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How Pre-Service Elementary Teachers Deal with Mathematical Literacy Problems? A Case Study

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ABSTRACT
Pre-service elementary teachers (PSETs) must understand in-depth mathematical concepts and procedures. Still, they must also improve their mathematical ability and skills in solving mathematical problems and applying them in all aspects of life. Such mathematical capacity is known as mathematical literacy. This study aimed to describe the mathematical ability of PSETs in solving mathematical literacy problems. The mathematisation process carried out by PSETs is the main focus that will be observed and explored. Some Errors and obstacles PSETs face in struggling to solve mathematical literacy problems are also described. This study is expected to make a valuable contribution to designing learning or other professional development programs for PSETs related to mathematical literacy. The qualitative method with a case study design was used in this research. Data were collected using tests (the sequences of PISA and PISA-like problems in moderate and most difficult levels) and interviews from 77 PESTs of the primary teacher education program at a private university in Banda Aceh. The results showed that the ability of PSETs in solving mathematical literacy problems was still low. Most of them are still very constrained in formulating real-life problems into mathematics. However, the lack of knowledge of related mathematics topics also needs to be considered.

Keywords: *Mathematical literacy, Pre-service elementary teachers, PISA-like problems.*

1. INTRODUCTION

Pre-Service Elementary Teachers (PSETs), as future teachers, must have a deep understanding of mathematical concepts and procedures, the ability and skills to use both in solving mathematical problems and their application in all aspects of life also need to be improved [1]. Such mathematical abilities and skills are closely related to mathematical literacy [2]–[4]. The importance of mathematical literacy possessed by PSETs was to ensure and support mathematical literacy-oriented learning at the elementary level [5], [6]. This is in line with the projected orientation of 21st-century education, where literacy (including mathematical literacy) must be developed and integrated into Indonesian education [7]–[9]. The importance of the teacher's role in building and developing mathematical literacy in the education of their students is a very strong reason that the mathematical literacy of PSETs must also continue to be developed and improved in teacher education programs or institutions [10]–[13]. This condition is further strengthened by the data from research conducted by PISA, which shows the literacy ability of Indonesian students is still low in each year of implementation. This forces us to make various efforts to improve student literacy, one of which is to prepare prospective teachers who have qualified literacy skills to help develop students' mathematical literacy.

Literacy is generally defined as: "*Literacy is the ability to identify, understand , interpret, create, communicate and compute, using printed and written (and visual) material associated with varying contexts.*"[14]. This understanding defines literacy as the ability to identify, understand, interpret, create, communicate and calculate, using printed and written (even visual) materials related to various contexts. This is following the etymological definition of literacy which means (1) the ability to read and write; and (2) competence or knowledge in a particular field" [15].

Literacy in mathematics is often termed mathematical literacy. NCTM as the initiator of mathematical literacy within the framework of the vision of mathematics education to make students mathematically literate interprets mathematical literacy

as "*an individual's ability to explore, to conjecture, and to reason logically as well as to use a variety of mathematical methods effectively to solve problems. By becoming literate, their mathematical power should develop*" [16]. This definition tells us that at the beginning of the emergence of mathematical literacy, it only required logical reasoning in solving problems (mathematics). But over time, the meaning of mathematical literacy also develops and is often associated with a person's ability to identify and understand problems in which mathematics plays a role in all spheres of life [4], [10], [17]–[21].

OECD, which stands for Organization for Economic Co-Operation and Development (OECD), also provides a clear definition of mathematical literacy and uses this definition as the basis for the assessment and analytical framework of the Program for International Student Assessment (PISA). Although the definition presented by the OECD underwent several changes in the period 1999-2021, this definition remains the reference for the definition of mathematical literacy that is commonly used by some studies [22].

The definition of mathematical literacy in the PISA 2021 framework presented by the OECD emphasizes problem-solving and reasoning abilities in its assessment [19]. The mathematical literacy constructs used in this new 2021 framework demonstrate an individual's capacity to reason mathematically and solve problems in a variety of 21st-century contexts. Mathematical literacy is not considered synonymous with minimal or low-level knowledge or skills [19], [23]. Instead, it is intended to describe an individual's capacity to reason mathematically and solve problems using mathematical concepts, procedures, facts, and tools to describe, explain and predict phenomena.

To become mathematically literate, the students must be able to use mathematical content knowledge to recognize the mathematical nature of a situation (problem), especially situations encountered in the real world, and then formulate it in mathematical terms. This transformation of real-world situations requires mathematical reasoning. After the transformation is successful, the resulting mathematical problems need to be solved using mathematical concepts, algorithms, and procedures taught in schools. Therefore, it is true that mathematical reasoning can be observed in the process of formulating, using mathematical concepts, procedures, facts, and tools, and interpreting everyday life problems [19].

