Jurnal Pendidikan Matematika (Kudus)
P-ISSN 2615-3939 | E-ISSN 2723-1186
https://journal.iainkudus.ac.id/index.php/jmtk
DOI: http://dx.doi.org/10.21043/jpmk.v7i2.26069
Volume 7, Number 2, Desember 2024, pp. 169-188

Solving PISA-like Quantity Content: Mathematical Literacy Students Viewed by Level of Mathematical Logic Intelligence

Annisa Alvi Elyasarikh[1*], Masriyah[1]

[1]Department of Mathematics Education, Universitas Negeri Surabaya, Surabaya, Indonesia
**Correspondence: annisaalvi.20046@mhs.unesa.ac.id*

Abstract

Mathematical literacy related to problem-solving can be measured through PISA or PISA-like, which requires mathematical logic intelligence. Differences in levels of mathematical logical intelligence can result in varying levels of students' mathematical literacy. Therefore, the objective of this study is to describe the mathematical literacy of students based on the level of mathematical logic intelligence when it comes to solving PISA-like problems in quantity content. This study used a descriptive-qualitative approach. Purposive sampling was applied to select three students representing low, medium, and high levels of mathematical logical intelligence. The instruments used were a mathematical logic intelligence test, a PISA-like test, and interview guidance. Data reduction, data display, and making conclusions were data analysis techniques used in this study. The results indicate that a student with high mathematical logical intelligence met all indicators of mathematical literacy. A student with medium mathematical logical intelligence met only the 'formulate' indicator, while a student with low mathematical logical intelligence did not meet any indicators. Teachers can utilize the study's findings to build learning experiences that can improve mathematical literacy of students in solving both PISA and PISA-like problems based on their level of mathematical logic intelligence.

Keywords: Level Of Mathematical Logic Intelligence; Mathematical Literacy; PISA-like; Quantity Content

Abstrak

Literasi matematis berkaitan dengan pemecahan masalah dapat diukur melalui PISA atau PISA-like yang memerlukan kecerdasan logis matematika untuk menyelesaikannya. Perbedaan tingkat kecerdasan logis matematis memungkinkan perbedaan literasi matematis siswa. Oleh karena itu, tujuan penelitian ini adalah mendeskripsikan literasi matematis siswa berdasarkan tingkat kecerdasan logis matematis dalam menyelesaikan soal PISA-like konten bilangan. Penelitian ini

menggunakan pendekatan deskriptif kualitatif. Tiga siswa dipilih secara *purposive sampling* yakni subjek yang memiliki kecerdasan logis matematis tinggi, sedang, dan rendah. Instrumen yang digunakan adalah tes kecerdasan logis matematis, tes PISA-like, dan pedoman wawancara. Analisis data penelitian ini mencakup reduksi data, penyajian data, dan penarikan kesimpulan. Temuan penelitian menunjukkan bahwa siswa dengan tingkat kecerdasan logis matematis tinggi mampu mencapai semua indikator kemampuan literasi matematis, siswa dengan tingkat kecerdasan logis matematis sedang hanya dapat mencapai kemampuan formulate, sedangkan siswa dengan tingkat kecerdasan logis matematis rendah tidak mampu mencapai semua kemampuan literasi matematis. Guru dapat memanfaatkan temuan penelitian ini sebagai bahan untuk merancang pembelajaran yang dapat meningkatkan literasi matematis siswa dalam memecahkan masalah PISA maupun PISA-like berdasarkan tingkat kecerdasan logis matematis siswa.

Kata Kunci: Konten Bilangan; Literasi Matematis; PISA-like; Tingkat Kecerdasan Logis Matematis

Introduction

In modern times, we need mathematical literacy that relates to mathematical reasoning and problem-solving (Hayati & Kamid, 2019). Mathematical literacy is the ability of a person to formulate, apply, and interpret real-world problem solving in mathematics (OECD, 2019a). According to the (OECD, 2019a), standards of measurement of student mathematical literacy include mathematization, representation, communication, reasoning, formulating problem-solving strategies, use of language and symbolic, formal, and technical operations, as well as the use of mathematics tools. These eight mathematical cognitive competencies correspond to the objectives of Indonesian learning in mathematics. Mathematical literacy forms a comprehensive foundation for understanding mathematics and its applications. It implies the importance of mathematical literacy as a competence to be developed among students.

