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Mathematics Pre-Service Teachers' Numerical Thinking Profiles

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Abstract: Numerical thinking is needed to recognize, interpret, determine patterns, and solve problems that contain the context of life. Self-efficacy is one aspect that supports the numerical thinking process. This study aims to obtain a numerical thinking profile of Mathematics pre-service teachers based on self-efficacy. This study used descriptive qualitative method. The data obtained were based on the results of questionnaires, tests, and interviews. The results of the self-efficacy questionnaire were analyzed and categorized (high, moderate, and low). Two informants took each category. The results showed the following: informants in the high self-efficacy category tend to be able to interpret information, communicate information, and solve problems with systematic steps. Informants in the moderate self-efficacy category tend to be able to interpret and communicate information, but tend to be hesitant in choosing the sequence of problem-solving steps. Meanwhile, informants in the low self-efficacy category tend not to be able to fully interpret the information. As a result, the process of communicating information and solving problems goes wrong. Another aspect found in this study is the need for experience optimization, a good understanding of mathematical content, and reasoning in the numerical thinking process.

Keywords: *Numerical thinking, reasoning, self-efficacy.*

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Introduction

Numeracy is needed by every individual in solving various problems related to everyday life. The numeracy needs of each individual differ depending on living conditions and the social context they face (Angermeier & Ansen, 2020). To be able to have good numeracy requires knowledge of mathematics and its application in the context of life (Tout, 2020). The use of mathematics in real life requires the ability to recognize, interpret, determine patterns and relationships, and use mathematical tools to help solve problems (Gravemeijer et al., 2017). A person who has a good numeracy not only knows and uses efficient methods, but is also able to evaluate, analyze situations, and draw conclusions (Goos et al., 2014). Adults with higher numeracy tend to have higher problem-solving rates (Xiao et al., 2019).

Problems that are frequently encountered are problems in solving mathematics that contain artificial contexts and the use of mathematical concepts to solve real-world problems (Verschaffel et al., 2020). The results of previous studies showed that most of the pre-service teachers had difficulty in providing answers related to numeracy (Stables et al., 2004). There is a substantial difference in numeracy skills between high and low achieving students (Hall & Zmood, 2019). Students have difficulty in applying mathematical and statistical concepts in the context of life (Lloyd & Frith, 2013). These results indicate that numeracy needs to be a concern for pre-service teachers.

Numeracy is the ability to identify, apply, communicate mathematical understanding and procedures, and manage problem-solving situations in life contexts (Geiger et al., 2015; Liljedahl, 2015; Nortvedt & Wiese, 2020; Prince & Frith, 2020). In another definition, numeracy means accessing, using, and critically reasoning about mathematical content represented in various ways to manage the mathematical demands of various situations in adult life (Tout, 2020).

According to the Program for the International Assessment of Adult Competencies (PIAAC Numeracy Expert Group, 2009) numeracy behavior involves situations in real contexts related to mathematical content through cognitive processes and is represented in various ways. Real context is related to individual, social, work, or further learning

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problems (PIAAC Numeracy Expert Group, 2009; Tout & Gal, 2015). The form of representation is presented in text or symbols, images of physical objects or objects, structured information, and dynamic applications (Tout, 2020).

The ability to solve real-life problems cannot be separated from the affective factors possessed. These factors include: self-efficacy (Begum et al., 2021; Gatobu et al., 2014), numeracy motivation (Persson et al., 2021), learning independence (Shodiqin et al., 2021), mathematical anxiety (Angermeier & Ansen, 2020), and others. According to the Organization for Economic Co-operation and Development (OECD, 2012), willingness, capacity to survive, confidence, positive attitude towards mathematics, and the ability to overcome mathematical problems are needed in learning mathematics that involves numeracy.

The results of previous studies showed that 40% of students who took the numeracy test were unsure of the correct answer and 20% assumed the answer was wrong (Forgasz et al., 2017), there is lack of confidence in providing their numeracy experience (Campbell et al., 2020), and there is a need for self-efficacy in teaching mathematics (Bjerke & Solomon, 2020). Pre-service teachers have inconsistent self-efficacy scores on understanding math content (Norton, 2019). These results show that apart from numeracy, self-efficacy also needs attention for pre-service teachers.

When mathematics self-efficacy is low, it will affect reading comprehension and problem-solving skills (Öztürk et al., 2019). The results of previous studies show that self-efficacy predicts numeracy performance (Gatobu et al., 2014), mediates numeracy (Begum et al., 2021), and contributes to basic numeracy performance (Gatobu et al., 2014). This shows that there is a relationship between self-efficacy and numeracy.

A person who has good self-efficacy tends to: survive in adversity (Bandura, 1997), exert all efforts (OECD, 2013), devote time, energy, and develop various strategies (Li et al., 2020). In addition, they are able to interpret the results obtained (Hammad et al., 2020).

