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Students' Computational Thinking Skills in PISA Problem Solving: Insights from Multiple Intelligences Theory

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ABSTRACT

Computational thinking (CT) has become one of the essential skills in responding to the dynamic and rapid advancement of technology, as it enables individuals to solve problems effectively, efficiently, and optimally. Various studies have examined CT in mathematics education, but few have considered students' cognitive diversity, particularly the theory of multiple intelligences. The connection between CT and multiple intelligences theory has not been widely explored, even though this theory offers a holistic approach to cognitive potential. This study aims to describe students' computational thinking abilities in solving PISA questions on space and shape content from the perspective of multiple intelligences. The method used in this study is descriptive qualitative. The research instruments include a computational thinking test, interview guidelines, and a multiple intelligences test. The research subjects consist of three students from SMP Muhammadiyah 2 Surakarta who were selected based on their dominant type of intelligence to represent each intelligence category, namely Linguistic-Verbal (LV), Logical-Mathematical (LM), and Visual-Spatial (VS). The research findings show that students with LV intelligence were able to fulfill all indicators of CT, namely decomposition, pattern recognition, abstraction, and algorithm. Students with LM intelligence demonstrated competence in decomposition, pattern recognition, and algorithm. Students with VS intelligence fulfilled pattern recognition and abstraction.

Keywords: *Computational thinking, PISA, multiple intelligences*

Kemampuan Berpikir Komputasional Siswa dalam Pemecahan Masalah PISA: Wawasan dari Teori Kecerdasan Majemuk

ABSTRAK

Berpikir komputasional menjadi salah satu kemampuan penting dalam menghadapi dinamika perkembangan teknologi yang semakin pesat, karena memungkinkan individu untuk memecahkan masalah secara efektif, efisien, dan optimal. Berbagai penelitian telah mengkaji CT dalam pendidikan matematika, tetapi hanya sedikit yang mempertimbangkan keragaman kognitif siswa, khususnya teori kecerdasan majemuk. Hubungan antara kemampuan berpikir komputasional dan teori kecerdasan majemuk belum banyak dieksplorasi, meskipun teori ini menawarkan pendekatan holistik terhadap potensi kognitif. Penelitian ini bertujuan untuk menggambarkan kemampuan berpikir komputasional siswa dalam menyelesaikan soal PISA pada konten space and shape ditinjau dari perspektif kecerdasan majemuk. Metode yang digunakan dalam penelitian ini adalah deskriptif kualitatif. Instrumen penelitian meliputi tes berpikir komputasional, pedoman wawancara, dan tes kecerdasan majemuk. Subjek penelitian terdiri atas tiga siswa SMP Muhammadiyah 2 Surakarta yang dipilih berdasarkan jenis kecerdasan dominan untuk mewakili masing-masing kategori kecerdasan, yaitu Linguistik-Verbal (LV), Logis-Matematis (LM), dan Visual-Spasial (VS). Temuan penelitian menunjukkan bahwa siswa dengan kecerdasan LV mampu memenuhi keempat indikator berpikir komputasional, yaitu dekomposisi, pengenalan pola, abstraksi, dan berpikir algoritma. Siswa dengan kecerdasan LM menunjukkan kemampuan pada indikator dekomposisi, pengenalan pola, dan berpikir algoritma. Siswa dengan kecerdasan VS memenuhi indikator pengenalan pola dan abstraksi.

Kata Kunci: *Berpikir komputasional, PISA, kecerdasan majemuk*

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1. Introduction

The rapid development of technology that has occurred in the last decade has had a significant impact on various sectors, one of which is the education sector. In response to these technological developments, acquiring knowledge and skills related to technological systems is essential for students, as these competencies enable them to find effective problem-solving (Czerkawski & Lyman, 2015). One of the problem-solving skills that students must have to face the rapid development of technology and information is computational thinking (CT) (Cahdriyana & Richardo, 2020).

Wing (2006) popularized the term CT. Wing (2006) and Rahma et al. (2024) explained that CT is a thinking concept that adopts computer science by using logic to solve problems, understand human behavior, and design systems to find effective, efficient, and optimal solutions. Li & Oon (2024) and Hurt et al. (2023) define CT as a cognitive process for solving problems effectively and efficiently that involves selecting and applying the appropriate tools and practices and developing a mental model of computational tool's functionality. In general, there are four main indicators of CT, namely decomposition, pattern recognition, abstraction, and algorithm (Cachero et al., 2020; Elyasarikh et al., 2025).