The level of mathematical literacy can be seen through the results of the PISA test by the OECD (Organization for Economic Cooperation and Development). In 2018, Indonesia was rated 73rd of 79 nations with an average PISA math score of 379 and a global average of 489 (OECD, 2019b). In 2022, Indonesia ranked 69th out of 81 countries with a total average of 366 math scores, while the global PISA average for mathematics was 480 (OECD, 2023). In addition, by 2022, only 18% of Indonesian students were be able to reach level 2 upwards (OECD, 2023). It demonstrates that the quality of mathematics literacy in Indonesia remains poor.

PISA covers four content areas: uncertainty and data, change and relationships, space and shape, and quantity (OECD, 2022). Quantity content is the most important aspect of mathematics in life-related to measurements, units, and

number patterns and is widely applied in real life, such as determining bank interest, buying and selling transactions, measuring time, and measuring distance. Therefore, number content is very important to learn in school because it is very close to students' daily lives (Munfarikhatin, Natsir, & Rahajaan, 2022). If a student's ability in quantity content is low, it can negatively affect their understanding of related concepts in other PISA areas. This has been confirmed by Murtiyasa (2015), who states that quantity is the main method for describing and measuring distinct objects (space and shape), including testing changes and relationships (change and relationship), organizing, interpreting, measuring, and assessing data (uncertainty and data). However, quantity content consistently scores below the PISA average. The 2012 PISA results show that the average score for students' quantity content was the lowest among all content areas, at 362. This was followed by change and relationship content (364), space and shape (383), and uncertainty and data (384) (OECD, 2014). In addition, the 2022 PISA results show that the quantity content score at 363 is lower than the average PISA mathematics score at 379 (OECD, 2023). The mathematical literacy abilities of Indonesian students, especially quantity content, are very low due to the lack of familiarization with mathematical literacy in the classroom, and the problems students face do not reflect real-world contexts (Djadir, Awi, & Sulhijrah, 2018; Duyen & Loc, 2022; Munfarikhatin et al., 2022). Another reason Indonesian students struggle with PISA problems is PISA problems use a foreign context, the problem's difficulty level is also higher (Putri Wahyuni & Masriyah, 2021). Therefore, this study aims to explore more deeply students' abilities in completing PISA quantity content.

To train students in solving PISA problems, they can be given PISA-like problems—equivalent problems based on the PISA mathematical framework. The framework includes context (personal, work, social, and scientific), content (space and shape, uncertainty and data, change and relationships, and quantity), PISA problem levels (level 1 to level 6), and the dominant processes when problem solving, including the processes of formulating, implementing, interpreting and evaluating (OECD, 2022).

In solving PISA and PISA-like problems, students must have intelligence. According to Bustomi (2012), intelligence is the ability to understand information in order to build knowledge and awareness. It is also the capacity to process information to solve problems and expand understanding. One type of intelligence is multiple intelligences (Hoerr, 2007). One of the multiple intelligences according to Gardner (2011) is mathematical logical intelligence. Gardner (2011) suggests that mathematical logical intelligence is an individual's capacity to think deductively and

inductively, solve problems, think logically, and understand and analyze patterns. Mathematical logic intelligence can be realized in the form of calculating, categorizing or classifying, thinking scientifically with scientific processes, making analogies, etc (Irvaniyah et al., 2014). With mathematical logical intelligence, it can be said that students are capable of thinking critically, creatively, deductively, inductively and another skill (Erlina & Hakim, 2019). Mathematical logic intelligence is needed to complete mathematical literacy because students will have the ability to identify problems, carry out calculations and reason abstractly.

Mathematical logical intelligence can be separated into three categories: high, medium, and low. Students with high, medium, and low levels of mathematical logical intelligence have different problem-solving abilities (Hidayah, 2017). According to Gardner (2011), someone with a high level of mathematical logic intelligence can solve problems quickly, analyze information easily, and understand cause-and-effect relationships. According to Hidayah (2017), students with a high level of mathematical logical intelligence can provide correct answers and solutions through various methods and often generate unique answers based on their own ideas. Students with a medium level of mathematical logical intelligence can solve problems accurately and use appropriate work procedures through different methods, although they typically do not produce unusual answers (Hidayah, 2017). Students with a low level of mathematical logic intelligence do not have the ability to give unusual answers (Hidayah, 2017).

