
MATHEMATICAL LITERACY OF JUNIOR HIGH SCHOOL STUDENTS IN SOLVING PROBLEMS PISA CONTENT QUANTITY

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Abstrak: Literasi matematika didefinisikan sebagai kemampuan siswa untuk merumuskan, menggunakan dan menafsirkan matematika dalam berbagai konteks. Kemampuan tersebut termasuk penalaran matematis dan menggunakan konsep matematika, prosedur, fakta dan alat untuk menggambarkan, menjelaskan dan memprediksi fenomena. Kemampuan tersebut membantu individu dalam mengenali fungsi matematika di dunia dan untuk membuat penilaian dan keputusan yang beralasan yang dibutuhkan oleh warga negara. Konten *quantity* mencakup kemampuan bernalar secara kuantitatif, mempresentasikan sesuatu dalam angka, memahami langkah matematika, berhitung diluar kepala dan melakukan penaksiran. Soal-soal pada konten *quantity* paling banyak diimplementasikan dalam kehidupan sehari-hari, seperti dalam penukaran *kurs* mata uang, menentukan bunga bank, berbelanja, menghitung pajak, mengukur waktu, mengukur jarak, dan lain-lain. Tujuan dari artikel ini adalah untuk mendeskripsikan level kemampuan literasi matematika siswa SMP dalam menyelesaikan soal PISA konten *quantity*. Data hasil penelitian ini diambil dari hasil tes soal PISA konten *quantity* dan wawancara terhadap siswa. Pengambilan subjek didasarkan pada hasil tes siswa yang memiliki nilai tertinggi, karena diharapkan mendapatkan hasil analisis literasi siswa yang tinggi. Pada penelitian ini, peneliti menggunakan indikator level kemampuan literasi matematika menurut PISA. Berdasarkan hasil penelitian dan pembahasan, diperoleh kesimpulan yaitu terdapat siswa yang memiliki level literasi matematika yang tinggi setara level 5.

Kata kunci : *Literasi Matematika, Soal PISA, Konten Quantity*

Abstract: Mathematical literacy is defined as students' capacity to formulate, employ and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals in recognising the role that mathematics plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged and reflective citizens. Quantity content includes the ability in reasoning quantitatively, representing something into numbers, understanding mathematical steps, counting by heart and making assessments. The questions on quantity content are mostly implemented in everyday life, such as in exchanging currency exchange rates, determining bank interest, shopping, calculating taxes, measuring time, measuring distance and others. The purpose of this article is to describe the level of mathematical literacy ability of junior high school students in solving Quantity content PISA questions. The data from this study were taken from the results of the PISA test questions on quantity content and interviews. Subject taking is based on the test results of students who have the highest scores,

as it is expected to get the results of the analysis of students' high literacy skills. In this research, the researcher is using indicators of mathematical literacy level according to PISA. Based on the results of research and discussion, it is concluded that there are students who have high mathematical literacy skills equivalent to level 5.

Keywords: *Mathematical Literacy, PISA Problems, Quantity Content*

INTRODUCTION

In this modern era, learning mathematics is not only memorizing formulas and counting, but students are expected to have logical and critical reasoning skills in problem solving. This problem solving is more about solving problems that related to daily life. These mathematical abilities are known as mathematical literacy ability. Mathematical literacy is defined as students' capacity to formulate, employ and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals in recognising the role that mathematics plays in the world and to make the well-founded judgements and decisions needed by constructive, engaged and reflective citizens (OECD, 2016).

One of the International assessments that assess mathematical literacy is PISA (Programme for International Student Assessment). PISA initiated by the OECD is a study to evaluate the education system that followed by more than 70 countries around the world. Every 3 years, 15-year-old students from randomly selected schools take tests in the main subjects of reading, math, and science. Indonesia has participated in PISA studies since 2000. Based on the results of PISA study that published by OECD, in the mathematics domain is assessing students' mathematical literacy skills, Indonesia's ranking tends to be at the lower.