Reasoning in solving problems through formulating, employing, and interpreting real-world problems into mathematics was known as mathematization [24]. This process (see Figure 1) is essential in mathematical literacy. Its implementation of the choice of method or representation depends on the situation or context of the problem to be solved. Therefore, students need to experience problem-solving processes in different situations and contexts to use their skills effectively [20], [25]–[28]. Therefore, prospective teacher students at the basic education level, especially in elementary schools, must have knowledge and skills in creating mathematical literacy-based learning where the mathematization process is the primary process in learning.

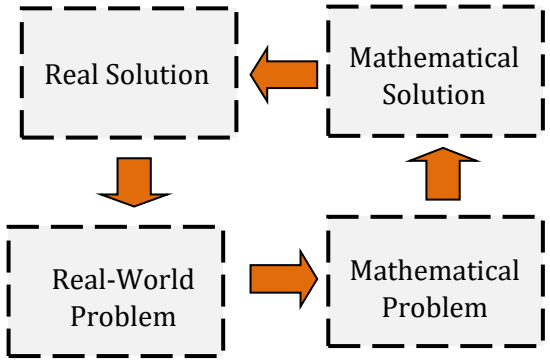


Figure 1. mathematisation cycle (OECD, 2009)

There are some studies and surveys which state that the mathematical literacy of teachers in primary education still experiences obstacles and limitations [10], [11], [13], [29]–[31]. This circumstance motivated us to explore further the current state of PSETs' mathematical literacy. We believe that this description may serve as a foundation for building support programs or planning appropriate learning for them. Therefore, this research is considered important to be carried out to enrich the literature related to the obstacles and difficulties faced by PSETs related to mathematical literacy. The results of this study can contribute to efforts to improve the mathematical literacy of PSETs and design courses that are oriented towards mathematical literacy. We need to say that this research is preliminary research of our primary research to develop mathematical literacy-oriented learning for students.

2. METHODS

This study uses a qualitative method with a case study design. The selection of a case study design with a holistic type [32], [33] is used to examine and describe various field findings related to the research question, namely how the mathematical ability of PSETs in solving problems related to mathematical literacy, as well as what obstacles they face in doing so. The mathematisation process carried out by PSETs is the main focus that will be observed and described in this paper. The approach taken in this research emphasizes more on interpretive studies for data analysis.

The subjects of this study were 77 pre-service elementary teachers in the second year of the primary teacher education program at a private university in Banda Aceh, Indonesia. Therefore, we expected that they would be interested in mathematics and want to learn more about it. The data were collected through test and structural interviews about mathematical literacy. The test contained four items of mathematical literacy problems, which was adopted from PISA questions [34] and Pisa-like questions developed by several researchers [35], [36]. The four problems consist of two questions at the moderate level (levels 3&4), and the other two include questions at the most difficult level (levels 5 and 6). All questions from each of the four content categories tested by PISA are change and relationships, space and shape, quantity, uncertainty & data. We translate the PISA questions in Bahasa first before being tested on PSETs.

Analysis of the data used in this study is a descriptive qualitative analysis using the Miles et al. model [37], which consists of data reduction, data display, conclusion drawing, and verifying. To analyze the process carried out by PSETs in solving PISA problems, we use a mathematisation process framework proposed by the OECD 2012 as shown in Table1.While Table 2 attempts to depict the categories of the mathematising process based on student responses to mathematical literacy problems.

Table 1. Framework for Analyzing PSETs Answer related to Mathematising Process

Mathematical Literacy	
Indicators for mathematising	
Formulating *situations mathematically*	Identify the underlying mathematical variables and structures in the real-world problem, and make assumptions so that they can be used
Employing *mathematical concepts, facts, procedures, and reasoning*	Conceptualize the problem mathematically or interpret the solution within the context of the original problem (may be needed in problems whose major emphasis is on employing)
Interpreting, applying, and evaluating *mathematical outcomes*	Understand the extent and limits of a mathematical solution that is a consequence of the mathematical model employed

Source [38]

At the data reduction stage, we try to classify students' answers and their reasons, respectively. The coding process is carried out using the Nvivo 12 Plus software systematically.

At the data display stage, we try to present data or information that has been arranged to draw conclusions and take action. Various representations such as graphs or screenshots of PSETs' answers regarding the mathematization process are presented to give a clear picture of the results obtained.

Table 2. Framework For Classifying PSETs Answer Related to Mathematising Process.

