungan, melakukan interprete dengan benar vs interprate kurang tepat; dan (3) menilai kewajaran ide, memberikan alasan logis dengan satu pilihan vs alasan logis dengan satu pilihan tetapi kurang yakin. Hal ini mengarah pada kesimpulan bahwa kreativitas mahasiswa calon guru dalam membangun ide masih kurang, penalaran dalam mengungkapkan dan memilih ide masih lemah sehingga menyebabkan pengambilan keputusan yang kurang matang. Temuan penelitian ini memberikan saran bagi pendidik untuk memberikan tugas terstruktur dan bagi peneliti lain untuk menemukan faktor-faktor yang mempengaruhi pengambilan keputusan calon guru dalam pemecahan masalah matematika guna mendorong keterampilan pengambilan keputusan mahasiswa calon guru.

Kata kunci: Pengambilan Keputusan, Literasi Matematis, Penyelesaian Masalah

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INTRODUCTION

Covid-19 pandemic has caused drastic changes in various fields. These changes require individuals to have the ability to adapt quickly by using good thinking skills. This is in line with the demands of 21st-century skills that are based on thought processes (Koh, Chai, Wong, & Hong, 2015); one of which is decision making (AACTE & Partnership For 21st Century Skill, 2010; Ontario Ministry of Education, 2016; Dianty, Supeno, & Astutik, 2020). Decision-making is the process of choosing something from a set of alternatives based on given criteria (Wang & Ruhe, 2007). Decision-making is done through a thinking process starting from generating ideas, clarifying ideas, and evaluating the reasonableness of ideas (Swartz & Reagan, 1998; Swartz, Fischer, & Parks, 1998). Decision-making is an important skill to deal with problems that occur unexpectedly, such as the Covid-19 pandemic.

In educational setting, these problems can take the form of questions or mathematical problems related to everyday life. The application of mathematics to real problems is commonly referred to as mathematical literacy (Lange, 2006; Ojose, 2011). The mathematical literacy problems used in PISA consist of real-life contexts (Güler & Çiğdem Arslan, 2019). In solving a contextual problem, there are various mathematical processes that students must go through, namely formulating, employing, and interpreting mathematics in various contexts (OECD, 2013). The words "formulate," "employ," and "interpret" provide valuable and meaningful structures for individuals to connect the context of the problem with mathematics in solving mathematical literacy problems (Apriandi, Murtafiah, Ayuningtyas, & Rudyanto, 2020).

The ability to solve mathematical literacy problems is a complex skill that students need in which students must be familiarized with mathematical literacy problems. PISA results show that the majority of Indonesian students have not yet reached the second level (level 2), and some have not even reached the lowest proficiency level (level 1) for mathematics (OECD, 2013; OECD, 2015; OECD, 2018). Other studies also show that most students still lack literacy skills (Damayanti, Suarsana, & I Putu Pasek Suryawan, 2017). The majority of the students can only answer questions in a standard and familiar context in which all relevant information is available with straightforward questions (Khoirudin, Dwi Styawati, & Nursyahida, 2017). This problem needs to be addressed immediately sought for solutions so that Indonesian students can improve their mathematical literacy skills. It is crucial to prepare students to face the National Assessment in the form of *Assessment Kompetensi Minimum* (Minimum Competency Assessment), designed to measure students' cognitive learning outcomes, literacy, and numeracy (Ministry of Education and Culture, 2020).

One way that can be designed to improve students' mathematical literacy skills is developing the mathematical literacy skills of pre-service mathematics teachers. In order to teach students good mathematical literacy skills, pre-service teachers must have good mathematical literacy skills. However, 56% of pre-service mathematics Indonesian teachers show low ability to solve

mathematical literacy problems. They can only use 1 of 3 mathematical processes, including formulating, using, and interpreting (Apriandi et al., 2020). Apriandi did not explore how the thought process, such as decicion making process in solving mathematical literacy problems, of pre-service mathematics teachers. Therefore, this topic needs to be further explored. Through the decision-making process that will be conducted, it will be possible to know the line of thought by pre-service teachers in solving problems such as mathematical literacy problems (Swartz & Reagan, 1998).