Table 1. Indonesia PISA Results

Year	Indonesia Avarage Score	Indonesian Ranking	Total Participate Countries
2000	367	39	41
2003	360	38	40
2006	391	50	57
2009	371	61	65
2012	375	64	65
2015	386	65	72
2018	379	73	79

From the table above indicates that the mathematical literacy ability of Indonesian students is still low and it indicates that the quality of education in Indonesia is still lagging behind other countries.

PISA has classified students' mathematical literacy skills into six levels, each level shows the different students' cognitive abilities. Mathematical literacy level according to PISA as follows:

1. The first level as the lowest level that exists in students including the ability in answering clear questions according to relevant information in a known context. They are able to identify information in general ways and act according to the simulation.
2. Level two, there is a skill in interpreting and recognizing context situations that directly require conclusions. In addition, students can choose relevant information from one source with one solution. Students also have the ability to work on basic algorithms, use formulas, carry out the procedures and give the precise reasons for the completion results.
3. Level three, there is the ability to work through steps or procedures clearly. To solve problems, simple strategies can be applied. Another skill that emerges is the ability to communicate the results of interpretations and representations based on different sources of information.
4. Competencies that appear in level four are skills in working effectively with models in concrete and complex situations related to the real world. Students are already competent in expressing the reasons in a clear context. Then explain and communicate based on interpretation followed by logical reasons.
5. At level five, has appeared the ability to develop and work with models in complex situations, identify the problems, and establish the assumptions. In that process, students selecting, comparing, and evaluating appropriately problem solving strategies that related to complex problems that connected to the model. Working strategically can be seen from the broad thinking and reasoning process, it is also exact in connecting the representation of symbols, formal characteristics and knowledge related to the situation. Even students are able to reflect on work besides formulate and communicate interpretations followed by reasons.
6. At level six, there is a high level of logical reasoning ability to apply concepts, knowledge, mathematical symbols and operations, generalizations, and information based on study and modeling in complex situations. In addition, students are capable to reflect, formulate and also communicate appropriately the findings and can interpret, express the opinions and suitability with the real situations.

PISA questions are developed based on 4 contents, they include: Shape and Space, Change and Relationship, Quantity, and Uncertainty. One of four contents of PISA questions is Quantity content. Quantity content includes the ability to reason quantitatively, to present something in numbers, to understand mathematical steps, to count by heart and make assessments (OECD, 2014). Questions on quantity content are mostly implemented in everyday life, such as in exchanging currency rates,

determining bank interest, shopping, calculating taxes, measuring time, measuring distance and others (Anisah, Zulkardi, & Darmawijoyo, 2016).

The results of Sari, Hartoyo & Hamdani's research (2016) regarding students' mathematical literacy on Quantity content in Junior High Schools, that is students who have an upper level of ability are able to reach level 5 mathematical literacy on Quantity content, which means they have reflection competence which is the highest competency of mathematical literacy. From the results of this study, it is known that there are students with high literacy skills, which is contrary to the Indonesian PISA score. Therefore, there will be a possibility that there are other Indonesian students who also have high mathematical literacy skills.

Based on the description and results of that research, it is necessary to conduct a study on mathematical literacy abilities in Junior High School students. The purpose of this article is to describe the level of mathematical literacy ability of Junior High School students in solving Quantity content PISA questions.

RESEARCH METHOD

This kind of research based on its approach is a qualitative research with a descriptive research design. The subjects in this study are 8th grade students of MtsN 1. Subject selection by purposive sampling technique, which is taken 1 student with the best test results. Data analysis is done by analyzing and describing the results of student tests, and the results of interviewing students. Then the analysis was applied according to the level of mathematical literacy according to PISA.

Data collection techniques in this research are written tests and student interviews. A written test is conducted to obtain data on the literacy level of students in solving PISA questions of quantity content. Student interviews are conducted to find out how the subject completed the written test and as a support in determining the level of students' literacy skills in solving quantity content PISA questions..