Level	***Student Responses to Problems***
High	▪ Students identify variables and mathematical structures that underlie real problems or make appropriate and correct assumptions to use. ▪ Students use the correct concept or interpretation of the context correctly from the given problem and succeed in applying it**.** ▪ Solutions built by students are correct and able to connect the solutions found with the problem correctly.
Middle	▪ Students identify variables and mathematical structures that underlie real problems or make assumptions but are incomplete or still limited. ▪ Students use the correct concept or interpretation of the context correctly from the given problem but fail to apply it (e.g., wrongly doing calculations) ▪ Solutions built by students are correct but are unable to connect the solutions found with the problem**.**
Low	▪ Students identify mathematical variables and structures that do not make sense or do not answer at all. ▪ Students use concepts or misinterpret concepts from the context to solve problems or do not answer. ▪ The solution developed by students is incorrect or does not provide a solution at all based on the model developed.

In the last step, namely drawing conclusions, we try to formulate research results that will answer the research focus based on a series of data analysis results carried out.

3. RESULT AND DISCUSSION

The results of the analysis conducted on the score for tests (quantitative data) were analyzed first using descriptive statistics, and qualitative data (students' solutions) were used to follow up on the quantitative results

Figure 2 presents the analysis results using descriptive statistics regarding the classification of mathematical literacy in terms of the mathematization process carried out by PSETs. The data shows that the

percentage of PSETs mathematical literacy at the low level still dominates at each level of the PISA problem. For the moderate level (PISA level 3 and 4), an average of 48.70% of PSETs are at the Low level for their mathematical literacy. Different from the moderate level (levels 5 and 6 of PISA), where an average of 71.43% of PESTs have not solved the given mathematical literacy problem.

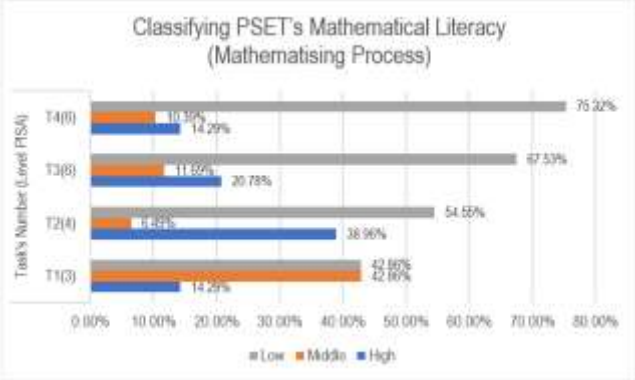


Figure 2. The results of the descriptive analysis of PSETs mathematical literacy based on each task.

Furthermore, Figure 3 shows that more than half of the total participants (59.74%) in this study were in the low category in solving their mathematical literacy problems. This condition means that PSETs' mathematical literacy skills are still constrained.

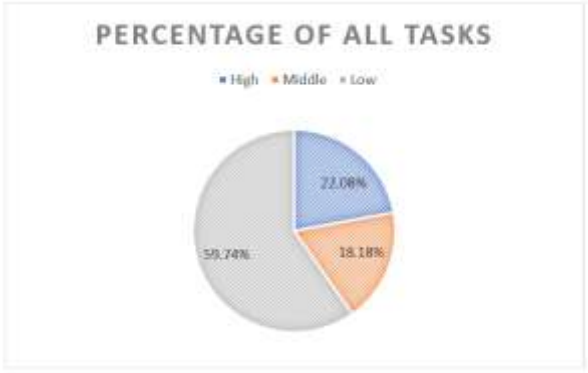


Figure 3. The results of the descriptive analysis of PSETs mathematical literacy for all given tasks

Qualitative data analysis by coding all the answers given by PSETs provides an overview of the strategies and difficulties they face in carrying out the mathematization process. In the coding process, several themes were obtained from the forms of difficulties PSETs' faced, including difficulties in formulating situations mathematically, difficulties in applying concepts correctly, and difficulties in interpreting the results obtained in the context of the given problem.

We will try to present these three forms of difficulty for further discussion. As an example, the strategies and various difficulties listed by PESTs in Task 1. Figure 4 shows the Task Q1 given in the test, which takes a personal context with Quantity content [35]. This task asks PSETs to share a pizza based on the amount of money each child is given. Of course, knowledge of the concept of rational numbers (fractions) in comparisons will greatly assist PSETs in solving this problem.

