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Students' Math Literacy in Solving Pisa-Like Problems in Papuan Local Context

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ABSTRACT

Mathematical literacy in Indonesia is still relatively low. Student achievement in PISA questions is also still not adequate. Mathematical literacy is not limited to the ability to apply quantitative aspects of mathematics, it employs knowledge of mathematics in a broad sense. Mathematical literacy skills are closely related to interpreting problems related to local contexts into mathematical problems. This study aims to describe students' mathematical literacy activities in solving problems similar to PISA in the regional context; the context in which this research is desired is the local Papuan context. The research method employed is the descriptive qualitative method. The samples were 8th graders of SMP Batik Program Khusus Kartasura, totaling six students. Data was collected using a written test consisting of two items of PISA-like problems, observations, and interviews. This research produces problems similar to PISA within the local context of Papua. PISA-like questions are declared to be valid, simple, and have the potential to determine students' mathematical literacy abilities. The PISA-like problems are valid based on the review by experts in the appropriate field in terms of aspects, content, structure, and language. This PISA-like problem was also developed based on seven basic mathematical abilities that employ mathematical literacy. We successfully concluded that the dominant aspects for students are making assumptions and conceptualizing. While the parts of structuring and formulating a model are not dominant. In addition, PISA-like problems have more potential effect on determining students' mathematical literacy.

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1. INTRODUCTION

PISA defines mathematical literacy as a forum for students to identify and understand the place of mathematics in the world, make sound judgments, and participate in mathematics to meet future needs in a constructive way (OECD, 2006). Mathematical literacy is defined as showing mathematical skills and processes useful in future life. The concept of mathematical literacy is closely related to several other ideas, the most important of which is the mathematical process and its component processes (De Lange, 2006). According to Genc & Erbas (2019), mathematical literacy is a person's ability to use appropriate methods to solve problems, assess what has been done, analyze the situation, and draw conclusions.

Seen the mathematical literacy of students in the world, it can be understood that the complexity of mathematics is a problem for now. This is the definition of mathematical literacy based on Niss & Højgaard (2019): "mathematical literacy is a person's insight to act appropriately and respond to all types of mathematical problems related to certain situations".

Mathematical literacy in PISA defines an individual's ability to formulate, use, and interpret mathematics in various contexts (PISA, 2016). This is in line with Hayati & Kamid (2019) opinion, which states that students' ability to formulate, use and interpret mathematics shows students know the role of mathematics in life and can make sound judgments and make constructive and reflective decisions.

Ojose (2011) also argues that mathematical literacy is knowledge to know and use basic mathematics in everyday life. In this case, every individual who has good mathematical literacy skills will be able to understand mathematical concepts that are relevant to the activities or problems they face (Hera & Sari, 2015).

In line with this definition, Kaye & Turner (2015) interprets that mathematical literacy is the ability to use mathematical thinking to solve everyday problems so that individuals are ready to face real issues in life. Mathematical ability means problem-solving thinking patterns, logical reasoning, communicating, and explaining. This mindset is based on concepts, procedures, and mathematical realities relevant to everyday life problems.

In general, the five opinions above emphasize the same thing, namely how to use mathematical knowledge to solve problems of everyday life better and more effectively (Hera & Sari, 2015). A person is also not enough to have mathematical abilities alone but must be able to use these mathematical abilities in everyday life (Mansur, 2018; Putra et al. 2016). Have good math skills in helping students solve everyday life problems (Johar, 2012). Students who participate in mathematical literacy activities will experience mathematical literacy skills (Pradana et al., 2020).

Literacy skills are not only limited to the ability to use arithmetic knowledge in mathematics but also to use broader knowledge (De Lange, 2006). Mathematical literacy ability corresponds to the mathematical ability assessed in the Program for International Student Assessment (PISA). Focus PISA is mathematical information that focuses on reading, mathematics, and literacy (Sari & Valentino, 2017). PISA aims to assess the proposed mathematical literacy based on the occurrence of everyday problems in basic mathematics and to motivate processes, concepts, and stages of completion (OECD, 2015). Therefore, PISA's task is to guide students to acquire higher thinking skills by integrating students' knowledge in solving everyday math problems (Oktiningrum et al., 2016).