Data analysis techniques in this research consists of collecting data, reducing data, presenting data, and making conclusions. The validity of data in this research using triangulation techniques, that is by comparing the results of the written test with the results of subject's interview. The data or information in this study are collected from data in the form of students' worksheet on PISA quantity content questions and interviews based on student replies. Data analysis conducted in this study by analyzing and describing the results of student tests, and the results of interviews with students. Then the analysis was carried out according to the level of mathematical literacy according to PISA.

RESULTS AND DISCUSSION

The data from this research are taken from the results of the PISA test questions on quantity content and interviews. Taking subject is based on the test results of students that have the highest scores, for it is expected to get the results of the analysis of students' high literacy skills. In this research, the researcher using the level of mathematical literacy indicators according to PISA. The following shows the results of subject's answers along with a discussion of the subject's mathematical literacy ability.

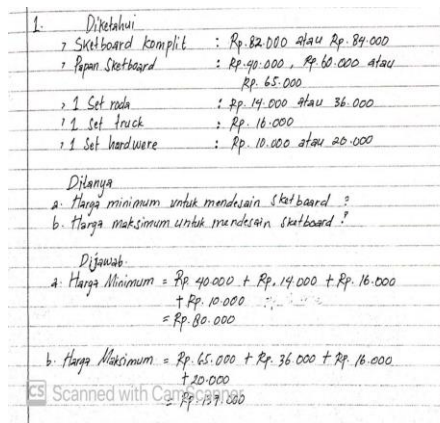


Figure 1. Answer to question number 1

For number 1, it can be seen in figure 1 that students are able to write down the important information contained in the questions and can solve them, it can be seen from the students are able to write down what is known in the questions. Students also already known what the questions want, it can be seen from students write down what is being asked in the questions. Students are also able to relate the information that obtaining to solve problems in question properly and correctly.

Furthermore, it is also supported by interviews with students, that students can explain what they are doing, it can be seen from the first question, students can explain what they know in the questions, then students also explain what is asked in the questions. Students are also able to explain the steps of working on the questions, it can be seen from how students answer each step by step of it. From this, it can be seen that students have mathematical literacy skills equivalent to level one, it is the ability to answer questions clearly in accordance with relevant information in context. They are able to identify information in general ways and act according to the simulation.

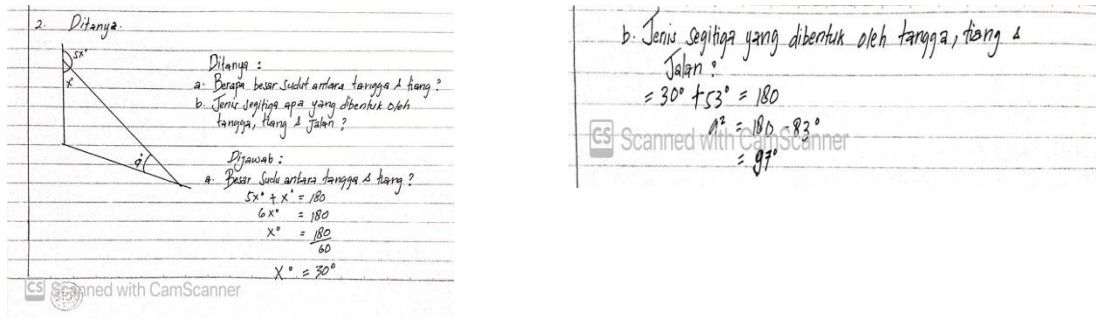


Figure 2. Answer to question number 2

For number 2, it can be seen in figure 2 that students can interpret what they know in the questions by the picture, students can correctly place the recognized angles in the picture. Students also transcribe what is asked in the question correctly. Students can answer questions using the information they have obtained correctly and appropriately, and can make the conclusions from the results. Students are able to use basic skills and basic procedures in solving problems. Students also use the correct steps.

Moreover, it is supported by interviews with students, that students can clearly explain the reasons they draw as in the picture, and they can also explain what is being asked in the question. Students are able to use the basic concepts of triangles, and they are able to apply it in solving problem number 2. Students can provide logical reasons for the answers they have completed. From this, it can be seen that students have mathematical literacy skills equivalent to level two, which can interpret and recognize contextual situations that directly require conclusions. In addition, students can select the relevant information from one source, with one solution. Students also have the ability to work on basic algorithms, use formulas, do the procedures and provide precise reasons for completion results.