Among academics and practitioners, the high relevance of CT skills in the digital era has made it very popular in various fields of knowledge (Juldial & Haryadi, 2024). This makes CT also recognized at the international level as an important ability that needs to be integrated into the education system to prepare for a better generation in the future (Sukirman et al., 2024). The Programme for International Student Assessment (PISA) has also highlighted this issue. The most recent draft of the PISA 2022 framework includes CT as part of its assessment, marking a significant shift from previous years (*PISA 2022 Assessment and Analytical Framework*, 2023).

PISA, as one of the international student assessment programs, evaluates students' thinking skills with a primary focus on core school subjects such as reading, mathematics, and science. In mathematics, test items are categorized into four content areas: quantity, change and relationships, space and shape, and uncertainty and data (*PISA 2022 Assessment and Analytical Framework*, 2023). One of the four contents is the space and shape content, which refers to the analysis of geometry concepts or the representation of real shapes into mathematical solutions (Qadry et al., 2022).

Indonesia has participated in the PISA program since its initial implementation (Pertiwi & Setyaningsih, 2024). However, the country's performance in the program has remained concerning, with Indonesia consistently ranking near the bottom globally. Qadry et al. (2022) and PISA 2022 Assessment and Analytical Framework (2023) report that the rankings achieved by Indonesia in the PISA surveys demonstrate that Indonesian students' problem-solving abilities remain considerably low. Solving problems in PISA assessments requires a certain type of intelligence, specifically multiple intelligences (Kurniawati & Kurniasari, 2019).

Howard Gardner was the first scholar to introduce the theory of multiple intelligence. Gardner (1983) defined intelligence as the ability to solve problems and produce products in every situation, particularly in real-life contexts. In his book, Gardner outlines that humans possess nine types of intelligence: linguistic, logical-mathematical, visual-spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, naturalistic, and existential intelligences (Gardner, 2000).

Findings from studies conducted by Rosalina & Ekawati (2017) and Kurniawati & Kurniasari (2019) indicate a correlation between multiple intelligences, particularly Linguistic-Verbal (LV), Logical-Mathematical (LM), and Visual-Spatial (VS), and students' performance in solving PISA test items. Linguistic-verbal intelligence is essential for students to translate the verbal information in the problems into mathematical expressions. Logical-mathematical intelligence aids in understanding the problem, performing calculations, reasoning, and abstract thinking. Visual-spatial intelligence is required for visual representation and reasoning.

Studies about computational thinking skills in mathematics education have been conducted from various perspectives (Aminah et al., 2023; Utami et al., 2024; Zhang & Savard, 2023). However, most of these studies are still limited to local contexts, are technical, or do not use empirical data from students. Moreover, the connection between computational thinking and multiple intelligences theory has not been widely explored, even though this theory offers a holistic approach to cognitive potential. Meanwhile, studies on the relationship between multiple intelligences and mathematical problem-solving (Hasanah & Jailani, 2024; Nurhajarurahmah, 2021; Silwana et al., 2021) have not specifically examined their connection to students' computational thinking skills.

Although research on this area continues to grow, the integration between CT and the theory of multiple intelligences has yet to be thoroughly explored. This study aims to explore students' computational thinking abilities in solving PISA test items within the space and shape content area, viewed through the lens of multiple intelligences.

