Analysis of Literacy Skills in Solving PISA Questions Based on Gender

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Abstract. This study uses PISA questions to examine literacy skills from a gender perspective. Eighth-grade students of SMP Negeri 1 Kontakmacan, both males and females, participated in this study. Written tests, interviews, and data collection methods were used with a qualitative descriptive research methodology. Data analysis shows that the literacy rates of male and female students vary. Although there are still mistakes, males can overcome difficulties when given the correct instructions. Conversely, female students can also solve problems with the proper process, although they usually lack confidence in clearly stating the steps of their work. To become mathematically literate, one must possess the following skills: (1) Mathematical thinking and reasoning; (2) mathematical argumentation; (3) mathematical communication; (4) modeling; (5) proposing problems and solutions; (6) representation; and (7) problem-solving; (8) tools and technology; (7) symbols (using symbols), (using tools and technology).

Keywords: Literacy Skills · PISA · Gender

1 Introduction

The Program for International Student Assessment (PISA) is one of the surveys conducted by some industrialized countries that are members of the Organization for Economic Cooperation and Development (OECD) in Paris. Every three years, PISA tests students' knowledge and skills against students from other countries and advances education systems worldwide.

Through the PISA project, certain countries can enhance their talent and that of all their students. PISA's overarching goal is to evaluate the extent to which 15-year-old children in OECD countries have learned the reading, math, and science skills needed to make a significant contribution to their society. The 2002 PISA questions for math cover four different topics. The four contents are form and space, relationship and change, quantity (number), and probability or uncertainty (OECD, 2012).

A set of talents in reading, writing, speaking, mathematics, and problem-solving at a certain level of experience is collectively called literacy and is necessary for everyday life. As a result, literacy and linguistic skills go hand in hand. The Latin word for literacy is Literatus, which roughly translates to "those who learn." The National Literacy Institute

also defines literacy as skills necessary for work, family, and society, including reading, writing, communicating, counting, and solving problems. The ability to construct, apply and interpret mathematics in various contexts, including applying concepts, methods, and facts, is called mathematical literacy in the assessment framework.

In his writings, Jan de Lange [1] discusses the development of specific mathematical literacy skills, including (1) mathematical reasoning and thinking; (2) mathematical argumentation; (3) mathematical communication; (4) modeling (simulation); (5) problem solving and presentation; (6) representation (translate or present); (7) symbols; and (8) tools and technology (use of tools and technology).

Wardhani (2005) states that PISA questions emphasize logical thinking and problem-solving skills. A learner is believed to solve a problem by applying the knowledge he has learned to new and unfamiliar situations. This ability is included in high-order thinking skills [2]. According to Rofiah et al. [3], higher-order thinking skill is the capacity to combine, modify, and change knowledge and experience to engage in critical and creative thinking. To make choices and solve problems. Presentation of learning outcomes evaluation tools in schools that are less related to the living environment that students live in is one of the variables that influence students' lack of habit of working on PISA-based questions [4].

Learning mathematics requires paying attention to various factors, including internal factors, external factors, and gender is another crucial factor for students. All elements that affect students internally, including psychological and physical, are called internal factors. External factors are all influences that do not depend on the student himself, such as the influence of the environment, family, and school. This gender factor makes people consider whether the way of thinking, learning, and conceptualization process is also different based on gender. Therefore, gender is the socially constructed differences in duties, obligations, and tasks between males and females that can change over time (Afandi, 2016; Nurmasari et al., 2014; Purwanti, 2013) [5]. The learning approaches of males and females differ; for example, females are more likely to use learning techniques than males. Their capacity to skim can vary depending on these traits. There is not much difference in talent between males and females, and the difference lies in attitude. This difference in attitude is also seen when learning strategies are used (MZ, 2013; Nurmalaliah, 2013) [6].

Genus, which means type in Latin, is the origin of the word gender. Males and females have different intrinsic traits and behaviors influenced by their social and cultural environment. "Gender and sex are not the same," as Jagtenberg and D'Alton. Males and females learn mathematics differently, with gender explicitly referring to social meanings tied to biological differences. Our internalized values and prejudices about gender significantly impact how we see ourselves and interact. Susento argues that gender differences do not only result in differences in math skills but also in the methods of teaching these subjects.