3. Ditetahui:

Berat (gram)	Harga (Rupiah)
0 - 20	Rp. 46.000
21 - 50	Rp. 69.000
51 - 100	Rp. 102.000
101 - 200	Rp. 135.000
201 - 350	Rp. 213.000
351 - 500	Rp. 244.000
501 - 1000	Rp. 320.000
1001 - 2000	Rp. 401.000
2001 - 3000	Rp. 503.000

Ditanya:

> Berapa termurah untuk mengirim barang seberat 40 g dan 80 gram. Apakah dikirim dalam satu paket atau terpisah?

Jawab:

> Dipisah:

$$\begin{aligned} 40 \text{ gram} &= \text{Rp. } 69.000 \\ 80 \text{ gram} &= \text{Rp. } 102.000 \end{aligned} \quad \} + = \text{Rp. } 171.000$$

> Dibungkus 1 paket:

$$\begin{aligned} 40 \text{ g} + 80 \text{ g} &= 120 \text{ g} \\ 120 \text{ g} &= 135 \text{ g} \end{aligned}$$

> Jadi Paket lebih murah jika paket dikirimkan terpisah dengan total Rp. 171.000

CS Scanned with CamScanner

Figure 3. Answer to question number 3

For number 3, it can be seen in figure 3 that students can write in their own language what is asked in the question, also students write the information contained in the questions. Students are able to answer questions in a structured and clear ways. Students are able to choose an easy solution according to them, and able to make conclusions from the results of their work. Students answer correctly and exactly.

Furthermore, supported by interviews with students, that students can explain the steps for solving problem number 3. Students can also explain the steps in solving problems and explain the reasons for using the steps. Students answer all questions properly and correctly, even students can make conclusions from the questions. Then, it can be seen that students have mathematical literacy skills equivalent to level three, namely the ability in working with steps or procedures clearly. For solving the problem, a simple strategy is applied. Another skill that appears is the ability to communicate the results of interpretations and representations based on different sources of information.

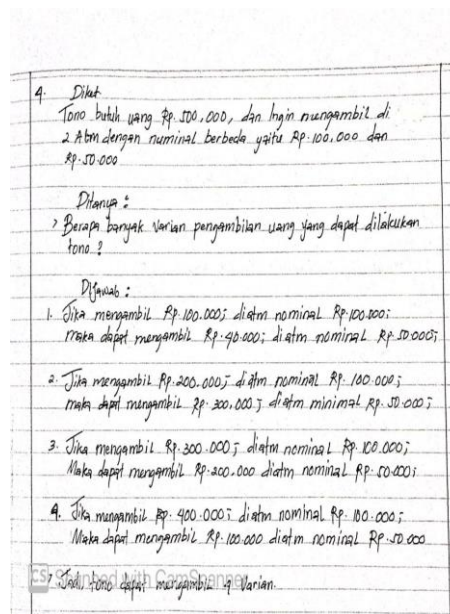
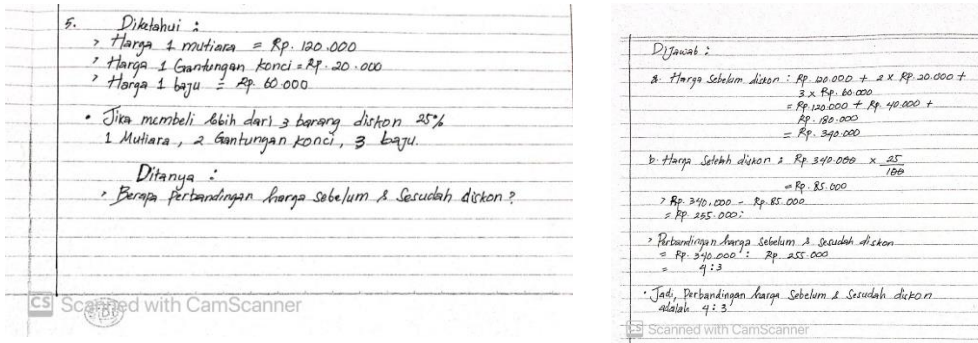


Figure 4. Answer to question number 4

For question number 4, it can be seen in figure 4 that students are able to answer the questions properly and correctly. Students answer questions in their own language and words, it can be seen from students' answers that students represent their own answers. Students no longer use formulas, but they using their own creativity and thinking in solving real problems in question number 4.