Different levels of mathematical logical intelligence lead to varying levels of students' mathematical literacy. Research by Umami et al. (2021) found that students with high mathematical logical intelligence met all mathematical literacy indicators. In contrast, students with low logical-mathematical intelligence failed to fulfill key indicators of mathematical literacy ability, including creating mathematical models, applying problem-solving strategies, and performing evaluations. This research is relevant in terms of its focus on students' mathematical literacy and the level of mathematical logical intelligence. However, it differs in the PISA content used; the previous research examines change and relationship content, while this study focuses on quantity content.

Based on this background, the novelty of this research lies in its focus on quantity content and its analysis of students' mathematical literacy according to their level of mathematical logical intelligence. Quantity content was chosen because it has rarely been discussed in previous research. By knowing how mathematical literacy is based on students' level of mathematical logical intelligence, teachers will be able to design a learning that can increase students' mathematical literacy in

dealing with PISA and PISA-like problems based on students' level of mathematical logic intelligence. Therefore, this study aims to describe students' mathematical literacy according to their level of mathematical logical intelligence when solving PISA-like problems focused on quantity content.

Method

This study used a qualitative approach with descriptive research. The qualitative approach allowed data from the natural environment to serve as a direct source, enabling findings to be described in words to analyze students' mathematical literacy within the PISA-like quantity content based on their level of mathematical logical intelligence. Descriptive research was chosen as it aligned with the study's aim to present a detailed, factual, and accurate description of students' mathematical literacy in solving PISA-like problems in quantity content, viewed through their mathematical logic intelligence levels. The study procedures were as follows: (1) Selection of the candidate class, conducted with 37 ninth-grade students from Al Falah Deltasari Sidoarjo Primary School. (2) Administered a mathematical logic intelligence test to the 37 students. (3) Selected research subjects by categorizing students into high, medium, and low levels of mathematical logic intelligence. (4) Administered the PISA-like test to the selected subjects. (5) Conducted interviews to analyze each subject's mathematical literacy in solving PISA-like problems.

Based on the research procedure above, this study selected the subjects using a purposive sampling technique, which taking the subject into particular consideration (Helaluddin & Hengki Wijaya, 2019). One student with a high level, one with a medium level, and one with a low level of mathematical logic intelligence were selected from Al Falah Deltasari Sidoarjo Junior High School. Here's the formula for categorizing the level of mathematical logic intelligence.

Table 1. Categorizing Formula the Level of Mathematical Logic Intelligence

Score range	Category
Score $< \bar{x} - SD$	Low
$\bar{x} - SD \leq$ Score $\leq \bar{x} + SD$	Medium
Score $> \bar{x} + SD$	High

(Arikunto, 2012)

With: $\bar{x}$ = mean

SD = standard deviation

The data collection approach in this study was a combination of tests and interviews, including a mathematical logic intelligence test, a mathematical literacy (PISA-like) test, and an interview. Therefore, the instruments in this research consisted of a mathematical logic intelligence test modified by Srirejeki (2021) that contains eight questions in essay form, a PISA-like test with one question modified by Wijayanti (2020), and the interview guidelines. Here's one of the instruments used by PISA-like.

School Supplies and Stationary Store "RAINBOW"

Some of the items for sale are as follows.

The items	Many items	Price
Bag *unisex* "Unity"	1 piece	Rp155.000,00
Pencil 2B "Kastell"	1 piece	Rp4.000,00
	1 pack (12 piece)	Rp45.000,00
Mechanical pencil "Kastell"	1 piece	Rp5.000,00
Pen "Filtran"	1 piece	Rp2.500,00
	1 pack (12 piece)	Rp24.500,00
Tipe-x "Alka" 12 m	1 piece	Rp10.000,00
Liquid Tipe-x "Alka"	1 piece	Rp5.500,00
Book "Sindu" 38 sheet	1 piece	Rp4.000,00
	1 pack (10 piece)	Rp37.000,00
Pencil case "Unity"	1 piece	Rp30.000,00
Ruler "Elephant" 30 cm	1 piece	Rp2.500,00
Highlighter "Stabyly"	1 piece	Rp4.000,00
Sharpener "Alka"	1 piece	Rp2.000,00
Crayon "Kastell"	1 pack (48 piece)	Rp59.000,00