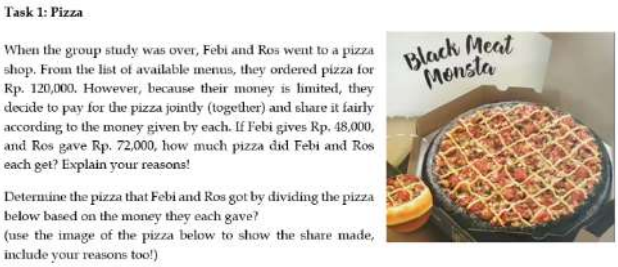


Figure 4. Task Q1

PSETs propose various strategies in solving this problem, including using comparisons and knowledge of decimal numbers (Figure 5) and the concept of fractions (Figure 6). And some other strategies that are not shown in this paper.

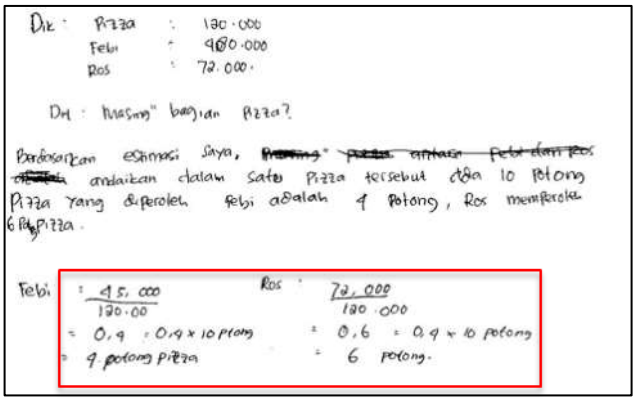


Figure 5. PSET' strategy in solving Task Q1 (by R1)

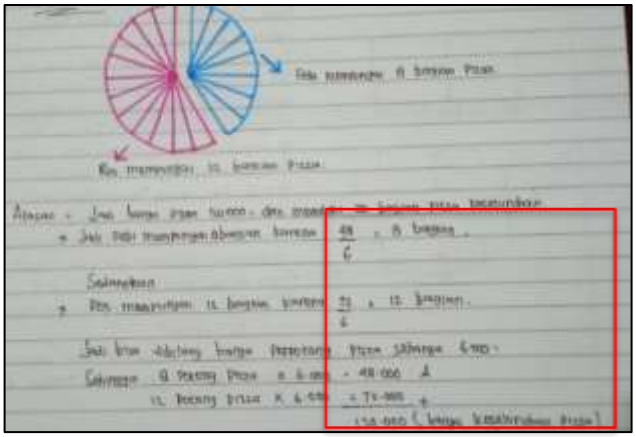


Figure 6. PSET' strategy in solving Task Q1 (by R2)

Figure 5 shows the strategy carried out by R1 by utilizing his knowledge of rational numbers, namely decimal numbers and the concept of comparison. Through these two pieces of knowledge, R1 tries to estimate if the pizza can be cut into ten equal parts and finally can determine the number of pizzas as a solution to the problem.

Next, in a slightly different way, Figure 6 shows R2, which assumes that the pizza can be divided into 20 parts with an estimated price of Rp. 6000 for each part. Using this information, R2 finally determined the amount of each pizza that Febi and Ros received.

From the two strategies shown, it can be seen that R1 and R2 can formulate problems mathematically well, apply their knowledge related to rational numbers (fractions and decimals), and interpret solutions from the application of these concepts to the real word problem.

On the other hand, we will also analyze the various difficulties and obstacles PSETs in their struggle to solve this Task Q1 problem. Some of the difficulties include:

a. *Unable to formulate the problem correctly and adequately*. This condition can be seen from the responses of the participants' answers, namely incorrectly formulating the problem (Figure 7) and not giving an answer at all or just drawing a circle (Figure 8).

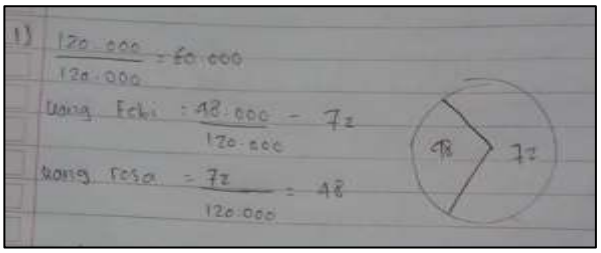


Figure 7. PSET' obstacle in solving Task Q1 (by R3)

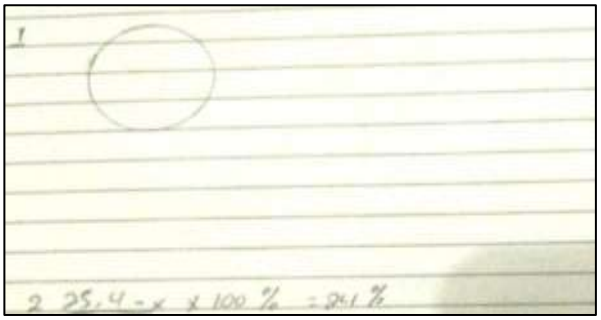


Figure 8. PSET' obstacle in solving Task Q1 (by R4)

b. *Have no ideas about applicable mathematical concepts.* In this case, the PSETs were able to formulate the problem but did not have the appropriate mathematical knowledge ideas that could be applied to find the right solution (Figure 9).