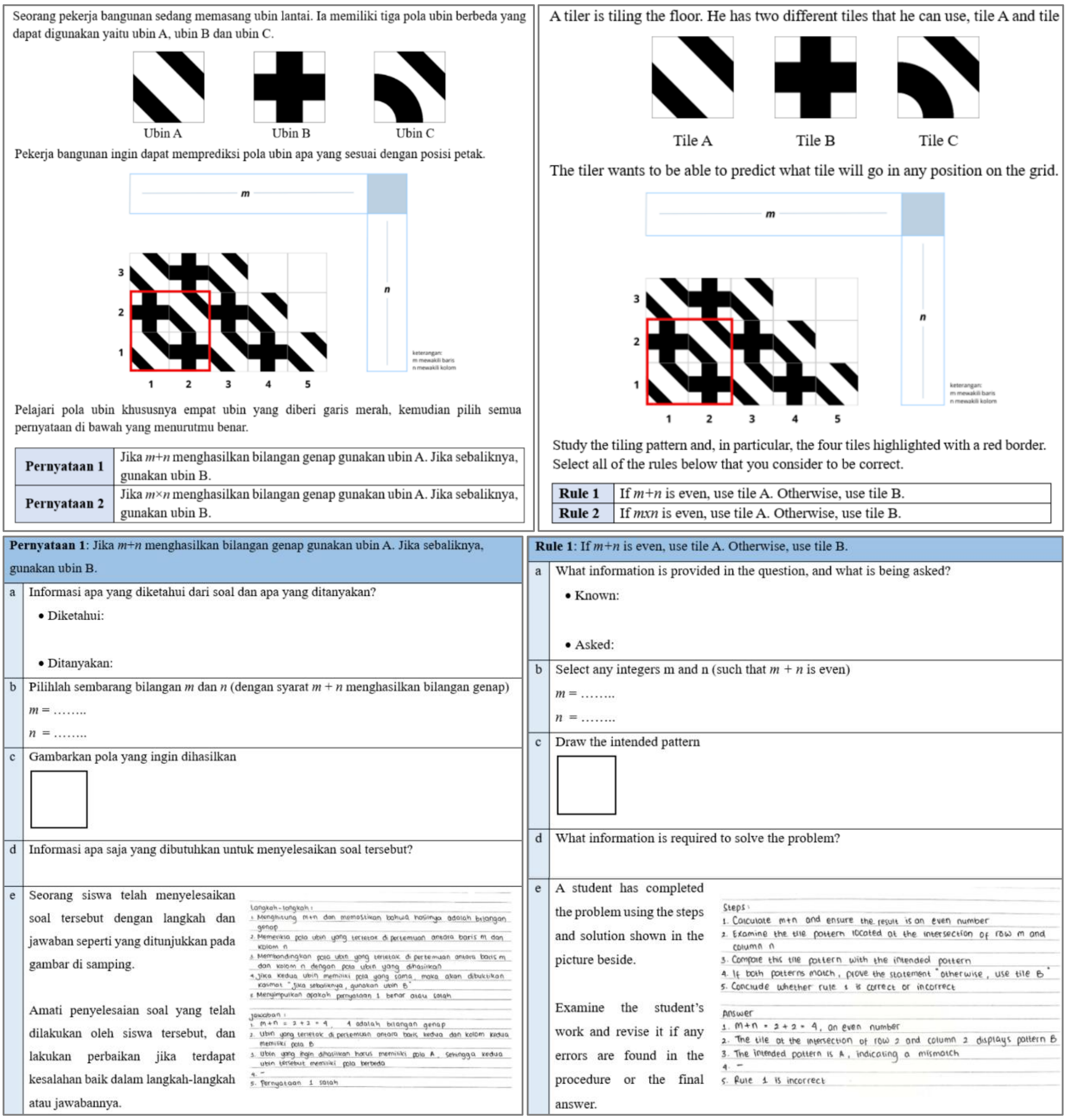
2. Method

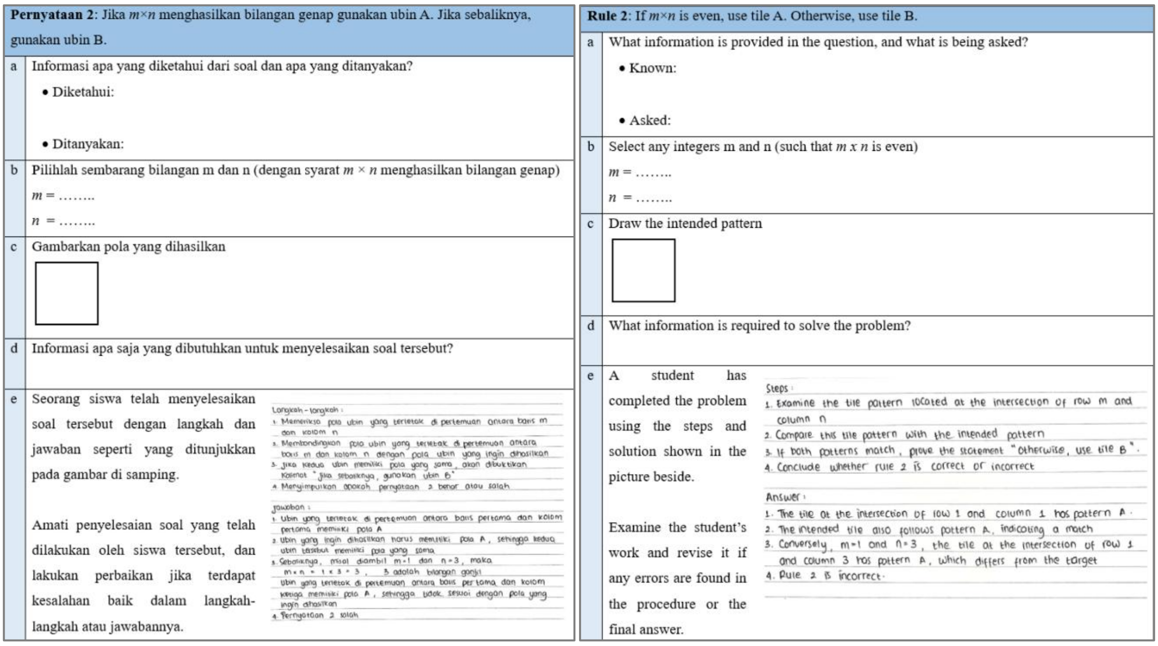
This research adopts a descriptive qualitative design to explore students' computational thinking abilities in solving PISA questions on space and shape content, based on their respective types of multiple intelligences. The subjects of this study were three seventh-grade students from SMP Muhammadiyah 2 Surakarta, consisting of one student with linguistic-verbal intelligence, one with logical-mathematical intelligence, and one with visual-spatial intelligence. To protect subjects' privacy and facilitate the research process, each selected subject was assigned initials. The subject codes are presented in Table 1.

Table 1. Research Subject Codes

No	Initials Name	Type of Multiple Intelligences	Subject Code
1	RA	Linguistic-verbal	LV
2	MI	Logical-mathematical	LM
3	NRM	Visual-spatial	VS

This study uses both primary and secondary data. The primary data consists of students' work on PISA questions and interview results. The secondary data comes from the results of a multiple intelligences test conducted before the study began. The research instruments included a computational thinking test, which was adapted from the PISA 2022 Assessment and Analytical Framework (2023) and presented in Figure 1, along with a structured interview guide and a multiple intelligences test.





Pernyataan 2: Jika $m \times n$ menghasilkan bilangan genap gunakan ubin A. Jika sebaliknya, gunakan ubin B.	