Self-efficacy is a person's belief to learn and act in a certain way to achieve goals that lead to successful outcomes (Šorgo et al., 2017; Tak et al., 2021; Unrau et al., 2018). A person who has self-efficacy can be seen in beliefs about their abilities before solving problems (Kirbulut & Uzuntiryaki-Kondakci, 2019).

There are three dimensions of self-efficacy: level, strength, and generality dimensions (Bandura, 1997). The level dimension is related to confidence in solving problems with various levels of difficulty. The strength dimension is related to individual belief in surviving various problems. The generality dimension is related to the belief to predict the effectiveness of the problem-solving steps taken.

Based on the problems discussed above, numeracy is an important skill to have, particularly when solving real-life problems and understanding the relationship between self-efficacy and numeracy. The aim of this study was to obtain a numerical thinking profile of Mathematics pre-service teachers based on self-efficacy.

Methodology

Research Design

The design in this study is a descriptive qualitative research design by describing the student's numerical thinking process based on the self-efficacy category. This study aims to obtain a numerical thinking profile for Mathematics pre-service teachers based on the self-efficacy category.

Sample and Data Collection

The data of this study were taken from the third semester students of Mathematics Education, Muhammadiyah University of Purwokerto, Indonesia. It involved thirty-three participants as research subjects. Six research samples were then selected using purposive sampling technique from these thirty-three research subjects. Purposive sampling is a sampling technique from data sources with certain considerations (Sukestiyarno, 2020). The concern in this study is to select samples with the criteria of high, moderate, and low self-efficacy. Research subjects (informants) were given a code to make it easier to analyze the data.

The self-efficacy questionnaire was developed based on the dimensions of level, strength, and generality (Bandura, 1997) which were adapted according to the purpose. 24 statements were used using a scale of 1 to 10, where 1 stated not sure, and 10 stated very sure. The development of test instruments and interview guidelines to obtain numerical thinking data refers to standardized tests (OECD, 2016b; PIAAC Numeracy Expert Group, 2009; Tout & Gal, 2015) which are adapted according to the objectives.

Expert judgment validates the numeracy test instrument and is declared eligible to be used to obtain data according to the purpose. Then, the researchers conducted a limited trial of the research instrument. The results of the validity test show that the numeracy questions are included in the valid and reliable categories. Meanwhile, expert judgment in the field of psychology validated the interview guide and self-efficacy questionnaire.

Analyzing of Data

Data analysis used descriptive analysis method, i.e., analyzing data by describing the data obtained to obtain a numerical thinking profile based on self-efficacy. Data was collected using self-efficacy questionnaire data which was divided into 3 categories, high, moderate, and low. Research subjects were given a numeracy test. The test results data from the selected informants were used as the basis for conducting in-depth interviews. The data analysis step was carried out using test results and in-depth interviews to be grouped, reduced, presented, and hypothesized (Sukestiyarno, 2020). Data credibility test uses triangulation test by comparing data from numerical thinking test results and in-depth interviews.

Findings/Results

This study started with collecting students' self-efficacy data using a questionnaire to 33 informants. Table 1 below is related to the results of the self-efficacy questionnaire.

Table 1. Informants Based on Self-Efficacy Questionnaire Data

No.	Informants	Score (S)	Category
1.	WJ, ZT, ZA	S > 185	High
2.	SN, MS, RI, EA, AO, SI, SS, LI, DF, ZJ, PA, AS, AM, HN, RP, DL, IA, SA, EN, ZH, ND, AS, SN, MM	141,5 ≤ S ≤ 185	Moderate
3.	DA, IW, AS, SD, DV, DS	S < 141,5	Low

Two informants were taken from each category to get a numerical thinking profile based on the self-efficacy category. The six informants were: WJ, ZT, ZH, SN, IW, and DV.

Numerical thinking profile was obtained based on test results, interviews with 6 informants, and documentation of informants' worksheets. There are three indicators used to measure numerical thinking, namely: interpreting information, communicating information, and solving problems. Interpreting information is characterized by the ability to select and interpret important information in a problem. The indicator of communicating information is characterized by the ability to present the information obtained in the form of an appropriate representation (pictures/mathematical symbols). The indicator of solving problems is characterized by the ability to determine the sequence of steps and methods of solving problems in order to obtain a solution. The following test questions are used to obtain a numerical thinking mathematics profile for pre-service teachers.

> There is a plot of land in the shape of a right triangle on the outskirts of the city that is to be planted with grass. The circumference of the ground is 108 m. The lengths of the sides have the same difference. If the costs incurred to plant grass is Rp24.300.000.-, then how much does it cost to plant grass per m^2?

Figure 1. Numerical Thinking Process Test Questions

The results of the tests and interviews were then compared and analyzed to get a picture of the numeracy ability profile of Mathematics pre-service teachers. The results of tests and interviews with informants are described below.