PISA also aims to monitor student learning outcomes in each country, consisting of 3 literacy: reading literacy, mathematical literacy, and scientific literacy. Of the three literacy, PISA divides the achievement of students' literacy abilities into six levels, ranging from level 1 (easy) to level 6 (difficult) for mathematical literacy and scientific literacy (PISA, 2015).

These levels will be used to describe the level of students' reasoning in solving mathematical literacy problems. Similar to each individual's level of mathematical literacy, the individual can describe a high level of primary mathematical abilities (Adams & Turner, 2012). Thus, an increase in basic math skills was associated with increased item difficulty. These observations have been used to describe various mathematical literacy levels in previous PISA surveys and will be discussed later in this framework. Several basic mathematical abilities will be used in this framework from the statements made.

Communication, mathematical literacy involves communication. With this communication, the individual feels the presence of several problems and is responded to recognize and understand the problem situation. Reading, deciphering, and interpreting statements, questions, tasks, or forms enables a person to form a mental model of a situation, which is the primary step in understanding, clarifying, and formulating a problem. Then, after getting a solution, students need to present the solution in their answer (PISA, 2015).

Mathematising, mathematical literacy can involve changing defined problems from the real world into mathematical problems (which includes structuring, conceptualizing, making assumptions, and formulating models) or evaluating mathematical results with everyday problems (Kaye & Turner, 2015; PISA, 2015). 2015). Representation, mathematical literacy often involves the representation of mathematical objects and situations.

The representations in question are graphs, tables, diagrams, pictures, equations, formulas, and concrete mat (Niss & Hojgaard, 2011; PISA, 2015). Reasoning and argument, this ability involves a thought process that explores and relates mathematical problems to make conclusions from students, check the justification given, or provide explanations for statements or solutions to a problem (Niss & Hojgaard, 2011; PISA, 2015).

Devising strategies for solving problems, mathematical literacy often requires strategies to solve problems mathematically. This skill is characterized as designing a plan or method used to solve issues contained in a context. This mathematical ability can be demanded in every problem-solving process. Using symbolic, formal, and technical language and operations, mathematical literacy requires figurative, language, and legal and technical operations. Using mathematical tools, mathematical tools include physical tools and computer-based tools already widely available. Mathematical tools can help students solve the problems they get and have an essential role in communicating the results (PISA, 2015).

Based on several basic mathematical abilities in the PISA framework (2015), researchers used one essential mathematical knowledge with several indicators of mathematical literacy. Although Mathematising was chosen as an indicator of mathematical literacy because mathematical literacy is related to everyday life (Afifah et al. 2019), mathematizing also involves mathematical literacy skills to transform problems from real problems into mathematical form. Therefore, mathematizing is chosen as a reference to determine students' mathematical literacy. Based on the seven basic mathematical skills used in the PISA framework, the indicators that can be taken are basic mathematical abilities mathematizing with several sub-indicators, namely, structuring, conceptualizing, making assumptions, and formulating a model. In addition, several previous studies on mathematical literacy have been carried out. These relevant studies are grouped into three main categories, the first focusing on developing an instrument to measure mathematical literacy.

The ability of students to reason and apply mathematical problems in everyday life is indispensable in solving problems similar to PISA (Julie et el., 2019). Mathematical literacy skills in solving problems similar to PISA, to solve this question, students must have the ability to think logically, critically and systematically in problem-solving (Muzaki & Masjudin, 2019). Mathematical literacy skills can be analyzed by looking at students in solving problems that require the ability to formulate, use, and interpret mathematics (Hidayati et al., 2020).

The instruments are 1) mathematical literacy written test (Pulungan, 2014); 2) interviews related to mathematical literacy skills (Masfufah & Afriansyah, 2021); 3) data for grouping mathematical literacy categories (Taufik et al. 2021); 4) the rubric for the assessment of mathematical literacy (Hervanda et al., 2020); and 5) testing students' literacy skills in solving problems similar to PISA (Nia & Mutia, 2019). After that, these studies focus on the factors that influence mathematical literacy. This research shows that the factors that affect the ability of Indonesian students to solve PISA questions are student identity, economic and cultural conditions, computer ownership, and books (Pakpahan, 2017). Due to the lack of these factors, the result is that students have a low level of mathematical literacy, only up to level 1 (Khoirudin et al., 2017). The third category of research raises literacy skills, namely high-level literacy skills (Mitari et al.,

2021), moderate literacy skills (Kusumawardani et al., 2018), and low-level literacy skills (Masjaya & Wardono, 2018).