In mathematics education, research related to decision making has been conducted by several researchers, such as Griffith and Groulx (2014), Kosko (2016), Abdillah, Nusantara, Subanji, Susanto, and Abadyo (2016), Murtafiah, Sa'dijah, Chandra, and Susiswo (2019), Murtafiah, Sa'dijah, Chandra, Susiswo, and Zayyadi (2020). Griffith and Groulx (2014) examined the teacher decision-making process where most teachers, regardless of grade level or content area being taught, adopt student-centered beliefs rather than standards-based or curriculum-based practices. Kosko (2016) examined the decision-making process done by pre-service mathematics teachers in giving math questions. Abdillah et al. (2016) examined students' decision-making in solving discount problems starting intuitively, then interactive and continued with analytics. Murtafiah et al. (2019) examined the decision-making of pre-service mathematics teachers in designing ICT-based mathematics learning media. Murtafiah et al. (2020) examined the decision-making process conducted by novice teachers and teachers experienced in designing math problems. However, none of those studies focuses on the decision-making process of pre-service mathematics teachers in solving mathematical literacy problems.

Higher education institutions that produce pre-service teachers must prepare their graduates to become professional teachers. Ministry of Education (2020) states that to become professionals, teachers must integrate decision-making in learning activities. Therefore, pre-service teachers must be equipped with good decision-making skills before teaching their students.Exploration of the decision-making process of pre-service teachers is important. The primary purpose of this study is to explore the decision-making process of pre-service mathematics teachers in solving mathematical literacy problems. The results of this study describe the decision making process conducted by pre-service mathematics teachers as a basis for developing learning tools to ensure that pre-service teachers have good decision-making abilities.

METHODS

This qualitative descriptive research explores the decision-making process of pre-service teachers in solving mathematical literacy problems. The subjects in this study were two students from 42 pre-service mathematics teachers in 3rd semester of the 2020/2021 academic year at PGRI Madiun University. They were selected based on the results of problem-solving tests taking into account their communication skills. The test given was a mathematical literacy problem with a real context, namely

a delivery company. The test is similar to that used by PISA is also a real life context (Güler & Çiğdem Arslan, 2019). The mathematical literacy problem used in this study was adapted from Lestari, Juniati, and Suwarsono (2018), as follows.

The shipping service company has determined the terms of package delivery costs based on the weight and use of package insurance as follows.

i. *If the package weighs no more than 1 kg, the minimum shipping cost is 25,000*
ii. *If the package weighs more than 1 kg, the excess weight of the package will be subject to an additional delivery fee of 5,000 / ounce.*
iii. *Electronic goods must be packed in wooden boxes, and the shipping service provider will do packaging with a packaging fee that is charged in addition to the package delivery cost.*
iv. *If there is an incident in which the package to be sent is lost, the delivery company will replace the lost item a maximum of 10 times the shipping cost. If the goods delivered are more than ten times the shipping cost, it is advisable to insure the package for a fee of 0.2% of the item price and an administration fee of 5,000.*

A customer will send 3,500,000 worth of electronic goods using this delivery service company. The delivery clerk informed him that the packaging cost was 200,000 and that the goods weighed 3.2 kg. a) if you are a delivery clerk, what possibilities will you offer to the customer? b) give the reasons for each of the possibilities you mention! c) of the possibilities you mentioned, which one is the best according to you, give the reason!

The written test results are grouped based on the patterns of answers obtained, namely the group with the correct answer and the group with the incorrect answer. Next, one subject with the best communication skills was selected from each group.

The data obtained from the written test were used to investigate pre-service mathematics decision-making. However, to obtain more complete and in-depth data, semi-structured interviews were also held based on the written test. The interview was based on indicators of the decision-making process according to (Swartz et al., 1998), as in Table 1 below. Thus, in this study, the data collection instruments used were written tests and interviews.

Table 1. Decision making process in solving mathematical literacy problems

Stages of the Decision Making Process	Descriptions
Generating Ideas	List possible options for solving mathematical literacy problems. Decision-makers collect a variety of ideas and can detail each idea so that they can help to find solutions to a given mathematical literacy problem.
Clarifying Ideas	Analyze existing ideas and refer to the idea-building stage. Decision-makers classify and can provide reasons and express assumptions from ideas in solving mathematical literacy problems.
Assessing the reasonableness of an idea	Assess all existing ideas (which have been built and clarified). Assessment can be made based on existing facts or

Stages of the Decision Making Process	Descriptions
	logical and correct principles to determine the correct idea.