High Self-Efficacy Category

To find the length of one of the sides of a triangle, WJ uses the known perimeter of the triangle and the information that the sides of a right triangle are equidistant. Based on this information, suppose the three sides are a, a + b, and a + 2b. This process produces one side of the triangle, i.e., a + b = 36. To get the difference between the sides of the triangle, WJ uses the Pythagorean theorem. Using the Pythagorean theorem, the difference between triangles is 9. Using the substitution method, we get the other two sides of the triangle. After the three sides are obtained, the next step is to determine the area of the triangle and the cost to plant grass per m^2. Figure 2 below is the result of WJ's work.

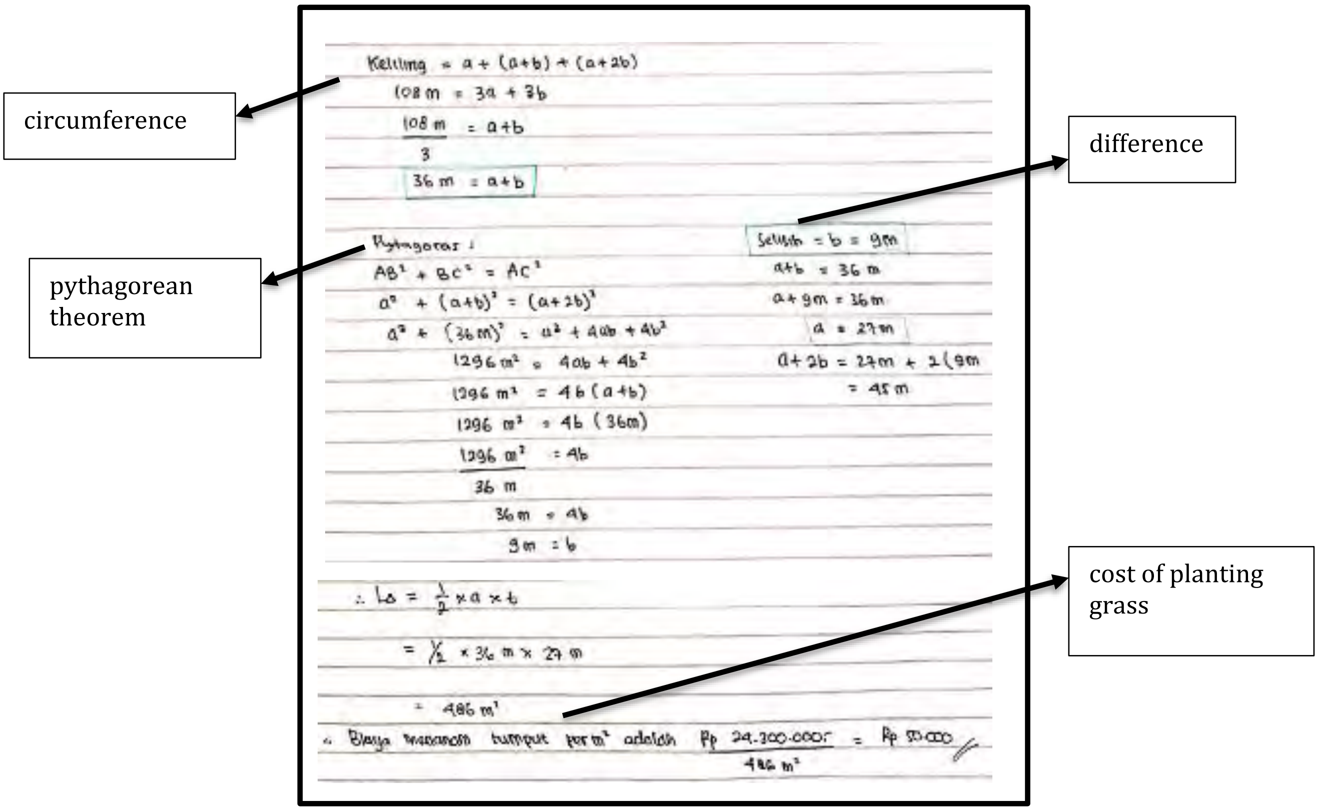

Figure 2. WJ's Response to the Test Item

WJ is able to use the information in the question well. Selection of the method is able to get the desired results. This informant took 4 steps, i.e., using the concept of circumference to determine one side of a right triangle, the Pythagorean theorem to get the difference between the sides of the triangle, substitution into the equation obtained using the concept of circumference, and the area of the triangle.