According to several studies, females are less stable than men, who are usually stable, meaning that when females with high mathematics achievement motivation undertake problem-solving activities in mixed groups, their performance is lower than when all members are present. Males' performance is not affected, but females' performance is. Females are more threatened when males and females are in mixed groups. There are

apparent gender differences in math aptitude, with masculine children doing better in science, sports, and calculating measurements. On the other hand, females perform this calculation better.

This study aims to identify gender differences in students' mathematical literacy skills. The gap in reading skills between male and female students can be seen widely. Therefore, the researchers are interested in whether male and female students have different levels of mathematical literacy. This research is needed to determine the impact of gender inequality on students' literacy and mathematical accuracy. It will not be known how the mathematical literacy skills of male and female students vary without this investigation.

2 Method

This type of research was qualitative. Described and analyzed experiences, social interactions, attitudes, beliefs, perceptions, and individual and group thoughts are the main themes of qualitative research, according to Bachri (2010) [7].

The research design was descriptive because it tried to describe and analyze literacy skills in answering PISA questions. In addition, the data collected was reviewed methodically after it was presented according to the facts. The researchers used volunteers to put the study findings into practice.

The participants in this research were students in eighth grade A at SMP Negeri 1 Konjamacan in the even semester of the 2021/2022 academic year. Six samples, three males and three females, were selected from 32 students. They were selected based on how complete their exam answers were for both genders.

This research was conducted independently to get the results expected by the researchers. After completing the test, the results were collected and adjusted to the level of students' literacy skills.

Interviews and written tests were used as data collection methods in this study. The PISA literacy test and interview guide served as research tools.

3 Results and Discussion

The results of the literacy assessment and PISA question-and-answer interviews at SMP Negeri 1 Kontakmacan, conducted on subjects selected based on the existing sample and will be explained and analyzed based on gender, are the data for this study.

The analysis findings come from answers to questions about literacy skills given by six samples, each consisting of 1 student with low literacy skills, 1 with moderate skills, and 1 with high skills. The literacy level of three male and three female students out of 32 is used as the sample. Furthermore, it will be explained and evaluated according to the level of expertise possessed by each student.

The results of the SR-L and SR-P subjects about literacy skills in solving PISA questions on a flat-sided geometric material show that they have not fulfilled what they wanted. The SR-L and SR-P subjects seem unable to remember the formula used to find the block volume, so both subjects have a low literacy level. Concerning the work of the

Table 1. Research code

No	Student Code	M/F	Skill Level	Sample Code
1	AH	P	Low	SR-P
2	CSD	L	Low	SR-L
3	CPI	P	Moderate	SS-P
4	RH	L	Moderate	SS-L
5	APP	P	High	ST-P
6	RNS	L	High	ST-L

SR-L and SR-P subjects, the following explains the results of the researcher's interviews with the SR-L and SR-P subjects (Tables 1 2, 3, 6 and 7).

Table 2. The Answer of SR-L

The Answer of SR-L	Direct Translation
$D1 : p : 60$ $1 : 50$ $t : 35$ $D2$ ·banyak air dalam akuarium? $D3 :$	$D_1 = p = 60$ $l = 50$ $t = 35$ $D_2 =$ Lots of water in the aquarium? $D_3 =$

Table 3. The Answer of SR-P

The Answer of SR-P	Direct Translation
p Dikerahui : $p : 60$ cm $1 : 50$ cm $t : 3,5$ cm Ditanya : Banyak air dalam akuarium! Pijawab : $= V$ balok $=$	Known $= p = 60$ cm $l = 50$ cm $t = 35$ cm Asked $=$ Lots of water in the aquarium? Answer $= V$ cuboid $=$

Table 4. The Interview Results of SR-L

Results of interviews with the SR-L subject	Direct Translation
Peneliti: "Dari soal yang diberikan apa yang diketahui?" SR-L: "Rumus volume balok." Peneliti: "Rumus volume balok apa?" SR-L: "Tidak ingat."	Researcher: "From the questions given, what do you know?" SR-L: "The formula for the volume of a Cuboid." Researcher: "What is the formula for the cuboid volume?" SR-L: "I do not remember."