Data analysis was conducted through the following stages: data reduction, data presentation, checking the validity of the data, and making conclusions regarding the decision-making process done by pre-service mathematics teachers (Miles, Huberman, & Saldana, 2014). To determine the validity of the data, triangulation techniques were employed, namely comparing the results of a mathematical literacy test with the results of a test-based interview. From the results of the data analysis, the decision-making process of pre-service Mathematics teachers in solving mathematical literacy problems was identified.

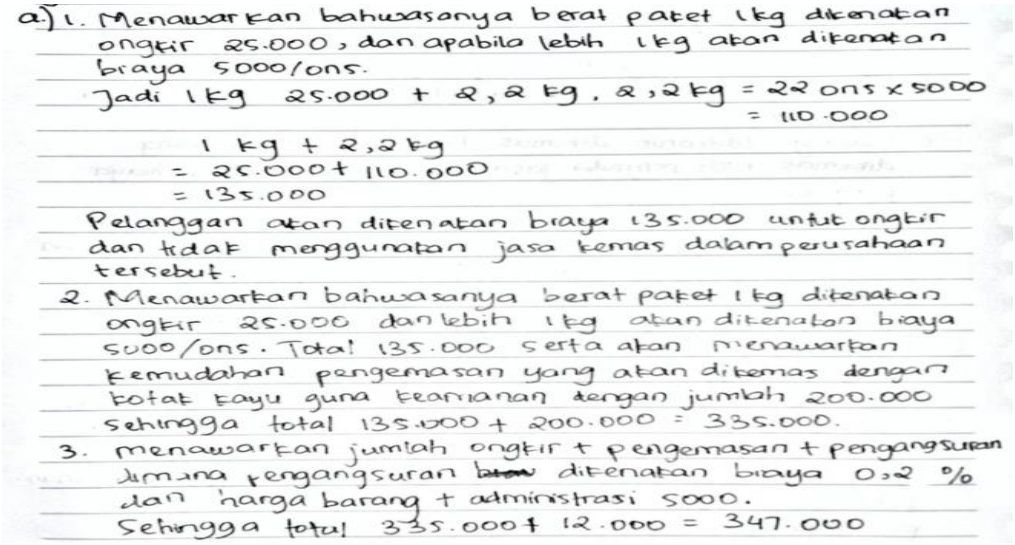
RESULTS AND DISCUSSION

This research was initiated with a mathematics literacy problem test given to 42 pre-service mathematics teachers for the 3rd semester of the 2020/2021 academic year at Universitas PGRI Madiun. The test results showed that 15 (35.71%) pre-service teachers answered correctly, and 27 (64.29%) answered incorrectly. From the study results, the researcher found that there were several patterns of answers. However, in this study, a pattern was selected based on correct answers, namely correct and incorrect answers. Two subjects were selected to represent each decision-making pattern with the initials of ST (Subject with correct answer) and SF (subject with incorrect answer). The subjects' decision-making process in solving mathematical literacy problems is presented as follows.

Decision Making Process with Correct Answers by ST

Generating Ideas Stage

This decision-making process starts from the stage of generating a solution. The ideas built by ST in solving mathematical literacy problems can be seen in Figure 1 below.


a) 1. Menawarkan bahwasanya berat paket 1kg ditentukan ongkir 25.000, dan apabila lebih 1kg akan ditentukan biaya 5000/ons.
Jadi 1kg 25.000 + 2,2 kg . 2,2 kg = 22 ons x 5000
= 110.000
1 kg + 2,2 kg
= 25.000 + 110.000
= 135.000
Pelanggan akan ditentukan biaya 135.000 untuk ongkir dan tidak menggunakan jasa kemas dalam perusahaan tersebut.
2. Menawarkan bahwasanya berat paket 1kg ditentukan ongkir 25.000 dan lebih 1kg akan ditentukan biaya 5000/ons. Total 135.000 serta akan menawarkan kemudahan pengemasan yang akan dikemas dengan kotak kayu guna keamanan dengan jumlah 200.000 sehingga total 135.000 + 200.000 = 335.000.
3. menawarkan jumlah ongkir + pengemasan + pengangsuran dimana pengangsuran ~~biaya~~ ditentukan biaya 0,2 % dan harga barang + administrasi 5000.
Sehingga total 335.000 + 12.000 = 347.000