ZT represents information in the form of a right-angled triangle. The image of a right triangle provides information on the lengths of the three sides of a right triangle. By using the concept of the perimeter of a right triangle, ZT ensures that the three sides obtained match. The next process is to determine the area of the triangle as shown in Figure 3. To determine the cost of planting grass per m^2, the informant uses the area of a triangle and the total cost. ZT divides the total price by the area of the triangle.

circumference = AB + BC + AC
= 27 m + 36 m + 45 m
= 108 m
cost of planting grass = Rp24,300,000
D_2 : cost of growing grass per m^2

$$D_2 = \frac{\text{cost of growing grass}}{\text{surface area}}$$

Surface area (right triangle shape)
Lb = 486 m^2

$$\text{cost per m}^2 = \frac{\text{Rp } 24{,}300{,}000}{486 \text{ m}^2}$$

cost per m^2 = Rp50,000

∴ so the cost of planting grass per m^2 is Rp50,000

Indonesian translation

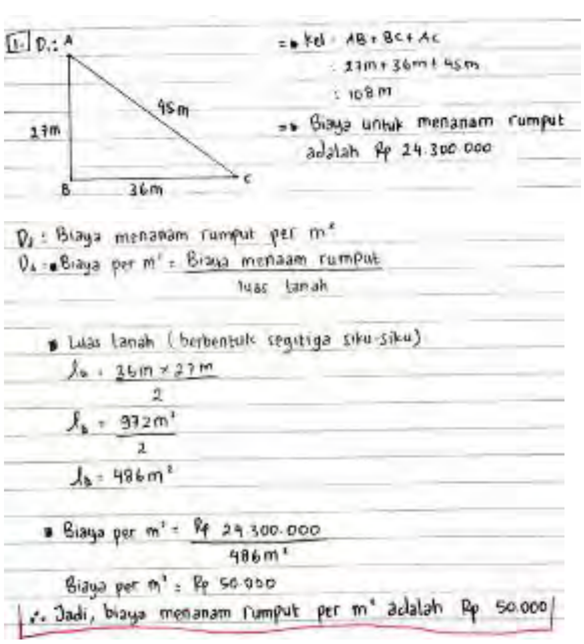

Figure 3. ZT's Response to the Item

The method used by ZT to find the three sides of a right triangle differs from that used by WJ. ZT allegedly uses the concept of side comparison of a right triangle to get all three sides. This is reinforced based on the results of interviews with ZT. The following is an excerpt from an interview with ZT.

P : How do you get all three sides of a right triangle?

ZT : By using the ratio of the sides of a right triangle (3:4:5)

P : What's the next step?

ZT : Dividing 108 by 3 gives 36. Dividing 36 by 4 makes the difference equal to 9. To get the other two sides multiply 9 by 3 and 5.

P : Are you sure about your answer?

ZT : Very sure.

Despite the differences in the processes, both informants were successful in resolving the problem. ZT's process tends to be faster and simpler. This informant only uses the concepts of comparison, perimeter, and area of a right triangle to get the desired results.

Moderate Self-Efficacy Category

ZH writes down the information in the problem verbally and assumes the three sides of a right triangle with u1, u2, and u3. This informant uses a right triangle with sides u1, u2, and u3. The informant assumes u1 with a, u2 with a + b, and u3 with a + 2b. ZH process tends to be less systematic as shown in Figure 4. When looking for the length of the shortest side, the informant substituted the difference between the sides of a right triangle. The process of working to determine the difference between the sides of a right triangle is written on the right of the process of determining the shortest side. However, the final result written is correct. After finding the three sides, the next process is to determine the area of the triangle and the cost of planting grass per m^2.