a	Informasi apa yang diketahui dari soal dan apa yang ditanyakan? • Diketahui: • Ditanyakan:
b	Pilihlah sembarang bilangan m dan n (dengan syarat $m \times n$ menghasilkan bilangan genap) $m =$ …….. $n =$ ……..
c	Gambarkan pola yang dihasilkan
d	Informasi apa saja yang dibutuhkan untuk menyelesaikan soal tersebut?
e	Seorang siswa telah menyelesaikan soal tersebut dengan langkah dan jawaban seperti yang ditunjukkan pada gambar di samping. Amati penyelesaian soal yang telah dilakukan oleh siswa tersebut, dan lakukan perbaikan jika terdapat kesalahan baik dalam langkah-langkah atau jawabannya. Langkah - langkah : 1. Memeriksa pola ubin yang terletak di pertemuan antara baris m dan kolom n 2. Membandingkan pola ubin yang terletak di pertemuan antara baris m dan kolom n dengan pola ubin yang ingin dihasilkan 3. Jika kedua ubin memiliki pola yang sama, akan dibuktikan kalimat "Jika sebaliknya, gunakan ubin B" 4. Menyimpulkan apakah pernyataan 2 benar atau salah Jawaban : 1. Ubin yang terletak di pertemuan antara baris pertama dan kolom pertama memiliki pola A 2. Ubin yang ingin dihasilkan harus memiliki pola A, sehingga kedua ubin tersebut memiliki pola yang sama 3. Sebaliknya, misal diambil m = 1 dan n = 3, maka m × n = 1 × 3 = 3, 3 adalah bilangan ganjil Ubin yang terletak di pertemuan antara baris pertama dan kolom ketiga memiliki pola A, sehingga tidak sesuai dengan pola yang ingin dihasilkan 4. Pernyataan 2 salah