Translation:

1. *Offers that the 1 kg package weight is subject to 25.000 shipping costs, and if more than 1 kg will be charged 5.000 / ounce.*
   So, 1 kg 25.000 + 2,2 kg . 2,2 kg = 22 ounces x 5000 = 110.000
   1 kg + 2.2 kg
   = 25,000 + 110,000
   = 135,000
   Customers will be charged 135.000 for postage and do not use the company's packaging services.
2. *Offers that the weight of a 1 kg package is subject to 25.000 postage and more than 1 kg will be charged 5000. A total of 135.000 and will offer easy packaging which will be packaged in wooden boxes for security with a total of 200.000 so that a total of 135.000 + 200.000 = 335.000*
3. *Offers the amount of shipping + packaging + installments where the installment is charged 0.2% and the price of goods + administration is 5.000.*

Figure 1. ST generates solution ideas

Figure 1 shows that ST developed a solution by having three ideas. First is offering delivery costs only, second is offering delivery costs and packaging costs, and third is offering delivery costs, packaging, and insurance. The ideas that were built were supported by the following interview quote.

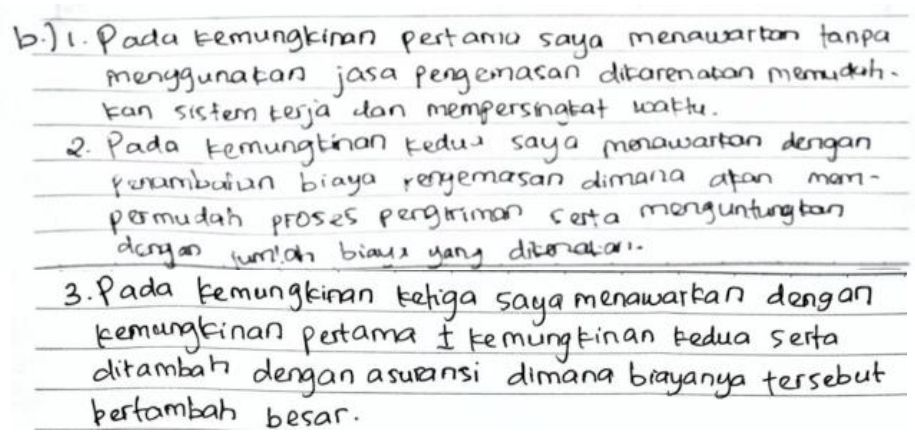
R : *What possibility of ideas that you have to solve this mathematical literacy problem?*
ST_1 : *I have three ideas. First, offering the delivery of a package with delivery cost of Rp.25.000 for 1 kg and additional Rp.5.000/ ounce for a package of more than 1 kg*.
R : *Okay, that is for the first idea. What about the second idea?*
ST_2 : *Second, I offer shipping costs plus the cost of packing the package of Rp.200.000, while the third, I offer it with shipping costs plus packaging costs and insurance costs of 0.2% from the price of the goods and administration fees of Rp.5000.*
R : *I see. Is there any other possibility?*
ST_3 : *No. I do not think so.*

The results of the interview show that ST has 3 possible ideas for solving mathematical literacy problems given (ST_1, ST_2). The results of written tests and interviews show that the idea developed by ST started with the idea of offering delivery costs only, then added with packaging costs, and then

added with insurance and administrative costs. ST developed ideas by providing some possible ideas to solve mathematical literacy problems. This is in line with Swartz and Reagan (1998) and Murtafiah, Sa'dijah, Chandra, and Susiswo (2020), that building ideas can be done by listing ideas or mentioning several ideas. When building this idea, ST formulated, recognized, and identified mathematical structures, to apply mathematical concepts, facts, procedures, and obtain mathematical answers (Apriandi et al., 2020).