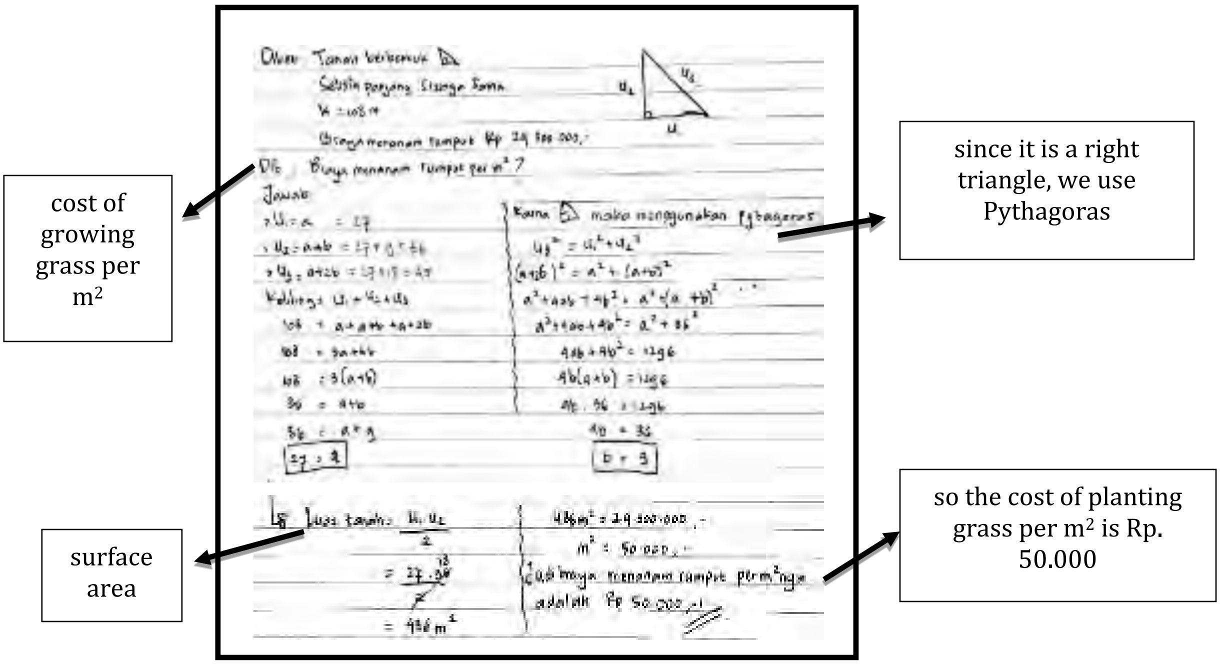

Figure 4. ZH's Response to the Item

Below are the results of the interview with ZH.

P : How do you get all three sides of a right triangle?

ZH : Suppose the three sides of a right triangle are u1 = a, u2 = a + b, and u3 = a + 2b. Using the concept of circumference, we get a + b = 36. To get the value of a, we use the Pythagorean theorem and substitute the result for the equation a + b = 36.

P : What is the next process?

ZH : The next process is to determine the land area and the cost of planting grass per m^2.

Meanwhile, SN writes down the information using a right triangle, with the three sides being x, x + y, and x + 2y. The first step is to calculate the second side of the triangle using the perimeter concept. The second side is 36. The informant uses the previous results to determine the length of the difference between the sides of the triangle. The process used tends to be the same as other informants (WJ and ZH). The informant uses the Pythagorean theorem to determine the difference and substitute the results into the equation x + y = 36, as shown in Figure 5. The next process is to determine the area of the triangle and the cost of planting grass per m^2. The informant gets the correct results according to the problem. During the interview, the informant stated that he was unsure of the order in which the steps should be completed. However, those doubts gradually diminished after finding the three sides of a right triangle.

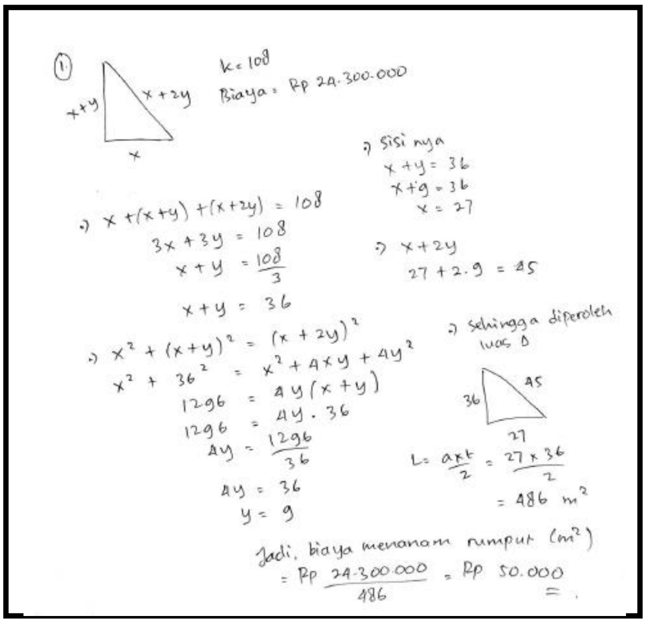

Figure 5. SN's Response to the Item

Low Self-Efficacy Category

IW tends to only use information that all three sides of a triangle are equal to determine the three sides. By assuming the difference between the three sides is 3, the three sides of the triangle are 33, 36, and 39. The informant forgot that the triangle in the problem is a right triangle. The next step is to determine the area of the triangle and the cost of planting grass per m^2 as shown in Figure 6.