Rule 2: If $m \times n$ is even, use tile A. Otherwise, use tile B.	
a	What information is provided in the question, and what is being asked? • Known: • Asked:
b	Select any integers m and n (such that $m \times n$ is even) $m =$ …….. $n =$ ……..
c	Draw the intended pattern
d	What information is required to solve the problem?
e	A student has completed the problem using the steps and solution shown in the picture beside. Examine the student's work and revise it if any errors are found in the procedure or the final answer. Steps : 1. Examine the tile pattern located at the intersection of row m and column n 2. Compare this tile pattern with the intended pattern 3. If both patterns match, prove the statement "Otherwise, use tile B". 4. Conclude whether rule 2 is correct or incorrect Answer : 1. The tile at the intersection of row 1 and column 1 has pattern A. 2. The intended tile also follows pattern A, indicating a match 3. Conversely, m = 1 and n = 3, the tile at the intersection of row 1 and column 3 has pattern A, which differs from the target 4. Rule 2 is incorrect.

Figure 1. PISA Test Question

The research procedure comprised four stages. First, the respondents were given a PISA test item. Second, the students' responses were analyzed based on computational thinking indicators. The computational thinking indicators by Cachero et al. (2020) used in this study are presented in Table 2. Third, the researcher triangulated the data to validate the analysis results through in-depth interviews with the subjects. In the final stage, conclusions were drawn based on the data analysis conducted in the third stage.

Table 2. Computational Thinking Indicators

Indicator	Definition
Decomposition	Breaking down data, processes, or problems into smaller, more manageable elements to facilitate analysis.
Pattern recognition	Examining data to detect patterns, trends, and recurring structures.
Abstraction	Identifying overarching principles or rules that account for the observed patterns.
Algorithm	Developing step-by-step instructions for solving the current problem and related tasks.

3. Results and Discussion

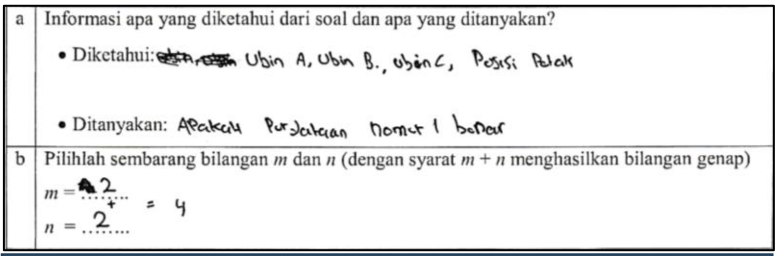
This study utilized two types of data: primary data and secondary data. The secondary data were obtained from the results of a multiple intelligences test previously completed by the students. These results served as the basis for selecting three students, each representing one of the following intelligences: linguistic-verbal, logical-mathematical, and visual-spatial.

The primary data were obtained from the students' responses to the PISA test item and results from interviews conducted with three selected seventh-grade students from class VII at SMP Muhammadiyah 2 Surakarta. The researcher utilized a PISA item within the space and shape content domain to assess the students' computational thinking abilities.

3.1 Subject LV's response

Subject LV's response to "Rule 1"

Based on Figure 2, it can be seen that the subject had no difficulty in solving the problem given, the subject was able to identify the known information correctly and completely, writing the answer to what was asked was also appropriate and written in the form of an interrogative sentence, and choosing the numbers used the provisions in the problem. The subject successfully illustrated the pattern as directed by the task, although there was a slight discrepancy between the drawing produced and the expected pattern. The information needed for problem-solving has been identified and written accurately and completely. The steps to solve the problem were also arranged coherently and logically. In addition, the subject has also proven the overall statement, accompanied by clear and precise reasons.


a Informasi apa yang diketahui dari soal dan apa yang ditanyakan?