Approaching the new school year, the "Rainbow" Store gives its customers a discount of 20% of the total normal price with term and condition that they buy at least 6 different types of goods and the total normal price is above Rp75,000.00 at the store. Determine whether Fiona's money of Rp200,000.00 is enough to buy a bag, 1 ballpoint pen, 1 pack of books, 1 paper stipo, 1 pencil case, and 1 mechanical pencil.

Figure 1. PISA-like test

Data reduction, data display, and drawing conclusions were data analysis techniques based on the results of mathematical literacy tests and interviews obtained. Sorting important information based on research indicators was a step in the data reduction process. The research indicators are as follows.

Table 2. Research Indicators

Mathematical Literacy	Indicator	Indicator's Code
Formulate	Identify the problem by describing what was known and asked in the question	F
Employ	Applying mathematical concepts by outlining the steps to find solutions.	E
Interpret and evaluate	Drawing the conclusions obtained into the context of the problem	I1
	Criticizing and re-checking the solution	I2

After reducing the data, the data was presented in the form of tables and images so that it is easier to analyze, and the final stage was to draw conclusions

based on the results of the mathematical literacy test and the interview about the student's mathematics literacy in solving the PISA-like problems according to their level of mathematical logic intelligence.

Results

In this study, two tests were performed. The first test was a mathematical logic intelligence test conducted with a ninth-grade class of 37 students. Based on the mathematical logic intelligence test, the calculation and classification of the level of mathematical logic intelligence were based on the formula in Table 1, and the range of the score as follows.

Table 3. Range the Level of Mathematical Logic Intelligence Scores

Range of Scores	Category
Score $>$ 58.88	High
17.17 $\leq$ Score $\leq$ 58.88	Medium
Score $<$ 17.17	Low

Based on the score ranges above, the researcher selected one female student with a high level of mathematical logic intelligence, one with a medium level, and one with a low level. The three selected subjects were as follows.

Table 4. Selected Subjects

Subjects' Initials	Score	Category	Subjects' code
SAH	88	High	SH
KAAA	37	Medium	SM
RACDS	16	Low	SL

The three subjects were given the PISA-like test, and interviews were conducted to assess their mathematical literacy when completing the PISA-like quantity content. The PISA-like test results and three subjects' interviews with researchers given the code "R" (researcher) are as follows.

Subject who has a High Mathematical Logic Intelligence (SH)

Here's SH's answer to PISA-like.