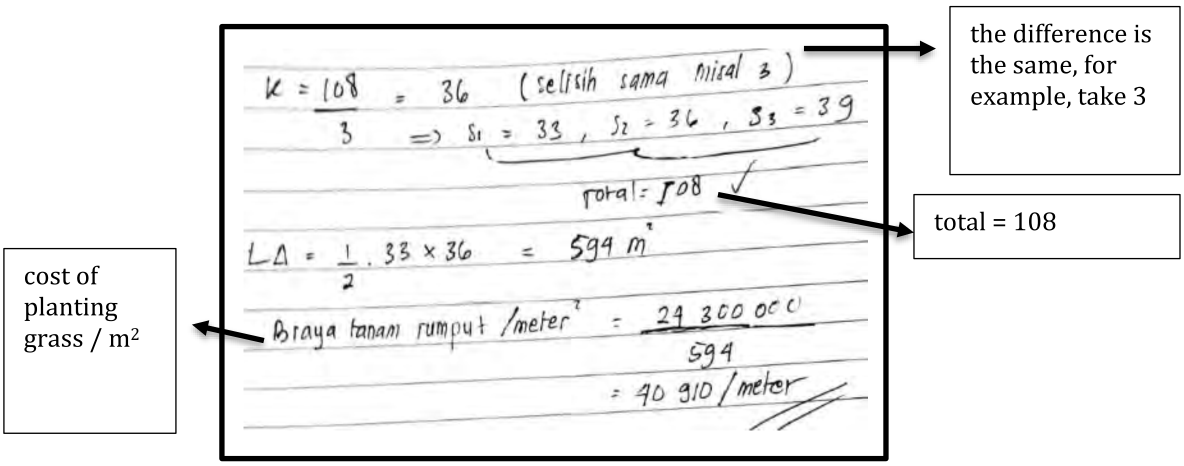

Figure 6. IW's Response to the Item

These results are strengthened based on the results of interviews with IW. The following is an excerpt from an interview with IW.

P : How do you get all three sides of a right triangle?

IW : Using the same difference information, then divide the perimeter of the triangle by 3. The shortest side is subtracted by 3, and the longest side is added by 3.

P : Why take the difference of 3 instead of anything else.

IW : Perhaps we can use a difference other than three.

P : Are you sure about your answer?

IW : Not sure about the answer given.

P : What to do when faced with a difficult problem.

IW : I will work on it my best

According to the findings of this interview, IW exhibited a lack of understanding and interpretation of the information contained in the questions as a whole. The informant tends to have a poor understanding of the concept of right triangles. Errors in understanding the information as a whole result in errors in the next process and make the results wrong. The informant feels unsure of the answers that have been given.

Just like IW, DV allegedly did not understand the full information. DV divides the perimeter by 3, so that the second side is 36. The informant uses an image representation of a right triangle with three sides, i.e., 34, 36, and 38 (Figure 7). By using the difference of 2, two other sides are obtained, i.e., 34 and 38. These results are used by the informants to determine the area of a right triangle and the cost of planting grass per m^2. Due to the wrong initial process, the final result obtained is wrong.

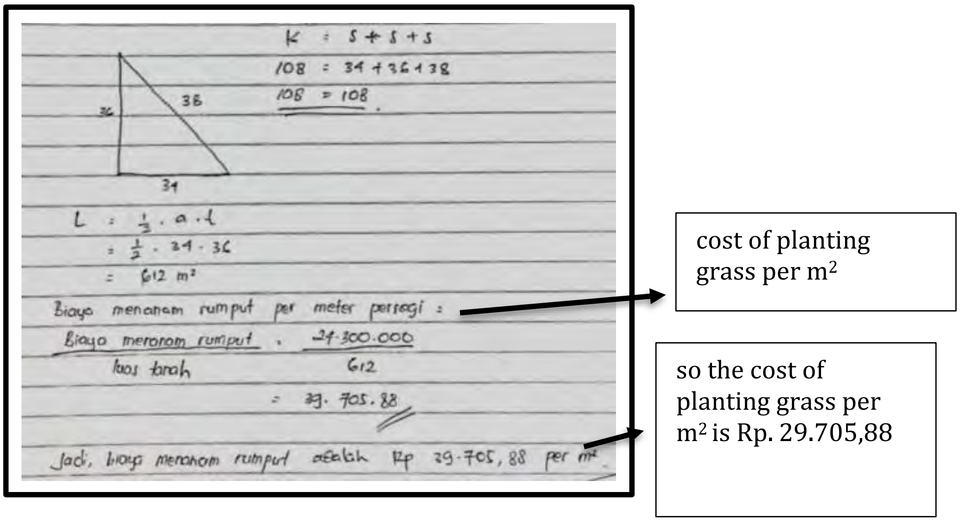

Figure 7. DV's Response to the Item

IW and DV interpret the difference as equal to dividing the length of the circumference by 3. The results obtained are used by the two informants as the second side. Because the difference is the same, the two informants subtract the second side and add to get the third side. Table 2 presents the numerical thinking process of each informant.