Clarifying Ideas Stage

ST clarified the idea she had developed in Figure 1 by providing reasons/explanations related to the choice of his idea, as shown in Figure 2 below.


b.) 1. Pada kemungkinan pertama saya menawarkan tanpa menggunakan jasa pengemasan ditarenakan memudah-kan sistem kerja dan mempersingkat waktu.
2. Pada kemungkinan kedua saya menawarkan dengan penambahan biaya pengemasan dimana akan mem-permudah proses pengiriman serta menguntungkan dengan jumlah biaya yang ditentukan.
3. Pada kemungkinan ketiga saya menawarkan dengan kemungkinan pertama & kemungkinan kedua serta ditambah dengan asuransi dimana biayanya tersebut bertambah besar.

Translation:

1. *In the first possibility, I offer without using packaging services because it makes the work system easier and shortens time.*
2. *In the second possibility, I offer an additional packaging fee which will simplify the shipping process and be profitable with the amount of fees charged.*
3. *In the third possibility, I offer the first possibility + the second possibility and plus insurance*

Figure 2. ST clarifies solution ideas

Figure 2 shows that ST clarified the three possible solutions to the ideas given at the idea-building stage. The clarification made by ST was also conveyed in an interview, which is shown by the following excerpt.

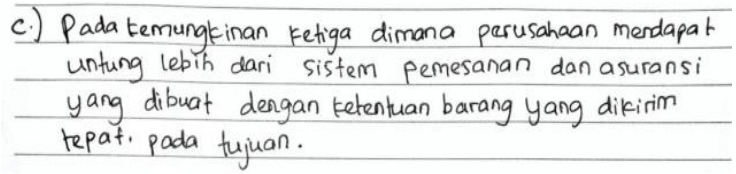
R :*What is your reason for giving the first idea?*
ST_4 :*I offer for package delivery with only Rp.25.000 shipping costs for a weight of 1 kg and an additional cost of Rp.5000 / ounce for a weight of more than 1 kg because I think the offer simplifies the company's work system and takes less time for the delivery process*.
R :*Next, what is the reason for the second idea?*
ST_5 :*Secondly, I offer delivery cost plus packaging fee of Rp.200.000, because in my opinion it will increase the security of the condition of the goods and increase profits with additional packaging costs charged to the sender.*
R :*Okay, what about the third choice?*
ST_6 :*For the third one, I offer it with delivery plus packaging costs and insurance costs of 0.2% from the price of the goods and an administration fee of Rp.5000. The reason is that the safety*

of the goods is guaranteed to anticipate undesirable things and to increase the company's revenue.
R :*Okay. Is there any other reason?*
ST_7 :*No. That is all I have.*

Based on the written test and interview results, ST made the first offer which is the cost of shipping only without using packaging services because it facilitates the company's work system and speeds up the delivery process. For the second possible offer, ST offers delivery costs and packaging costs because the offer will increase the security of the goods and increase the company's profits with the packaging costs charged to the sender. In the third option, ST offers shipping, packaging and insurance, and administration costs because it will guarantee the safety of the goods, anticipate unexpected things and increase the company's revenue. ST's clarification of his ideas is in line with Swartz and Reagan (1998), that clarifying ideas can include providing reasons and expressing the assumptions of the ideas given. When clarifying the idea to solve this problem, ST has interpreted it, which is to reflect on mathematical solutions and interpret them in the real context of everyday life on a given problem (OECD, 2010; Apriandi et al., 2020).

The Stage of Assessing the Fairness of Ideas

ST assesses the reasonableness of ideas related to solving mathematical literacy problems, as shown in Figure 3 below.


c.) Pada kemungkinan ketiga dimana perusahaan mendapat untung lebih dari sistem pemesanan dan asuransi yang dibuat dengan ketentuan barang yang dikirim tepat pada tujuan.

Translation:
c) *In the third possibility where the company gets more profit from the ordering and insurance system that is made with the condition that the goods are sent right to the destination.*

Figure 3. ST assesses the fairness of solution ideas

ST provided a logical reason for her final choice. ST evaluated the reasonableness of the idea by providing logical reasons regarding the best choice in her opinion. This reason is also conveyed in the following excerpt.