There have also been many studies that discuss mathematical literacy. Of the many studies on PISA questions and how to solve problems using PISA questions, no research has provided PISA-like questions using local contexts. Based on the research that has been done and the issues that occur, this article discusses mathematical literacy in solving problems similar to PISA in a local context. Therefore, the researcher hopes to discover the potential of PISA-like questions in the local Papuan context on mathematical literacy skills. In the local context, students are expected to have broad insight and get to know the culture so that students can solve the problems given (Usnul et al., 2019).

2. METHODS

The research used is descriptive qualitative research. The qualitative description provides an extensive description of a phenomenon or event and focuses on students' perspectives (Creswell, 2012). It aims to describe how students' mathematical literacy skills solve problems similar to PISA using the Papuan context.

The subjects in this study were 8th-grade junior high school students. The samples taken were 8th-grade students at SMP Batik Program Khusus Kartasura, totaling six students. The characteristics of the students taken for the sample are students who have low levels of mathematical literacy, namely levels 1 and 2, medium levels are levels 3 and 4, and high levels are levels 5 and 6 (PISA, 2015). This article presents data from 6 subjects consisting of each category of low level, medium level, and high level.

Data collection techniques used in the study were interviews, observation, and a written test consisting of two essay problems taken from the material of arithmetic sequences and the concept of plane shapes. The PISA-like problems were developed based on local wisdom from Papua, namely: Papuan batik with Tifa and Honai motifs and a picture of a Honai house. The theme chosen for the context of the problem is because it utilizes local wisdom that can improve students' mathematical literacy skills, make learning more effective and students can achieve exemplary achievements, and bring character education to students.

Table 1. PISA-like problems to measure students' mathematical literacy.

Arithmetic Sequence Problem

1 Piece 2 Piece 3 Piece

Putri will make pieces of cloth from a piece of Papuan batik cloth with a Tifa Honai motif. The princess cuts the fabric neatly and regularly. Some of the pieces look like the image above. Complete the table below, and give reasons for each piece

Piece To -	Many Tifa motifs	Many Honai motifs
1	1	0
2	1	1
3	3	3
4		

5 6
Two-dimensional Figure Problems
There are many traditional houses in Indonesia, one of which is the Honai traditional house in Papua. The *Honai* house is made of natural materials and has many pillar structures, as shown in the following picture: Honai houses have walls, roofs, and supports in the form of stairs. The support part helps the *Honai* stand upright so that the distance between the ground and the *Honai* floor wall is 95 cm. The ladder that touches the ground in the *Honai* house is 35 cm wide. What mathematical concepts are the pillars and the roof in the picture of the *Honai* house on the side? If the supports are by mathematical concepts, what is the area of the supports in the *Honai* house?

Researchers made observations to include a description of events, answer indicators, and evaluate by measuring students' mathematical literacy abilities. The instruments used by researchers have been validated by one lecturer at the Universitas Muhammadiyah Surakarta and two teachers from SMP Batik Program Khusus Kartasura. The test is employed to obtain data on students who have low, medium, and high mathematical literacy skills in solving problems similar to PISA. By conducting interviews, researchers can analyze one by one and draw overall conclusions (Sagala et al., 2019).

Table 2. Validator Review

Comments and Suggestions	Follow-up
Questions about meeting the PISA indicators	-
Questions meet the criteria for mathematical literacy	-
Number 2, the problem given is still ambiguous	Change the sentences in the questions to be simpler and can be understood by students.
Question number 1, information is given	Look for good-quality images that fit the local context.
Question number 1, described each picture. For example, pictures 1, 2, and 3.	described each picture, which is located below the figure.

After collecting data, the data will be analyzed in 3 stages. The first stage is to reduce the data, and this stage is taken from student work in the PISA-like test questions to measure mathematical literacy skills. The second is the presentation of data by collecting information taken from the results of

interviews and observations. The last is concluding; at this stage, the conclusions will be drawn after collecting data in observations, tests, and interviews.

3. FINDINGS AND DISCUSSION

The results presented are the work of students who have high-level, medium-level, and low-level mathematical literacy skills. The question presented is question number 1, because question number 1 has a high PISA level, level 3.