Table 2. Description of the Numerical Thinking Process of Each Informant

Informants	Interpreting Information	Communicating Information	Solving the Problem
WJ	Information on the length of the perimeter of a right triangle and the three sides having the same difference is used to determine the second side of a right triangle Using the Pythagorean theorem based on the information that the soil is a right triangle	Representing perimeter and right triangle information using mathematical symbols	Determining the second side based on the information about the perimeter of a right triangle Finding the difference between sides using the Pythagorean theorem Determining the area of the triangle and the cost per m^2
ZT	The informant uses the comparison of the three sides of right-angled triangles to make it easier to understand the problem	Using mathematical symbols and pictures to facilitate problem-solving.	Using the ratio of the sides of a right triangle, determine the three sides Determining the area of the triangle and the cost per m^2

Table 2. Continued

Informants	Interpreting Information	Communicating Information	Solving the Problem
ZH	Almost all the information in the questions is written verbally Changing the form of representation from verbal to mathematical symbols Doing double math symbolization	Using mathematical symbols and pictures to facilitate problem-solving. The writing of the completion steps looks less systematic	Using two instances Determining the second side using the information about the perimeter of the triangle Using the Pythagorean theorem to find the other two sides. Determining area and cost per m^2
SN	Assuming the three sides of a right triangle using the information in the problem. Using the Pythagorean theorem based on information on the area of the land in the form of a right triangle	Using pictures and mathematical equations to solve problems	Finding the second side using the perimeter of the triangle Using the Pythagorean theorem to find the difference between the sides of a right triangle Determining area and cost per m^2
IW	Dividing the length of the perimeter by 3 based on the information that the ground is a right triangle. Supposing the difference is equal to 3 based on the information that the three sides have the same difference.	Using mathematical symbols by assuming the three sides of a right triangle with the difference is 3	The meaning of incomplete information causes errors in the problem-solving process The final result is wrong due to an error in the initial process of completion
DV	Dividing the length of the perimeter by 3 based on the information that the ground is a right triangle. Supposing the difference is equal to 2 based on the information that the three sides have the same difference.	Using the image of a right triangle with each side difference equal to 2	Incomplete meaning making of an information causes errors in the problem-solving process The final result is wrong due to an error in the initial process of completion

Table 2 shows that each informant in various categories of self-efficacy has different tendencies in solving numeracy problems. WJ, ZH, and SN use almost the same settlement pattern. In interpreting information about the difference between the sides of a right triangle, the three informants use symbols and images of right triangles to represent them in form. They use the concept of perimeter and the Pythagorean theorem to get all three sides of a right triangle. ZT uses the ratio of the sides of a right triangle to get all three sides. IW and DV divide the perimeter of the triangle by 3. Then, the results are used to get the shortest and longest sides. The incomplete meaning process causes errors in determining the completion steps. The numerical thinking profile based on the self-efficacy category is presented in Table 3.

Table 3. Numerical Thinking Profile Based on Self-Efficacy Category

Category	Interpreting Information	Communicating Information	Solving the Problem
High	Being able to interpret information well	Representing information in the form of symbols and images well	Troubleshooting with sequential steps Using comparisons to facilitate problem-solving
Moderate	Being able to interpret information well	Representing information in the form of verbal, symbols, and pictures well	Some informants solve problems with less systematic steps.
Low	Misinterpreting information	Representing information in the form of symbols and images is not appropriate	Due to misinterpreting the information, the problem-solving process produces the wrong final result

Table 3 shows that the profile of numerical thinking differs depending on self-efficacy. The higher the self-efficacy category, the better at interpreting information, the ability to choose and present the correct form of representation, and the ability to choose and use the correct method of problem-solving.

Discussion

Several factors are thought to influence differences in numerical thinking profiles. The ability to interpret information is regarded as a critical factor and the first step in numerical thinking. Failure to interpret the information will result in errors in subsequent numerical thinking indicators. Informants in the high and moderate self-efficacy categories tend to have no difficulty in interpreting the information as a whole. Meanwhile, low category informants tend not to be able to fully interpret the information. This finding is consistent with a previous study, which found that numeracy performance is partly dependent on the ability to read and comprehend texts (OECD, 2016a). The ability to comprehend text has an impact on understanding, reasoning, and communicating numeracy issues (Gal et al., 2020). The numerical ability will improve as more information is interpreted (Evans et al., 2017).

The ability to interpret information is thought to be linked to reasoning ability. Reasoning improves the process of understanding the problem and assessing the sufficiency of information (Saleh et al., 2018). Individuals with good reasoning will use their ability to process information selectively (Persson et al., 2021).

The ability to interpret information must be accompanied by understanding and application of mathematical content in the context of the problems at hand. The better the understanding of mathematical content, the more precise the use and solution of the problem will be (Kolar & Hodnik, 2021; Nurwahyu et al., 2020). Their mathematical understanding is a predictor of their numeracy (Reder et al., 2020). When there is a lack of understanding of mathematical content, the process of communicating in various forms of representation and problem-solving is flawed. This supports the findings of previous studies in which misconceptions about problems affect the process and outcomes of problem-solving (Ansari et al., 2021). This problem occurs in informants with low self-efficacy category. In the low self-efficacy category, they only focus on the length of the difference in the triangle without paying attention to the relationship between the lengths of the sides of a right triangle. As a result, the result of measuring the length of the triangle's side is incorrect.