PSETs do meaningless mathematical operations such as division, addition, and subtraction. They immediately apply the results of computations that do not make sense as a suitable solution (according to them).

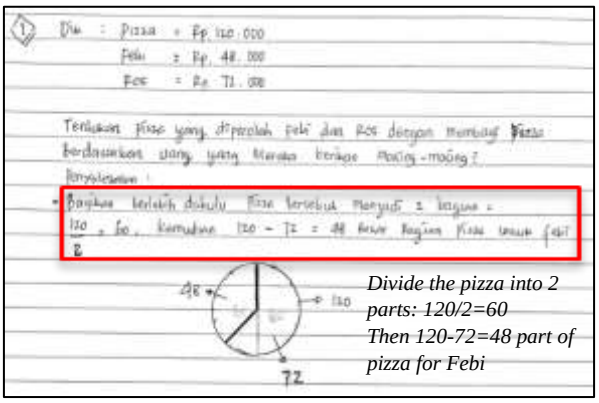


Figure 9. PSET' obstacle in solving Task Q1 (by R5)

In Figure 9, the meaning of 48 parts of pizza given for Febi seems confusing to express in daily life. This condition is by what was conveyed in the research of Putra et al. [38] regarding formal and informal knowledge of mathematics. Putra et al.[39] said that force In tackling daily life problems, formal mathematics does not ensure that it will make sense of the problem, implying that formal mathematics cannot solve the problem. So, learners need to have a sense of using formal mathematics, especially in interpreting the results of the calculations they get.

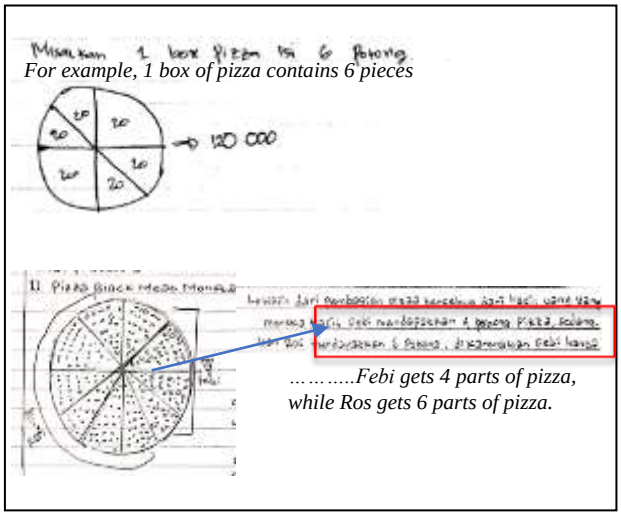
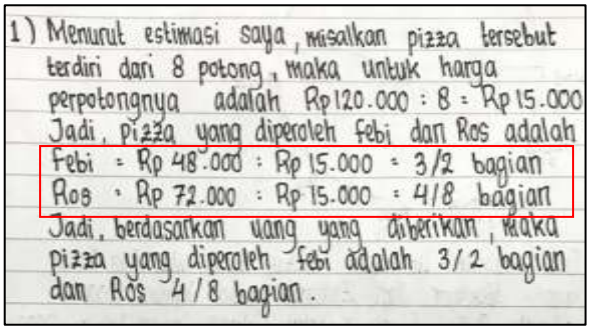


Figure 10. PSET' obstacle in solving Task Q1 (by R6 & R7)

Then, difficulties caused by errors in interpreting the mathematical concepts used are also often found, especially on the concept of fractions. Some participants had difficulty in determining the appropriate size of the pizza. For example, in Figure 10, it can be seen that the partition of the geometric shape that shows the size of the fraction required (in problem) is not appropriate. By dividing the 1/4 pizza into two parts, R6's desired 1/6th shape appears less accurate. Similarly, the R7 was created by discarding the concept of "half."