2.1. Subject data exposure 1

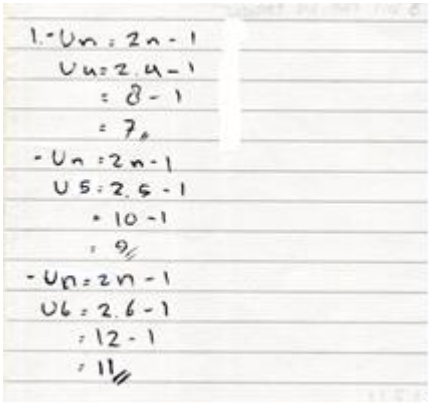

Figure 1. *The result of S1*

Figure 1 above shows that S1 solves the given problem properly and correctly. Based on the mathematizing sub-indicator, S1 fulfills all aspects of mathematical literacy. In the structuring aspect, S1 can turn real problems into mathematical problems by calculating the size of the problem. In the process, S1 completes it sequentially and structured. Thus, S1 gets results that include structuring. In the conceptualizing aspect, S1 is called. In the process, S1 uses a formula to find the value of the nth term, and then it is explained by two lines under the number, which indicates that the number is the final result. This shows that S1 understands the basic concept of finding the nth term.

In the aspect of making assumptions, S1 fulfills the part of making assumptions because, from the interview results, S1 can explain the essence of the problem in his language. S1 also explained that after reading the questions and making his assumptions, S1 had a picture or design strategy to solve the given problem. S1 can develop a mathematical model for each term to solve the given problem in formulating a model. S1 develops a mathematical model that is appropriate for the problems that occur. S1's mathematical literacy ability meets four sub-indicators, first, structural, the second is conceptualization, the third is making assumptions, and the last is formulating a model. Because S1 meets all four sub-indicators, S1 is categorized as a student with a level of mathematical literacy ability tall.

2.2. Subject data exposure 2

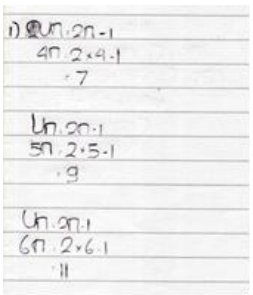

Figure 2. The result of S2

Figure 2 above shows that S2 solves the given problem properly and correctly. Based on mathematizing ability, a master's degree fulfills three aspects of mathematical literacy. In the structuring aspect, S2 does not fulfill this aspect because S2 completes it unstructured in the process. However, a master's degree can turn real problems into mathematical problems, as seen in a master's work writing formulas. Thus, S2 gets results that include structuring even though it is not structured.

In the conceptualizing aspect, S2 fulfills this aspect because, in the process, S2 can write the substitution of the nth term formula correctly. This shows that S2 understands the basic concept of finding the nth term. Even though he wrote the mathematical model wrong, S2 understood the idea of the given mathematical problem. In the aspect of making assumptions, S2 fulfills the part of making assumptions because S2 can explain in the context of the problems found in the questions. If S2 cannot make assumptions, students will have difficulty understanding and writing down the results. Although S2 does not meet the formulation of the mathematical model, S2 explains how students solve mathematical problems given well and clearly.

In formulating a model, S2 cannot formulate a mathematical model to solve the given problem. S2 writes it as 4n, 5n, and 6n. This shows that S2 is wrong in formulating the mathematical model. S2's mathematical literacy ability fulfills two sub-indicators: the second aspect of conceptualization and the third is making assumptions. S2 does not meet the sub-indicator the first is because the results that S2 writes are not structured, and the last is formulating a model because of a mistake in writing a mathematical model. So S2 is categorized as a student with a moderate level of mathematical literacy ability.

2.2. Subject data exposure 2

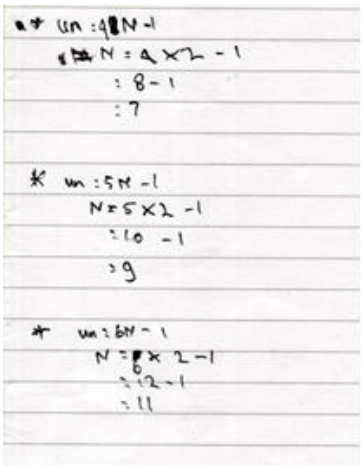

Figure 3. The result of S3

Figure 3 above, shows that S3 solves the given problem. Based on mathematizing ability, S3 fulfills one aspect of mathematical literacy. In the structuring aspect, S3 does not fulfill this aspect because S3 seems hesitant in writing answers in the process. Students do not write in a structured way how he solves the problems given. Students also cannot turn real problems into mathematical problems.