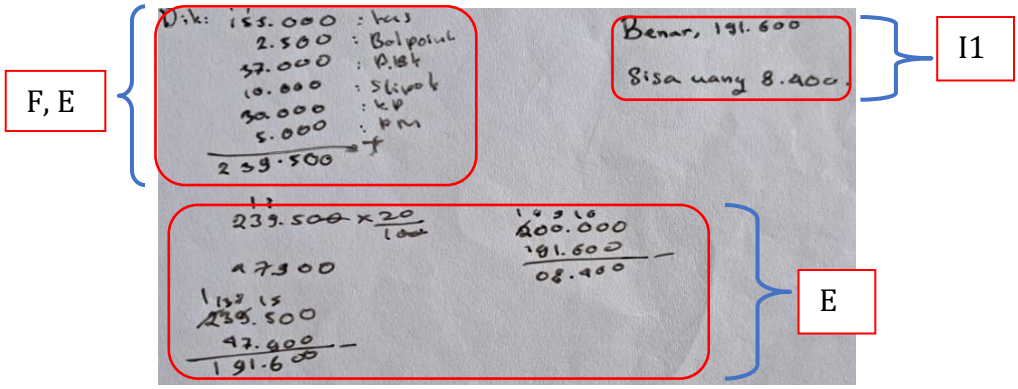


Figure 2. SH's work of PISA-like

Table 5. The result of an interview by SH

Transcript Code	Interview snippet	Indicator Code
P-01	What do you understand about this problem?	F01
SH-01	Fiona's money was enough to buy a bag, a bolpoint, a book pack, a tipe-x, a pencil case, and a mechanical pencil. Is the statement true?	F01
P-02	Well now explain what's known to solving the question?	F01
SH-02	The price of the bag Rp155.000,00, the price of 1 pen Rp2.500,00, the price of a pack of book Rp37.000,00, the price of tipe-x Rp10.000,00, the price of pencil case Rp30.000,00, and the price of mechanical pensil Rp5.000,00. Then Fiona's money Rp200.000,00 and 20% discount on the condition of buying at least 6 different items and the total are above Rp75.000,00.	F01
P-08	Are you sure this answer is correct?	I02
SH-08	I'll check again. (count again). I'm sure InsyaAllah.	I02
P-09	Why?	I02
SH-09	Because the total of the things were right while I counted it again and the discount was right, so InsyaAllah thats right.	I02

In SH's written answer, the subject only includes the names and prices of the items but does not fully state the known information or restate the question However, during the interview, SH is able to describe the details of the problem, including the items to be bought, Fiona's money, and the discount information (SH-02), and can explain what is being asked correctly (SH-01). Furthermore, based on the answer, it can be concluded that the subject has completed the question correctly. She added up all the prices of the item concerned to find the price after the discount and then produced the correct answer. The subject can answer that the statement is true. From SH's written answers, it is evident that SH can conclude that the statement in the question is true, supporting this with the total price of the items

and the remaining amount of Fiona's money. Based on the interview above, SH has been convinced that the answer obtained is the right answer (SH-08). The reason is that the subject of SH has recalculated for each of the settlement steps and found that the answer remains the same (SH-09). This aligns with research by Umami et al. (2021) which states that students with high mathematical logic intelligence are able to draw conclusions from real-world problem-solving outcomes and evaluate each solution step.

The subject who has a Medium Mathematical Logic Intelligence (SM)

Here's SM's answer to PISA-like.

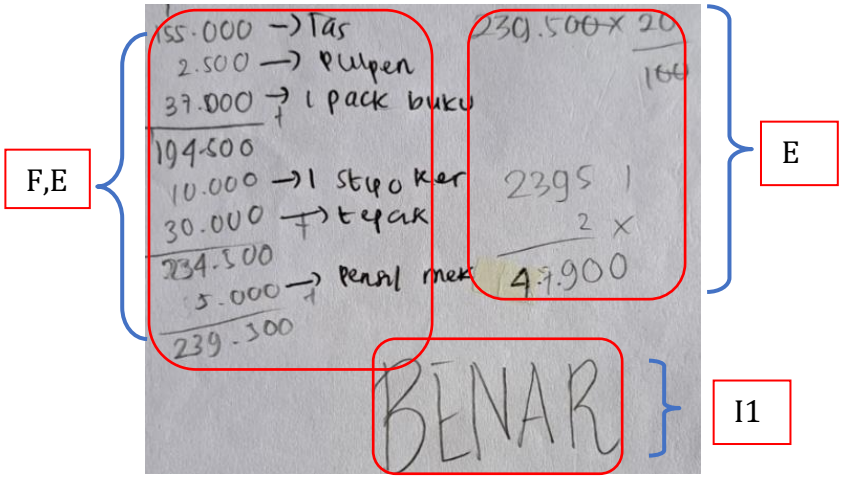


Figure 3. SM's work of PISA-like

Table 6. The result of interview by SM

Transcript Code	Interview snippet	Indicator Code
P-01	What do you understand from this problem?	F01
SM-01	Is the statement if Fiona's money is enough to buy a bag, pen, 1 pack of books, 1 tipe-x, 1 pencil case, and 1 mechanical pencil?	F01
P-02	OK, now explain what was known to solve the problem!	F01
SM-02	Fiona's money is Rp200.000,00, the price of the bag is Rp155.000,00, the price of 1 pen is Rp2.500,00, the price of 1 pack of books is Rp37.000,00 the price of a tipe-x is Rp10.000,00, the price of a pencil case is Rp30.000,00, the price of a mechanical pencil Rp5.000,00, 20% discount provided you buy a minimum of 6 different items and the total is above Rp75.000,00	F01