According to my estimation, suppose the pizza consists of 8 pieces, then the price per piece is Rp. 120,000 : 8 = Rp. 15,000. So, the pizzas that Febi and Ros got were

Febi ……3/2 part

Ros……4/8 part

Figure 11. PSET' obstacle in solving Task Q1 (by R8)

The conditions shown in Figures 10 and 11 illustrate that PSETs still have difficulty understanding the concept of fractions, especially related to the interpretation of meaning and representation of fractions. As a result, strengthening the concept of fractions or mathematical objects known as rational numbers must be strengthened for PSETs.

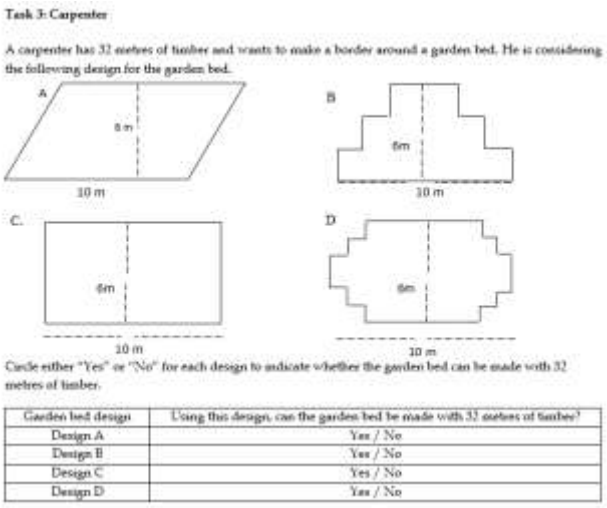


Figure 12. Task Q3

The condition of the limited mastery of the PSETs concept is also evident from the completion of Task Q3 (Figure 12). The problem presented in Task Q3 is at level 6 PISA with space and shape content. Analysis of all participants' answers to this question showed that 67.53% of PESTs could not solve this question. One reason they fail to find the right solution is the lack of understanding of PSETs on the concept of the perimeter of geometric shapes.

Many of the PSETs answered that a design that could not be formed from a wood supply was a D or B design. Of course, this condition will affect their success in using the concept. So that improving the ability of PSETs on mathematical concepts needs to be a significant concern before developing other mathematical competencies.

c. *Unable to interpret the solutions obtained to the given real context problems*. This condition is shown from several PSETs answers that try to complete Task Q1 but seem meaningless. They perform a series of procedures but have not connected the obtained solution to the problem (Figure 13).

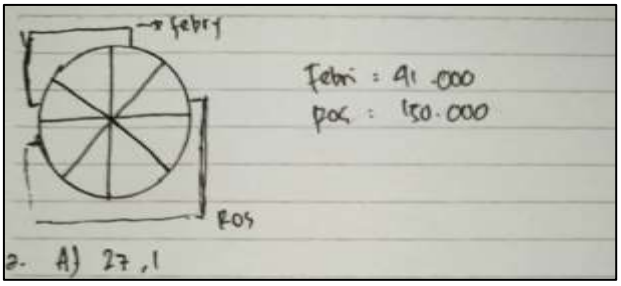


Figure 13. PSET' obstacle in solving Task Q1 (by R9)

Based on the analysis of the three constraints presented above, the first stage of the mathematization process, namely formulating the problem mathematically, is still the main obstacle to PSETs in doing PISA or like PISA problems. The ability to understand and model a given problem in mathematics seems to be a challenging thing to do. So that the mathematics learning process that provides opportunities for PSETs to carry out the mathematisation process needs to be familiarized and continue to be developed. In addition, the strengthening of basic mathematical concepts in each mathematics course in the elementary teacher program also needs to be emphasized by the lecturers.

In addition, another finding obtained in this research is that the use of PISA and PISA-like questions is likely to build a further discussion on mathematical social or

how social aspects affect mathematics education or mathematical solution. This statement is based on various alternatives presented by PSETs in solving the PISA problem.

4. CONCLUSION

The discussion of the research results quantitatively and qualitatively described above leads us to numerous conclusions: (1) PSETs mathematical literacy is still low (low category), especially in solving the most difficult level of Pisa mathematical literacy questions (5 and 6); (2) Most PSETs are still having difficulties formulating situations mathematically, such as representing the situation mathematically and recognizing the mathematical structure contained in the problem. In addition to having limited knowledge of mathematical concepts is also something that must be considered. Mastery of the concept of mathematical content makes PSETs often misinterpret and determine the completion of mathematical literacy problems. As a contribution for this research to the literature are: (1) increasing PSETs' mathematical literacy must continue to be developed and improved as a long-term effort to support mathematical literacy for students; (2) the development of mathematical literacy in PSETs allows researchers to see how social aspects affect mathematics education; (3) it is proposed that the process of mathematics learning in primary school teacher education programs can prioritize and strengthen the basic concepts of mathematics for PSETs.