Table 5. The Interview Results of SR-P

Results of interviews with the SR-P subject	Direct Translation
Peneliti: "Dari soal yang diberikan apa yang diketahui?" SR-P: "Volume balok." Peneliti: "Rumusnya volume balok apa?" SR-P: "Tidak begitu ingat."	Researcher: "From the question given, what do you know?" SR-P: "The volume of the cuboid." Researcher: "What is the formula for the cuboid volume?" SR-P: "I do not remember

Table 6. The Answer of SS-L

The Answer of SS-L	Direct Translation
$D_1 = p = 60$ cm $\ell = 50$ cm $t = 35$ cm $D_2 =$ banyak air dalam aruarium ? $D_3 =$ Volume $= p \times \ell \times t$ $= 60 \times 50 \times 35$ $= 105.000$ cm³	$D_1 = p = 60$ cm $1 = 50$ cm $t = 35$ cm $D_2 =$ Lots of water in the aquarium? $D_3 =$ Volume $= p \times l \times t$ $= 60 \times 50 \times 35$ $= 105.000$ cm³

The interview excerpt in Table 4 and Table 5 show that the SR-L and SR-P subjects cannot remember all the formulas because SR-L and SR-P subjects do not remember the formula for the cuboid volume. From the interviews conducted, it can be concluded from the written tests and interviews that the SR-L and SR-P subjects cannot provide accurate information about the formula for the volume of a cuboid.

The results of the SS-L and SS-P subjects about literacy skills in solving PISA questions on a flat-sided geometric material show that both sufficiently fulfill what is

Table 7. The Answer of SS-P

The Answer of SS-P	Direct Translation
$D_1 : p = 60$ $l : 50$ $t : 35$ $D_2 :$ banyak air dalam akuarium ? $D_3 :$ Volume balok $= p \times l \times t$ $= 60 \times 50 \times 35$ $= 105.000$ cm³	$D_1 = p = 60$ cm $l = 50$ cm $t = 35$ cm $D_2 =$ Lots of water in the aquarium? $D_3 =$ Volume cuboid $= p \times l \times t$ $= 60 \times 50 \times 35$ $= 105.000$ cm³

desired. The SS-L and SS-P subjects look quite capable of answering the questions, they have answered correctly but have not fulfilled the correct answer, so both subjects are at a moderate literacy level. Concerning the results of the work of the SS-L and SS-P subjects, the following is an explanation of the results of the researcher's interviews with the SS-L and SS-P subjects regarding the work results (Tables 10 and 13).

The interviews in Table 8 and Table 9 show that the SS-L and SS-P subjects can recall all formulas. The SS-L and SS-P subjects can only give an unclear and incomplete explanation. They can provide accurate information about the formula for the volume of a cuboid and clarify the questions posed according to the findings of the written exam and interviews.

The results of the ST-L and ST-P subjects about literacy skills in solving PISA questions on a flat-sided geometric material show that both of them fulfilled what they wanted. The ST-L and ST-P subjects seem to be able to answer the questions, and they have answered correctly and fulfilled the correct answers, so both subjects have a high literacy level. Concerning the work results for the SS-L and SS-P subjects, the following is an explanation of the researcher's interviews with the ST-L and ST-P subjects related to work results.

Table 8. The Interview Results of SS-L

Results of interviews with the SS-L subject	Direct Translation
Peneliti: "Bagaimana cara kamu menyelesaikan permasalahan yang diberikan?" SS-L: "Mencari volume balok." Peneliti: "Kamu sudah yakin?" SS-L: "Ya, yakin, Kak."	Researcher: "How do you solve the given problem?" SS-L: "Find the volume of the cuboid." Researcher: "Are you sure?" SS-L: "Yes, I am sure."