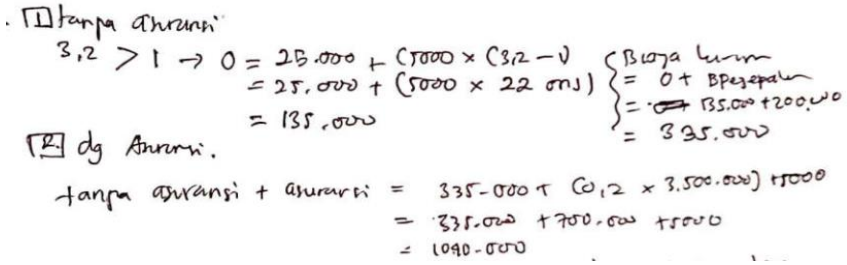
R : *Of the three possibilities you mentioned, which one do you choose as the best solution to this mathematical literacy problem?*
ST_8 : *I choose the third option*.
R : *only one choice? Why*?
ST_9 : *Yes, the third option. Because the company will gain the highest revenue from this option. Beside that, the company does not want to take any risk if undesirable things happen to the goods during the shipping process*.
R : *are you sure? Is there any other reason?*
ST_{10}: *Yes, I am sure. The goods being delivered indeed will be in the safest condition and will arrive on time.*

Based on the written tests and interviews, ST chose the third idea by offering shipping, packaging, and insurance costs to get more profit with the goods being sent safely and arriving on time. In assessing the reasonableness of this idea, ST made predictions based on the logical reasons. This is in line with Murtafiah et al. (2019) that in assessing the reasonableness of an idea, a person has confidence in his choice based on the given logical reason. Students have formulated, employed, and interpreted mathematics in solving mathematical literacy problems (Apriandi et al., 2020; Lestari et al., 2018).

Decision-Making Process with Wrong / Inaccurate Answers by SF

Generating Ideas Stage

SF made decisions in solving mathematical literacy problems. This decision-making process began at the stage of building a ideas. The ideas developed by SF can be seen in Figure 4 below.



Translations:

1 *Without insurance*
3,2 >1 ⟶ 0 *= 25.000 + (5000 x (3,2-1)*
= 25.000 + (5000 x 2,2 ons)
= 135.000

Shipping cost
= 0 + packing fee
= 135.000 + 200.000
= 335.000

2 *With insurance*
Without insurance + insurance = 335.000 – (0,2 x 3.500.000) + 5000
= 335.000 + 700.000 + 5000
= 1.040.000

Figure 4. SF Generates solution ideas

SF developed the idea by having two solutions: shipping goods without insurance and shipping goods with insurance. The following interview excerpt also supported the ideas developed by SF.

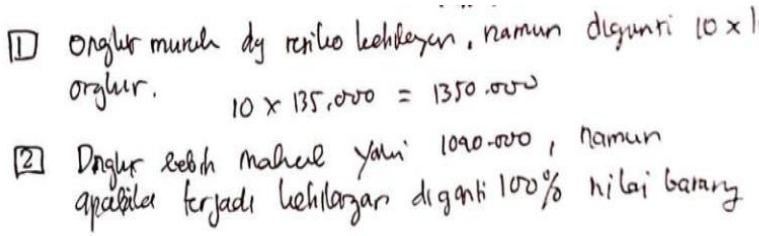
R : *What are the possible ideas that you have to solve this mathematical literacy problem?*
SF_1 : I have two possible ideas.
R : *I see. What are they?*
SF_2 : *The first is without insurance, and the second is with insurance.*
R : *Can you explain further?*
SF_3 : *So, the one without insurance, the sender will pay the delivery cost and the packaging cost. At the same time, the second option is the one with insurance where the sender will be charge for the insurance fee times 0,2 plus Rp.5000.*
R : *I see. So, because of the insurance cost of 0,2%, will the cost be directly times 0,2?*
SF_4 : *yes. Directly times 0,2 and added by Rp.5000.*
R : *Okay. Is there any possible other idea?*