The choice of the form of representation used will be influenced by the understanding of the information (Napitupulu et al., 2016). Almost all informants used pictures and mathematical symbols to present information and design problem-solving based on their understanding of the information contained in the questions. However, the presentation of the form of representation is incorrect due to poor interpretation of information on informants in the low self-efficacy category. The images and sizes presented are out of sync, rendering the images meaningless. The symbols and images used in this lesson represent numeracy behavior in various situations (OECD, 2016b; PIAAC Numeracy Expert Group, 2009; Tout & Gal, 2015). Furthermore, their ability to present in verbal, graphic, tabular, or symbolic forms will have an impact on their numeracy skills (Prince & Frith, 2020).

In the problem-solving process, informants in the high and moderate self-efficacy categories tend to be able to solve problems correctly. However, the problem-solving process appears less systematic in the moderate category. Meanwhile, in the low self-efficacy category, the process and results of problem-solving are incorrect because they begin with the interpretation of inaccurate information. The ability to understand the context of information, choose, use methods, and explore is required for a systematic problem-solving process. The process of solving numeracy problems requires the ability to choose, use methods, analyze situations, and evaluate the results obtained (Goos et al., 2014). In addition, it requires an understanding of the context and the ability to explore (Geiger et al., 2015).

Solving numeracy problems requires the ability to reason critically about the data and the context of the problem (Lloyd & Frith, 2013). Reasoning will help in the process of comparing, identifying patterns, choosing the right method, making connections, verifying, and drawing conclusions (Beatty & Thompson, 2012; Bronkhorst et al., 2020; Jeannotte & Kieran, 2017; Saleh et al., 2018; Tak et al., 2021). Thus, the success of numerical thinking must be supported by good reasoning abilities. When the reasoning ability possessed is not optimized, it will affect the process of interpreting information, communicating information, and planning problem-solving strategies.

In addition to the ability to understand, apply to mathematical content, and reasoning, success in numerical thinking processes based on self-efficacy aspects is thought to be influenced by experience. The greater one's self-efficacy, the more likely one is to optimize experience in solving problems that have a life context. Informants experience gives them confidence in writing important information, predicting completion steps, and selecting a more systematic settlement method. These findings support previous studies, which found that experience is one of the factors that influence a person's sense of self-efficacy (Al Sultan, 2020; Bandura, 1995; Gao, 2020; Kandil & Işıksal-Bostan, 2018; Sadi & Dağyar, 2015; Šorgo et al., 2017).

Owned self-efficacy provides calm, persistence, the ability to interpret information and results well, and the courage to take the most appropriate strategy to solve problems in the context of life. These findings are consistent with previous research that found self-efficacy helps reduce mathematical anxiety (Macmull & Ashkenazi, 2019; Rozgonjuk et al., 2020), helps achieve predetermined goals (Doğru, 2017), helps self-confidence in decision making (Falco, 2019), and helps interpret the outcomes of actions taken (Hammad et al., 2020).

Conclusion

Self-efficacy has an impact on the process of numerical thinking. The higher category of self-efficacy makes the better numerical thinking process. The indicator of interpreting information becomes the main indicator in the numerical thinking process. If this process is weak, it will have an impact in the next process. Optimizing experience, strengthening mathematical content, and reasoning become an important part in the process of interpreting information, communicating information in the form of an appropriate representation, and solving problems. When the understanding of mathematical content is weak, the meaning of information becomes incomplete and the form of representation presented is wrong. Then, when reasoning is not used, decision making is incorrect.

This study's practical implications are to provide knowledge for Mathematics pre-service teachers to always maintain and improve their self-efficacy in supporting the numerical thinking process. Mathematics pre-service teachers always optimize their experience, understanding of mathematical content, and reasoning in order to improve the numerical thinking process.

Recommendations

Almost all problems that exist in everyday life require a mathematical thinking process in solving it. The process of numerical thinking is needed in solving various problems that contain everyday life situations. Numerical thinking needs to be developed and accustomed to both learning and non-learning. In addition to knowledge factors related to mathematical content, self-efficacy is needed in numerical thinking. Further research is needed regarding the factors that influence the process of numerical thinking and its implementation in classroom learning and various problems of daily life in various contexts. Because of the importance of self-efficacy, other studies can look at it from a different angle, i.e., from the dimensions of self-efficacy.

Limitations

The limitation of this study is related to the profile of numeracy abilities which is only based on the category of self-efficacy. Meanwhile, it is possible that many other factors also influence a person's numerical thinking process. This study focuses on 3 categories of self-efficacy, i.e., high, moderate, and low. In addition, due to the COVID-19 pandemic, conducting online interviews made the character of each informant less exposed.

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Authorship Contribution Statement

Subekti: Conceptualization, design, data analysis, and writing. Sukestiyarno: Securing funding and critical revision of manuscripts. Wardono: Securing funding and critical revision of manuscripts. Rosyida: Securing funding and critical revision of manuscripts.

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