Table 9. The Interview Results of SS-P

Results of interviews with the SS-P subject	Direct Translation
Peneliti: "Bagaiman cara kamu menyelesaikan permasalahan yang diberikan?" SS-P: "Mencari volume balok, Kak." Peneliti: "Kamu sudah yakin?" SS-P: "Belum begitu yakin, Kak." Peneliti: "Apa yang membuat kamu belum yakin?" SS-P: "Mencari banyak air di dalam akuarium belum paham, Kak."	Researcher: "How do you solve the given problem?" SS-P: "Find the volume of the cuboid, Sis." Researcher: "Are you sure?" SS-P: "Not so sure, Sis." Researcher: "What makes you answer?" SS-P: "I do not understand how to determine how much water is in the aquarium."

Table 10. The Answer of ST-L

The Answer of ST-L	Direct Translation
$V = P \times l \times t$ $= 60 \times 50 \times 35$ $= 105.000 \, Cm^3$ $V = \frac{1}{2} \times V$ $= \frac{1}{2} \times 105.000$ $= 52.500 \, Cm^3$	$V = p \times l \times t$ $= 60 \times 50 \times 35$ $= 105.000 \text{ cm}^3$ $V = \frac{1}{2} \times V$ $= \frac{1}{2} \times 105.000$ $= 52.500 \text{ cm}^3$

The ST-L and ST-P subjects can maintain all formulations and are competent in answering questions, as shown in the interview in Table 11 and Table 12. Based on the results of the written test and findings from interviews, the ST-L and ST-P subjects can provide accurate information about the formula for the volume of a cuboid and provide an accurate and correct interpretation of the problem in question.

Table 11. The Answer of ST-P

The Answer of ST-P	Direct Translation
	Known = length = 60 cm width = 50 cm height = 35 cm Asked = How much water is in the aquarium? Answer = Volume of Cuboid = p x l x t = 60 x 50 x 35 = 105.000 cm3 How much water is in the aquarium? Volume = $\frac{1}{2}$ x V = $\frac{1}{2}$ x 105.000 = 52.500 cm3

Table 12. The Interview Results of ST-L

Results of interviews with the ST-L subject	Direct Translation
Peneliti: "Bagaimana cara kamu menyelesaikan permasalahan yang diberikan?" ST-L: "Mencari volume balok, kemudian mencari banyaknya air yang ada di akuarium." Peneliti: "Apa kamu yakin jawaban kamu sudah benar?" ST-L: "Yakin, Kak."	Researcher: "How do you solve the given problem?" ST-L: "Find the volume of the cuboid, then find the amount of water in the aquarium. Researcher: "Are you sure your answer is correct?" ST-L: "I am sure."

Table 13. The Interview Results of ST-P

Results of interviews with the ST-P subject	Direct Translation
Peneliti: "Bagaimana cara kamu menyelesaikan permasalahan yang diberikan?" ST-P: 'Pertama mencari volume balok terlebih dahulu, kemudian mencari banyaknya air yang ada di akuarium dengan cara membagi setengah dari hasil volume balok tersebut." Peneliti: "Apa kamu yakin jawaban kamu sudah benar?" ST-P: "Iya, yakin, Kak."	Researcher: "How do you solve the given problem?" ST-P: "First, find the volume of the cuboid first, then look for the amount of water in the aquarium by dividing half of the volume of the cuboid." Researcher: "Are you sure your answer is correct?" ST-P: "Yes, I am sure."

4 Conclusions

Several conclusions can be made based on the discussion of the findings of the literacy skills study in answering PISA questions from the gender perspective. First, the literacy skills of male students can be seen from the students who provide explanations and steps for completion and can draw conclusions about the literacy skills test in solving PISA questions correctly. In the interview session, male students can also explain the questions written confidently, although sometimes errors occur when answering test questions. However, male students have strong literacy skills. Students' capacities to interpret test questions correctly, draw conclusions about them, and explain procedures written during test interviews are other indicators of female students' literacy skills. As a result, female students have strong literacy skills, although they tend to lack confidence and are unable to explain the test questions correctly.

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