SF_5 : *No. I think that's all.*

From the written tests and interviews, SF had two possible ideas for solving mathematical literacy problems (SF_2, SF_3). For the first option, SF offered shipping and packaging costs with a total cost of Rp. 335,000, -. For the second option, SF offered the addition of insurance costs, but when calculating the insurance costs, SF made the mistake of directly multiplying 0.2 by 3,500,000, whereas it should have been 0.2% = 0.002 (SF_3, SF_4). This error resulted in the possibility of the second solution being wrong. At this stage, SF developed ideas by having more than one possible idea, although they were not as many as those developed by ST. This is in accordance with the opinion of Swartz and Reagan (1998), that in building an idea a person has several variations of ideas and is related to one's creativity. SF developed problem-solving ideas in everyday life using mathematical concepts. This is in line with Ojose (2011) that mathematical literacy is the application of basic mathematics in everyday life. SF can formulate, able to recognize and identify using mathematical structures (Apriandi et al., 2020). However, SF cannot employ the problem well because it makes a miscalculation for the second option. This also contradicts the OECD (2013) statement that employers are done by applying mathematical concepts, facts, and procedures so that they get mathematically correct answers.

Clarifying Ideas Stage

SF clarified the idea by giving reasons/explanations, as shown in Figure 5 below.



Translations:

1 *Cheap postage with the risk of loss, but replaced 10 times the postage*

10 x 135.000 = 1.350.000

2 *It is more expensive, which is 1,040,000, but if it is lost, it is replaced with 100% of the value of the goods.*

Figure 5. SF clarifying solution idea

The interview excerpt also supported the clarification of the idea conducted by the SF as follows.

R : *What is your reason for giving the first and second possible solution ideas?*

SF_6 : *The first solution is because it is affordable for the sender, although there is a possibility of good being lost during the delivery. However, the company has still replaced as much as ten times the delivery cost, although it is not fully replaced.*

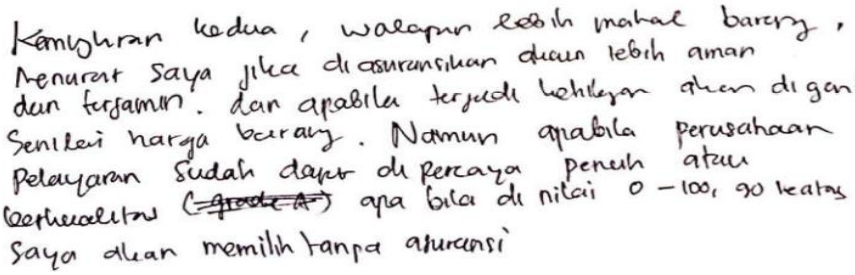
R : *I see. So you think that the cost can lighten the sender. Then, does it include the packaging cost?*

SF_7 : *of course, it is the shipping and packaging fees.*
R : *Okay. What about the reason for the second option?*
SF_8 : *for the second option, the delivery cost is more expensive because of the additional insurance cost. However, if the good is lost, the money can be refunded 100%.*
R : *Okay. Is there any other reason?*
SF_9 : *I think that's all I have.*

The results of written tests and interviews show that SF provided the reason for the first choice, the low cost for the sender where the shipping and packaging costs with the risk of losing being replaced by 10 x 135,000, resulting in 1,350,000. For the reason of the second option, the shipping cost is much more expensive for the sender, which is 1,040,000, but if the good is lost, it is replaced 100% of the value. For the second reason, SF made a miscalculation, thereby affecting the reasons given. Giving reasons at the stage of clarifying this idea is in accordance with Swartz and Reagan (1998) and Murtafiah et al. (2020), that clarifying ideas is done by conducting analysis by providing reasons for each idea given. At this stage, SF performed an interpretative, which can reflect on mathematical solutions and interpret them in the real context of everyday life on a given problem (OECD, 2013), even though there are calculations that are still wrong.

The Stage of Assessing the Fairness of Ideas

SF assessed the reasonableness of the solution idea by choosing the reasons as shown in Figure 6 below.


Kemungkinan kedua, walaupun lebih mahal barang, menurut saya jika di asuransikan akan lebih aman dan terjamin. dan apabila terjadi kehilangan akan di ganti senilai harga barang. Namun apabila perusahaan pelayaran sudah dapat di percaya penuh atau berkualitas (~~grade A~~) apa bila di nilai 0 – 100, 90 keatas saya akan memilih tanpa asuransi

Translation:
The second possibility, even though the goods are more expensive, I think if it is assumed that it will be safer and more secure and in the event of a loss it will be replaced at the price of the goods. However, if the service company is fully trusted or qualified if it is assessed, 0 -100 , 90 and above I would choose without insurance.