AUTHORS' CONTRIBUTIONS

All authors conceived and designed this study. All authors contributed to the process of revising the manuscript, and at the end all authors have approved the final version of this manuscript.

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REFERENCES

[1] Indonesia Ministry of National Education, Peraturan Menteri Pendidikan Nasional Republik Indonesia No. 16 Tahun 2007 tentang Standar Kualifikasi Akademik dan Kompetensi Guru. Jakarta, Indonesia: BSNP, 2007.

[2] J. De Lange, Mathematics for Literacy, in Quantitative literacy: Why numeracy matters for schools and colleges, B. L. Madison and L. A. Steen, Eds. United State of America: Woodrow Wilson Natl Foundation, 2003, pp. 75–79.

[3] OECD.v1, PISA 2018 Results: What Students Know and Can Do. OECD, 2019.

[4] K. Stacey, The Real World and The Mathematical World, in Assessing Mathematical Literacy: The PISA Experience, K. Stacey and R. Turner, Eds. Springer International Publishing, 2015, pp. 57–84.

[5] Rahmawati, Pentingnya Kemampuan Literasi dan Numerasi untuk Life-Skill Competency, Research on Improving Education Systems (RISE) Indonesia, 2021. https://rise.smeru.or.id/id/publikasi/pentingnya-kemampuan-literasi-dan-numerasi-untuk-life-skill-competency-dr-rahmawati (accessed Feb. 26, 2021).

[6] R. Novita and T. Herman, Using technology in young children mathematical learning: A didactic perspective, J. Phys. Conf. Ser., vol. 1957, no. 1, 2021, doi: 10.1088/1742-6596/1957/1/012013.

[7] UURI, Undang-Undang Republik Indonesia Nomor 20 tahun 2003 Tentang Sistem Pendidikan Nasional, Jakarta, 2003.

[8] M. Irfan, Role of Learning Mathematics in the Character Building, Int. Conf. Educ., pp. 599–604, 2016, [Online]. Available: https://core.ac.uk/download/pdf/267023545.pdf.

[9] Indonesia Ministry of National Education, Buku Pegangan Pembelajaran Berorientasi pada Ketrampilan Berpikir Tingkat Tinggi. Jakarta: Dirjen Guru dan Tenaga Kependidikan Kemendikbud, 2018.

[10] F. Haara, O. Bolstad, and E. Jenssen, Research on Mathematical Literacy in Schools - Aim , Approach and Attention, Eur. J. Sci. Math. Educ. Math. Educ., vol. 5, no. 3, pp. 285–313, 2017, doi: https://doi.org/10.30935/scimath/9512.

[11] S. Revina, Rapor Kompetensi Guru SD Indonesia Merah, dan Upaya Pemerintah untuk Meningkatkannya belum Tepat, SMERU Research Institute, 2019. https://theconversation.com/rapor-kompetensi-guru-sd-indonesia-merah-dan-upaya-pemerintah-untuk-meningkatkannya-belum-tepat-120287 (accessed Jan. 26, 2021).

[12] R. Yilmaz, Prospective Mathematics Teachers' Cognitive Competencies on Realistic Mathematics Education, J. Math. Educ., vol. 11, no. 1, pp. 17–44, 2020, doi: 10.22342/jme.11.1.8690.17-44.

[13] V. Yustitia, S. M. Amin, and Abadi, Mathematical Literacy In Pre-Service Elementary School Teacher: A Case Study, in Journal of Physics: Conference Series, Sep. 2020, vol. 1613, no. 1, p. 12054, doi: 10.1088/1742-6596/1613/1/012054.

[14] UNESCO, The plurality of literacy and its implications for policies and programs: Position paper, p.13. Paris: United National Educational, Scientific and Cultural Organization., 2004.

[15] Oxford, Oxford Learner's Pocket Dictionaries. Oxford: Oxford University Press, 2011.

[16] NCTM, Curriculum and Evaluation Standards for School Mathematics. Reston, VA: NCTM, 1989.

[17] J. De Lange, Mathematical Literacy for Living from OECD-PISA Perspective., Tsukuba J. Educ. Study Math., vol. 25, pp. 13–35, 2006, [Online]. Available: http://www.human.tsukuba.ac.jp/~mathedu/2503.pdf.

[18] OECD.v2, PISA 2012 Results: Excellence Through Equity Giving Every Student the Chance to Succeed. Paris: OECD Publishing, 2013.