In the conceptualizing aspect, S3 does not fulfill this aspect because it is in progress and looks doubtful. S3 has difficulty understanding the basic concepts of finding the nth term and identifying the given problem. In the aspect of making assumptions, S3 fulfills the part of making assumptions because S3 can explain what problems are found in the matter. Although he hesitated, his explanation proved that S3 could make his assumptions from the questions he got.

In formulating a model, S3 cannot formulate a mathematical model of the problem to solve the given situation. Besides being wrong in writing formulas, S3 is also less precise in solving problems even though it gets the right results. S3 mathematical literacy ability fulfills one sub-indicator in the

third aspect, namely making assumptions. S3 can only make assumptions from the given problem by solving the problem and getting a solution; S3 does not fulfill the first aspect, namely structure or identify real problems into mathematical form, the second aspect is conceptualization, and the last is formulating mathematical models. Thus, S3 is categorized as a student with a low level of mathematical literacy ability.

Discussion

Referring to the results of the analysis above, it can be stated that almost all students tend to use basic math skills, although several sub-indicators have not been fully or maximally realized. It can be seen that many students still have difficulty using their mathematical skills. This is in line with the research conducted by Masfufah & Afriansyah (2021). Students can only identify important points in the problems they get (Nia & Mutia, 2019).

In the structuring aspect, some students can understand the questions given, so some of them cannot write information using their language. This is evidenced by only four students out of 6 students who understand the information on the questions using their language. This is to the research results of Utami et al. (2020), which said that most of the students could fulfill the first mathematical literacy indicator, namely formulating a model.

In the conceptualizing aspect, students tend to understand the material concept of a given problem. They know what material, what formula is used, and how to apply it to the problem. This is evidenced by the fact that there are 5 students out of 6 students who understand the concept of the given problem. This activity is in line with the research conducted by Taufik et al. (2021) which concluded that some students can determine the information needed to describe the problem by mentioning the information or material understood. 76% of students can read, understand, and write down statements to obtain correct results (Mitari et al., 2021).

In the aspect of making assumptions, some students can make assumptions from the problems they get. After they understand the material and information in the situation, students make assumptions about what is being asked and how students solve the problem. This is evidenced by 6 students, and all students can make their assumptions. Students can analyze the information obtained into sentences or formulas that are more straightforward (Ishartono et al., 2021). This is in line with research conducted by Kholid, Pradana, et al. (2022;) and Muzaki & Masjudin (2019) who concluded that some students can solve complex problems given by using their own reasoning and can perceive the problem from various points of view.

In these activities, students have not been fully able to formulate a mathematical problem model on the given problem. Kholid et al. (2022) in their research concluded that students who have high, medium, and low levels of mathematical literacy have difficulty in applying mathematizing. This is evidenced by students not being able to write down the information contained in the questions fully, students not writing down what is known and asked and what steps will be answered; these things are formulating a mathematical problem model on the given problem.

This is in line with the research conducted by Mulyadi et al. (2015), which stated that the most errors were in the problem of understanding the problem, namely the problem of the subject who did not understand and recognize the concept. That is the ability of students to understand the problem is very influential in the process of mathematical literacy.

4. CONCLUSION

The results of this study are two questions with the theme of the local Papuan context with PISA characteristics and aim to determine students' mathematical literacy. PISA-like questions are said to be valid, simple, and have the potential to determine students' mathematical literacy abilities. The validity of the questions was based on several experts who said that the questions met the characteristics of PISA. This PISA-like problem was also developed based on seven basic mathematical abilities that

involve mathematical literacy. The dominant aspects for students are making assumptions and conceptualizing. At the same time, the parts of structuring and formulating a model are not chief because many students understand the theory of a given mathematical problem but cannot apply it to a mathematical formula or situation. Therefore, PISA-like problems have more potential to determine students' mathematical literacy.

In general, this research has been carried out as much as possible. Still, there are technical obstacles, namely, conducting face-to-face interviews with students to prevent the Covid-19 pandemic is carried out according to protocol. Referring to the above conclusions, the teacher should give the problem to the students so that students can think logically, critically and systematically. The situation given can be a PISA-like question using other local contexts.

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