Figure 6. SF assessing the reasonableness of idea

SF evaluated the reasonableness of the idea by choosing the second option, but SF also provided another option: the first choice was by adding other logical reasons. The following interview results supports SF's assessment of the reasonableness of the idea.

R : *Of the two possible ideas you mentioned, which one do you choose to be the best solution to this mathematical literacy problem?*
SF_{10} : *I chose the second one because even though it was more expensive than the first. If the*

item is lost, it will be refunded according to the value of the item.
R : *Really? Isn't it too expensive?*
SF_{11} : *Yes. But the lost item will be refunded if it happens.*
R : *Okay. Are you sure about choosing the second choice?*
SF_{12} : *Yes. But if the shipping company is already trustworthy, I will choose the first option.*
R : *Okay. So, which one is you more sure about?*
SF_{13} : *The second option since the quality of the shipping company is yet to be known*.

From the written tests and interviews, SF assessed the reasonableness of the idea of completion by choosing the second possibility, which is offering to use insurance. However, SF provided another option, choosing the first possibility as long as the shipping company is trustworthy. This shows that SF is less confident in assessing the reasonableness of ideas. In line with Murtafiah et al. (2019), SF made predictions based on logical reasons even though SF was not sure about his choice. There is a complex relationship between the belief system and problem-solving implications. Understanding what the person believes cannot guarantee that the correct problem-solving process will be conducted (Muhtarom, Juniati, & Siswono, 2017). At the stage of assessing the reasonableness of the idea, SF formulated it correctly but did not employ and interpret it correctly. Students with low math abilities have inadequate or incomplete mathematical literacy skills (Khoirudin et al., 2017; Apriandi et al., 2020).

ST as a pre-service teacher with the correct solution and SF as a pre-service teacher with an incorrect solution have a different decision-making process in solving mathematical literacy problems. Many factors influence a person's decision-making, including knowledge formed by experience (Lestari, Juniati, & Suwarsono., 2019; Borko et al., 2008) and background, beliefs, goals, and situations (Borko et al., 2008). Furthermore, Borko et al. (2008) mentioned that gender is included as part of the background. The findings of this study strengthened the view that gender may be one of the factors that causes differences in people's decision-making. This is evident in the data presented in Table 2.

Tabel 2. The numbers of students with right and wrong solution

Gender Differences	Right Solution	Wrong Solution
Male Students	0	20
Female Students	15	7
Total	15	27

The data in Table 2 above show that female pre-service teachers are better at finding the solution, which means that they may also have better decision-making skills. This result is in line with Murtafiah, et al. (2020), that female math teachers and senior male math teachers have different decision-making processes in designing math problems. In addition, the results of Sa'dijah et al. (2021) also show that there are differences in the decision-making process between male and female

teachers in teaching HOTS to students. Thus, there is a need for consideration, one of which is gender differences in providing structured assignments so that pre-service Mathematics teachers can make the best decisions for a mathematical problem. The finding of this study implies that educators should provide structured assignments to assist pre-service teachers in making good-decisions. It also provides suggestions for other researchers to find factors that can influence pre-service teachers' decision-making in mathematics problem solving to improve pre-service teachers' decision-making skills.

CONCLUSION

There are differences in the decisions made by pre-service mathematics teachers with correct and incorrect solutions. Students with correct solutions had three solution ideas in building problem-solving ideas, while students with in correct solutions had two solution ideas. Students with the correct solutions formulate and employ the problem correctly, while students with incorrect solutions do not formulate correctly and employ the problem less precisely. Students with correct solutions give their respective reasons according to logic at the stage of clarifying ideas, while students with incorrect solutions gave wrong reasons due to calculation errors. Students with correct solutions interpret correctly, while students with incorrect solutions do not interpret properly. When assessing the reasonableness of an idea, students with correct solutions gave logical reasons with one best choice. In comparison, students with less precise solutions gave logical reasons with one choice even though they were less sure. The differences in the decision-making process also provide differences to the final determined solution. The finding of this study implies that educators should provide structured assignments to assist pre-service teachers in making good decisions. It also provides suggestions for other researchers to find factors that can influence pre-service teachers' decision-making in mathematics problem-solving to improve pre-service teachers' decision-making skills.

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