Transcript Code	Interview snippet	Indicator Code
P-08	Are you confident that your answer is true?	-
SM-08	I'm sure.	-
P-09	Why are you sure?	-
SM-09	Because the steps for the total items are correct and the discounts are also correct.	-

In SM's written answer, SM only noted the item names and prices and immediately proceeded to solve the problem by adding the item prices. The subject also did not write down what was asked in the question. However, in the interview, SM was able to correctly explain the question's meaning, clearly identifying the known information (SM-02) and accurately stating what was being asked (SM-01). Then it can be seen on the answer sheet that SM solved the problem by first adding up the prices of the things and then multiplying the discount percentage by the total price of the goods. This approach is incorrect, as SM misunderstood the discount calculation. SM multiplied the initial total price by the discount percentage without subtracting this result from the initial price, leading to an incorrect final answer of Rp. 46,900.00. This is relevant to Umami et al. (2021) who also found that students with a moderate level of mathematical logic intelligence were able to design a problem-solving strategy accurately, but the final solution may still be incorrect. Subject SM then drew the conclusion that the statement was true because the calculation result was less than Fiona's money, namely Rp200.000,00. SM expressed confidence in the answer (SM-08), explaining that the subject believed the steps taken were correct (SM-09). However, SM demonstrated a misconception regarding the discount calculation, indicating that SM was unable to evaluate the solution critically.

The subject who has a Low Mathematical Logic Intelligence (SL)

Here's SL's answer to PISA-like.

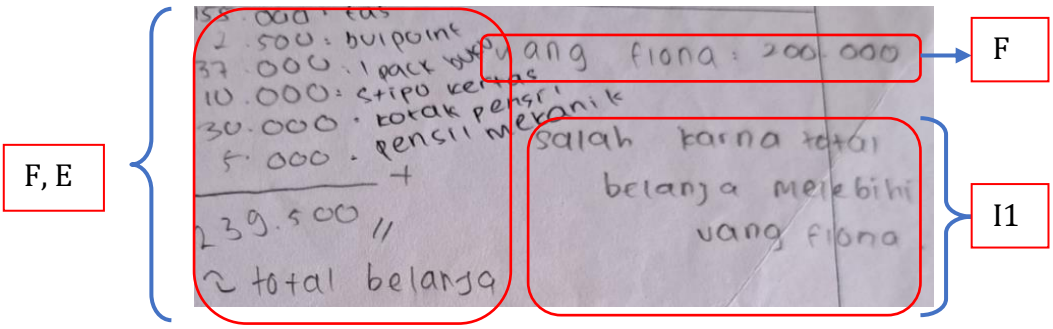


Figure 4. SL's work of PISA-like

Table 7. The result of interview by SL

Transcript Code	Interview snippet	Indicator Code
P-01	What do you understand from the question?	F01
SL-01	Fiona wants to buy a bag, 1 pen, 1 pack of books, 1 tipe-x, 1 pencil case, and 1 mechanical pencil. So the question is Fiona's money is it enough?	F01
P-02	OK, now explain what was known in the question?	-
SL-02	The price of a bag is Rp155.000,00, the price of a ballpoint pen is Rp2.500,00, the price of a pack of books is Rp37.000,00 the price of a tipe-x is Rp10.000,00 the price of a pencil case is Rp30.000,00, and the price of a mechanical pencil is Rp5.000,00. Fiona's money is Rp200.000,00.	-
P-07	Are you confident that your answer is true?	-
SL-07	I'm sure	-
P-08	Why?	-
SL-08	I think the steps are correct. The calculation is also correct.	-

Based on the interview, SL was able to explain the meaning of the question correctly (SL-01) so that he could explain what was asked in the question. In the written solution above, SL wrote down what he knew, starting with the prices of Fiona's goods and money. However, subject SL did not mention the terms of the discount as a thing that was known to help solve the question. Next, SL outlines the steps by simply adding up all the items without using the concept of discounts. Although SL selected six items, the total price exceeded Rp75,000.00, especially since the bag alone cost Rp155,000.00. Therefore, subject SL made a mistake in the solution steps, namely, subject SL did not calculate the discount that Fiona got. Fiona already met the requirements for a discount. This also shows that the SL subject was less careful in solving the questions. Then, the SL subject drew conclusions regarding the solution steps taken, namely stating that the statement is true, accompanied by reasons. However, SL's conclusion was incorrect due to errors in the solution steps. However, the SL subject was also sure of the answer (SL-07) and did not try to check again (SL-08). The SL subject In fact, SL did not use a complete strategy, as SL failed to calculate the discount on the initial price.