[19] OECD(b), PISA 2021 Mathematics Framework (Draft), 2018.

[20] B. Ojose, Mathematics Literacy: Are We Able To Put The Mathematics We Learn Into Everyday Use?, J. Math. Educ., vol. 4, no. 1, pp. 89–100, 2011.

[21] K. Stacey and R. Turner, The Evolution and Key Concepts of The PISA Mathematics Frameworks," in Assessing Mathematical Literacy: The PISA Experience, Springer International Publishing, 2015, pp. 5–33.

[22] U. Umbara and D. Suryadi, Re-Interpretation of Mathematical Literacy Based on the Teacher's Perspective,iInt. J. Instr., vol. 12, no. 4, pp. 789–806, 2019, doi: 10.29333/iji.2019.12450a.

[23] K. Stacey, The PISA View of Mathematical Literacy in Indonesia, J. Math. Educ., vol. 2, no. 2, pp. 95–126, Jul. 2011, doi: 10.22342/jme.2.2.746.95-126.

[24] OECD, Learning Mathematics for Life: A Perspective from PISA, vol. 3. Paris: OECD Publishing, 2009.

[25] T. Herman, Aktivitas dalam Pembelajaran Matematika di Sekolah Dasar, no. 2. Bandung: Universitas Pendidikan Indonesia, 2010.

[26] NCTM, Principles to Action:Ensuring Mathematical Succes for All. Reston, VA: NCTM, 2014.

[27] NRC, Adding it up: Helping Children Learn Mathematics. Washington, DC: National Academy Press (National Research Council), 2001.

[28] G. Yilmazer and M. Masal, The Relationship Between Secondary School Students' Arithmetic Performance and Their Mathematical Literacy, Procedia Soc. Behav. S ciences, vol. 3, no. 152, pp. 619–623, 2014, doi: doi:http://dx.doi.org/10.1016/j.sbspro.2014.09.253.

[29] J. Colwell and M. C. Enderson, When I Hear Literacy: Using Pre-Service Teachers' Perceptions of Mathematical Literacy to Inform Program Changes in Teacher Education, Teach. Teach. Educ., vol. 53, pp. 63–74, 2016, doi: 10.1016/j.tate.2015.11.001.

[30] R. H. N. Sari, Literasi Matematika: Apa, Mengapa dan Bagaimana?, in Seminar Nasional Matematika dan Pendidikan Matematika UNY 2015, 2015, pp. 713–720.

[31] C. E. Scott, E. M. McTigue, D. M. Miller, and E. K. Washburn, The What, When, and How of Preservice Teachers and Literacy Across the Disciplines: A Systematic Literature Review of Nearly 50 Years of Research, Teach. Teach. Educ., vol. 73, pp. 1–13, Jul. 2018, doi: 10.1016/j.tate.2018.03.010.

[32] R. . Yin, Case study research: Design and method (6th ed.). Thousand Oaks, CA: SAGE Publications Inc., 2018.

[33] J. W. Creswell and C. N. Poth, Qualitative Inquiry and Research Design: Choosing Among Five Approaches. United Kingdom: SAGE Publications Inc., 2018.

[34] OECD, The PISA 2003 Assessment Framework: Mathematics, Reading, Science and Problem Solving Knowledge and Skills. Paris: OECD. Paris: OECD Publishing, 2003.

[35] R. Novita, Z. Zulkardi, and Y. Hartono, Exploring Primary Student's Problem-Solving Ability by Doing Tasks Like PISA's Question, J. Math. Educ., vol. 66, no. 3, pp. 37–39, 2012, doi: https://doi.org/10.22342/jme.3.2.571.133-150.

[36] S. I. Edo, Y. Hartono, and R. I. I. Putri,

"Investigating secondary school students' difficulties in modeling problems PISA-model level 5 and 6, J. Math. Educ., vol. 4, no. 1, pp. 41–58, 2013, doi: 10.22342/jme.4.1.561.41-58.

[37] M. B. Miles, A. M. Huberman, and J. Saldaña, Qualitative Data Analysis: A Methods Sourcebook (third edition). United State of America: SAGE Publications Inc., 2014.

[38] OECD, PISA 2012 Mathematics Framework, OECD Publ., pp. 1–42, 2010, [Online]. Available: http://www.oecd.org/pisa/pisaproducts/46961598.pdf.

[39] M. Putra, R. Novita, and Usman, What Kind of Mathematics For Doorsmeer Student Fits For in Solving A Mathematical Problem: A Discussion About Student's Informal Mathematics, Math Didact. J. Pendidik. Mat., vol. 8, no. 1, pp. 297–310, 2022.