Additionally, it is also supported by interviews with students that they are able to explain solving the question in number 4, students are also able to provide logical reasons that support the answer. From this, it can be seen that students have mathematical literacy skills equivalent to level 4, it is called the ability in working effectively with models in concrete and complex situations related to the real world.

Students are able in using clear contextual reasoning. Then, students explain and communicate based on interpretation followed by logical reasons.



5. Diketahui :

- ↳ Harga 4 mutiara = Rp. 120.000
- ↳ Harga 1 Gantungan kunci = Rp. 20.000
- ↳ Harga 1 baju = Rp. 60.000

• Jika membeli lebih dari 3 barang diskon 25%

1 Mutiara, 2 Gantungan kunci, 3 Baju.

Ditanya :

- Berapa perbandingan harga sebelum & sesudah diskon?

Dijawab :

a. Harga Sebelum Diskon : $Rp. 120.000 + 2 \times Rp. 20.000 + 3 \times Rp. 60.000$
 $= Rp. 120.000 + Rp. 40.000 + Rp. 180.000$
 $= Rp. 340.000$

b. Harga Setelah Diskon : $Rp. 340.000 \times \frac{25}{100}$
 $= Rp. 85.000$

↳ $Rp. 340.000 - Rp. 85.000$
 $= Rp. 255.000$

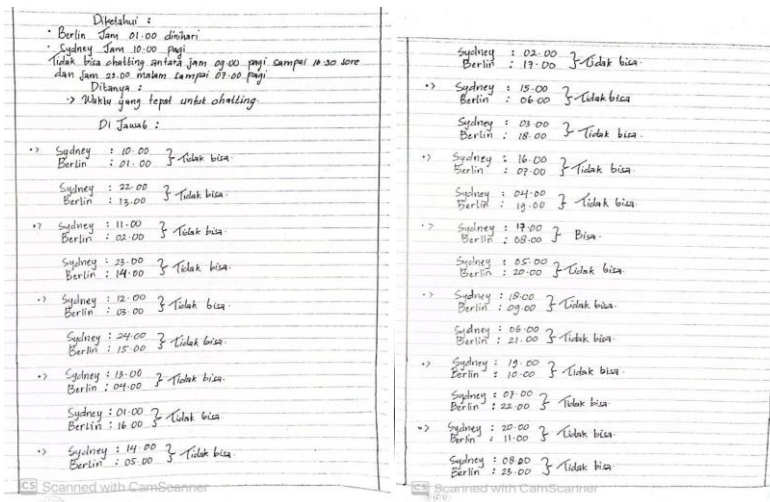
↳ Perbandingan Harga Sebelum & Setelah Diskon
 $= Rp. 340.000 : Rp. 255.000$
 $= 4 : 3$

↳ Jadi, Perbandingan Harga Sebelum & Setelah Diskon adalah 4 : 3

Figure 5. Answer to question number 5

For question number 5, it can be seen that students only write the useful information in solving question, students are also able to understand what is asked in question, from here it can be seen that students have the ability to identify the questions. Students are able to solve problems properly and accurately. Students are able to calculate the normal price and after the discount also students are able to compare the two prices. Students are also able to choose the proper discount for answering the problems in questions. Students are capable to determine the appropriate and effective stages in solving the problem in number 5.

Furthermore, it is also supported by interviewing students, that students are able to explain the reasons for solving the problems. students are capable to explain step by step in detail and sitematically. The students' reasoning ability can also be seen after they explain comparing two prices. Then, it can be seen that students have mathematical literacy skills equivalent to level 4.