Discussion

Mathematical Literacy for Students Who Have High Level of Mathematical Logic Intelligence

Based on the results and analysis of the mathematical literacy test data in solving the PISA-like problem and the interview above, it can be seen that, in terms of formulation ability, students who have a high level of mathematical logic intelligence can correctly explain the meaning of the subject in their language. However, students who have a high level of mathematical logic intelligence don't write down what is known completely and directly enter the solution steps, but they can explain what is known to solve the problem completely and what is asked correctly in the interview. This is consistent with a study by Umami et al. (2021) which states that students with a high level of mathematical logical intelligence are able to identify all aspects of the question by clearly writing and mentioning both the known and asked information. The same goes for a study by Kurniawati & Kurniasari (2019) that states that students have logical-mathematical intelligence through several processes, one of which is identifying the aspects of mathematics in the problem.

On employability, students who have a high level of mathematical logic intelligence solve problems correctly and use correct concepts and calculations. This corresponds with the study by Umami et al. (2021), that shows that students who have a high level of mathematical logic intelligence can design a problem-solving strategy and then implement a problem-solving strategy in detail, systematically, and accurately.

On interpret and evaluate abilities, students who have a high level of mathematical logic intelligence can interpret the results of calculations by applying the conclusions obtained into the context correctly. The conclusion has been written on the answer sheet and further clarified during the interview. In addition, students who have a high level of mathematical logic intelligence can also criticize and solve problems by submitting reasons to believe that the answers and the steps taken are the correct answers after re-checking by recalculating the solution steps along with the interview process. This is relevant to research by Umami et al. (2021) that states that students with a high level of mathematical logic intelligence can draw conclusions from the outcome of problem-solving in a real-world context and evaluate all of the solving steps. Furthermore, research by Munfarikhatin et al. (2022) also supports the statement that students with good abilities are able to justify any conclusions derived from the problem.

Mathematical Literacy for Students who have Medium Level of Mathematical Logic Intelligence

Based on the results and analysis of the mathematical literacy test data in solving the PISA-like problem and the interview above, it can be found in terms of formulation ability, students who have medium level of mathematical logic intelligence can identify the meaning of the problem by explaining it correctly. However, students with a medium level of mathematical logic intelligence do not write down all the given information or the question itself. During interviews, however, they could communicate what they knew to solve the problem completely and clearly explain what was asked. This result is confirmed by Nafis et al. (2023), which state that students who have a medium mathematical logic intelligence can identify information by rewriting the known and asked aspects correctly.

On employability, students who have a medium level of mathematical logic intelligence were unable to apply mathematical concepts and rules and perform calculations according to correct mathematical concepts. This happens because there is a misconception about the price after the discount, in which the student does not subtract the initial price from the price of the discount or only multiplies the percentage discount with the original price, so the answer is wrong. This is confirmed by Pradestya et al. (2020) which shows that students with a medium mathematical logic intelligence are unable to apply well-remembered concepts or formulas, so the values obtained are inaccurate. In addition, a study by Umami et al. (2021) also found that students with a moderate level of mathematical logic intelligence were able to design a problem-solving strategy accurately, although the final solution was still not correct.

On interpret and evaluate abilities, students who have a medium level of mathematical logic intelligence can interpret the results of calculations by applying the obtained conclusions within the context accurately. The conclusion has been written on the answer sheet that was clarified at the interview. However, students who have a medium level of mathematical logic intelligence are unable to criticize and re-check the problem-solving. This is because the student could not find and correct the errors in the steps due to errors in the price concept after the discount she did. This is relevant to the research by Susanti & Wulandari (2021), which states that students with a medium level of mathematical logic intelligence are not yet able to re-examine the solution to the problem. Similar to the study by Umami et al. (2021), which states that the students with a medium level of mathematical logic intelligence are writing the conclusion of their mathematics problem solutions back

to the real-world context but have not evaluated the overall measures of problem-solving so the results obtained are still incorrect.

Mathematical Literacy for Students Who Have Low Level of Mathematical Logic Intelligence

Based on the results and analysis of the mathematical literacy test data in solving the PISA-like problem and the interview above, it can be found that on formulate ability, students who have a low mathematical logic intelligence can identify the meaning of the problem by explaining what is asked about correctly. Students wrote down what was known and explained it through interviews. However, they were incomplete in describing what was known, namely not telling about the discount, discount terms, and discount percentage as known. This result is confirmed by Munfarikhatin et al. (2022), who stated that students with a low level of mathematical logic intelligence can write what is known but is still not complete and accurate.

On employability, students who have a low level of mathematical logic intelligence made errors in the steps to solve the problem. They did not apply the concept of a discount after summing up the prices of the goods, even though the total price and quantity qualified for a discount. Therefore, it can be concluded that students could not apply mathematical concepts and rules or perform calculations completely and correctly. These results are in line with Susanti & Wulandari (2021), who states that students with a low level of mathematical logic intelligence find it difficult to solve questions correctly.

On interpret and evaluate abilities, students who have a low level of mathematical logic intelligence can interpret the results of the calculation by drawing the conclusions obtained into the context correctly according to the steps of the solution. However, students with a low level of mathematical logic intelligence were unable to critique or re-check their solutions, as they did not identify any errors in their solution steps due to a lack of review. Meanwhile, the answer was wrong because the steps were incomplete. This is in line with a study by Susanti & Wulandari (2021) that states that students who have a low level of mathematical logic intelligence cannot re-examine their answers. The statement is also supported by Umami et al. (2021), who states that students with a low level of mathematical logic intelligence do not evaluate the problem-solving solutions obtained.

Based on the discussion above, there is a need to improve the research focus on increasing the mathematical literacy of students at each level.

Conclusion

In light of the results and discussions mentioned above, it can be concluded that students who have a high level of mathematical logic intelligence were able to meet all the indicators of math literacy, including the capacity to formulate, employ, interpret and evaluate. Students with a high level of mathematical logic intelligence were capable of identifying the problem by describing what was known and asked, capable of applying mathematical concepts by outlining steps to find solutions, capable of criticizing and re-checking the solution, and capable of contextualizing the conclusions drawn. Students with a medium level of mathematical logic intelligence were capable of meeting mathematical literacy indicators in formulation but were unable to meet employability standards and were somewhat able in interpretative and evaluative abilities. Students with a medium level of mathematical logic intelligence could only identify the problem by describing what was known and asked in the question and were also capable of drawing conclusions within the context, but were not capable of applying mathematical concepts through outlining steps, critiquing, or re-checking the solution. Meanwhile, students who have a low level of mathematical logic intelligence were not capable of meeting mathematical literacy indicators on formulating and employing abilities and was quite capable of interpreting and evaluating abilities. Students with a low level of mathematical logic intelligence were unable to identify the problem by describing what was known and asked in the question, as they could not mention all necessary information completely. Students who have a low level of mathematical logic intelligence were also unable to apply mathematical concepts by outlining the steps to find solutions and criticizing and re-checking the problem solution, but are capable of drawing the conclusions obtained in the context of the problem.

Based on these findings, teachers can use this information to design learning materials that enhance students' mathematical literacy when solving PISA and PISA-like problems, tailored to students' levels of mathematical logic intelligence. The researchers have a recommendation for teachers to practice teaching students to solve PISA-like problems so that students get utilized to working on international standard problems such as PISA, and it is intended to improve the mathematical literacy of Indonesian students. Specifically, students with a high level of mathematical logic intelligence can be trained to solve high-level PISA problems, while students with medium and low levels of mathematical logic intelligence should be encouraged to review their solution steps afterwards to better identify conceptual and computational errors. Furthermore, this research is limited to quantity and personal context, so it is better to do further research on all contexts,

contents, and levels of PISA so that we can get more thorough research findings about the mathematical literacy of ninth-grade students.

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