Diketahui :

- Berlin Jam 01.00 dinihari
- Sydney Jam 10.00 pagi
- Tidak bisa chatting antara jam 09.00 pagi sampai 11.30 sore dan jam 23.00 malam sampai 01.00 pagi.

Ditanya :

- ↳ Paksi yang tepat untuk chatting

Dijawab :

- ↳ Sydney : 10.00 } Tidak bisa
- ↳ Berlin : 01.00 } Tidak bisa
- ↳ Sydney : 22.00 } Tidak bisa
- ↳ Berlin : 13.00 } Tidak bisa
- ↳ Sydney : 11.00 } Tidak bisa
- ↳ Berlin : 02.00 } Tidak bisa
- ↳ Sydney : 23.00 } Tidak bisa
- ↳ Berlin : 14.00 } Tidak bisa
- ↳ Sydney : 12.00 } Tidak bisa
- ↳ Berlin : 03.00 } Tidak bisa
- ↳ Sydney : 24.00 } Tidak bisa
- ↳ Berlin : 15.00 } Tidak bisa
- ↳ Sydney : 18.00 } Tidak bisa
- ↳ Berlin : 04.00 } Tidak bisa
- ↳ Sydney : 01.00 } Tidak bisa
- ↳ Berlin : 16.00 } Tidak bisa
- ↳ Sydney : 14.00 } Tidak bisa
- ↳ Berlin : 05.00 } Tidak bisa

Sydney : 02.00 } Tidak bisa

Berlin : 17.00 } Tidak bisa

- ↳ Sydney : 15.00 } Tidak bisa
- ↳ Berlin : 06.00 } Tidak bisa
- ↳ Sydney : 03.00 } Tidak bisa
- ↳ Berlin : 18.00 } Tidak bisa
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- ↳ Berlin : 11.00 } Tidak bisa
- ↳ Sydney : 08.00 } Tidak bisa
- ↳ Berlin : 23.00 } Tidak bisa

Figure 6. Answer to question number 6

For question number 6, students are able to analyze in their own language at the right time to chat. Students are also able to determine and compare the exact time in Berlin as well as Sydney. From the results of students' answers, it can be seen that students are capable to choose the exact solution strategy according to their own opinion. Students are capable in connecting the information provided to get the right answer. Students' reasoning abilities are already to be seen from the results of answers where students write the time per hour at the time in Sydney and Berlin, until they found the exact time on the questions.

Furthermore, this is supported by interviewing students, it looks that students are able to explain the thinking process that they did in solving the question number 6. Students are explaining the reasons for choosing to write in one hour intervals. Students are also able I giving their opinion that in their opinion within an interval of one hour it is easier for students to answer the question number 6. From interviewing students, it can be seen that students are able to communicate their ideas, students are also capable to choose the right strategy in solving problems, students are also able to give logical

These findings are in line with the research by Syawahid & Putrawangsa (2017) that there are students with auditory and kinesthetic learning styles who are having mathematical literacy skills equivalent to level 4. Another study conducted by Wati, Sugiati & Muhtarom (2019) shows that the mathematical literacy ability of students with high mathematical abilities is quite good. The stages that can be achieved are identifying the mathematical aspects of a problem context in real life and identifying existed variables and determining mathematical models and simplifying the problems. Students are also capable to design and apply strategies to find out the solutions, determine the datum, procedures, algorithms and mathematical models in finding solutions. Students are also able to reflect, describe, and determine mathematical results, interpret mathematical results back into real life context, as well as evaluating mathematical solutions into real life context. This ability is equivalent to level 5 literacy skills.

CONCLUSIONS AND SUGGESTIONS

Based on the results of research and discussion, it is concluded that there are students who have high mathematical literacy skills equivalent to level 5. It is called the ability to develop and work with models in complex situations, identify the problems, and establish the assumptions. In the process, students selecting, comparing, and evaluating appropriately the problem solving strategies relating to complex problems that relate to the model. Working strategically is seen with broad thinking and reasoning processes, and it is precise in connecting symbol representations, formal characteristics and knowledge related to the situations. Even, students are able to reflect their works as well as formulate and communicate interpretations followed by the reasons.

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