- Diketahui: Ubin A, Ubin B., Ubin C, Posisi Petak
- Ditanyakan: Apakah Pernyataan nomor 1 benar

b Pilihlah sembarang bilangan m dan n (dengan syarat $m + n$ menghasilkan bilangan genap)

$m = 2$

$n = 2$ = 4

a. What information is provided in the question, and what is being asked?
- Known: Tile A, tile B, tile C, and grid position
- Asked: Is rule 1 correct?

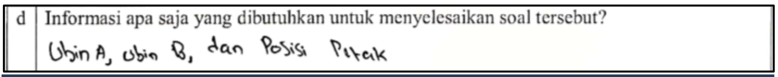
b. Select any integers m and n (such that $m + n$ is even)
$m = 2$
$n = 2$

Decomposition


c Gambarkan pola yang ingin dihasilkan

c. Draw the intended pattern

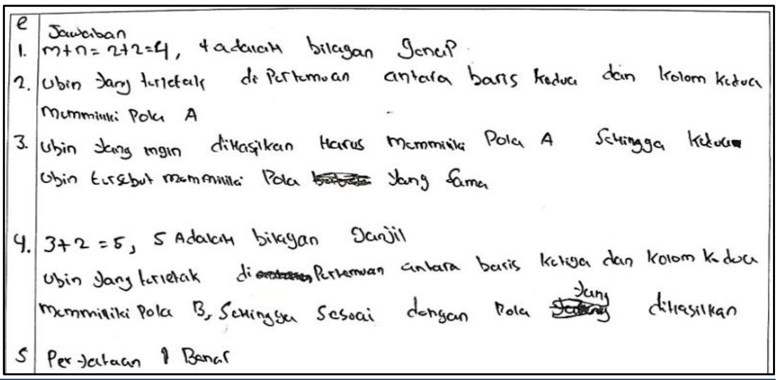
Pattern recognition


d Informasi apa saja yang dibutuhkan untuk menyelesaikan soal tersebut?

Ubin A, Ubin B, dan Posisi Petak

c. What information is required to solve the problem?
Tile A, tile B, and grid position

Abstraction


e Jawaban
1. m+n = 2+2=4, 4 adalah bilangan genap
2. Ubin yang terletak di pertemuan antara baris kedua dan kolom kedua memmiliki pola A
3. Ubin yang ingin dihasilkan harus memmiliki pola A sehingga kedua ubin tersebut memmiliki pola yang sama
4. 3+2 = 5, 5 adalah bilangan ganjil ubin yang terletak di pertemuan antara baris ketiga dan kolom kedua memmiliki pola B, sehingga sesuai dengan pola yang dihasilkan
5. Pernyataan 1 Benar

e. Answer
1. m+n = 2+2 = 4, which is an even number.
2. The tile at the intersection of the second row and second column has pattern A.
3. The expected tile also follows pattern A, indicating a match.
4. 3+2=5, which is an odd number. The tile at the intersection of the third row and second column has pattern B, which matches the expected pattern.
5. Rule 1 is correct.

Algorithm

Figure 2. Subject LV's answer to Item 1

Thus, it can be concluded that Subject LV demonstrated the ability to meet all computational thinking indicators in responding to the PISA item in Rule 1. This inference is further supported by the interview findings between Researcher (R) and Subject LV, which are presented below.

R: "From the three statements in the question, do you think there are similarities and differences? Mention if there are any."
LV: "Yes, there are. All statements ask to find even or odd numbers, and use tile A and tile B. The difference is that some use addition and some use multiplication. The difference is that some use addition and some use multiplication."
R: "What kind of information is needed to solve the question?"
LV: "Tile A, Tile B, and the position of the squares."
R: "Can you explain how you solved the question?"
LV: "First, I chose the numbers that the question asked for. Then, for the last question, I checked if the student's answer was correct or wrong."

Subject LV's response to "Rule 2"

Figure 3 shows that the subject can completely and correctly identify the known information. The subject also correctly stated what was being asked, formulated it as an interrogative sentence, and selected numbers that aligned with the following provisions in the problem. In general, the tile pattern drawn by the subject corresponded to the expected pattern, although there were minor differences from the correct version. The necessary information for solving the problem was provided completely and accurately. However, in the final question, the subject's response on the solution sheet lacked supporting justification. The subject concluded that the steps and answers given to the problem were already correct and thus did not revise their solution.

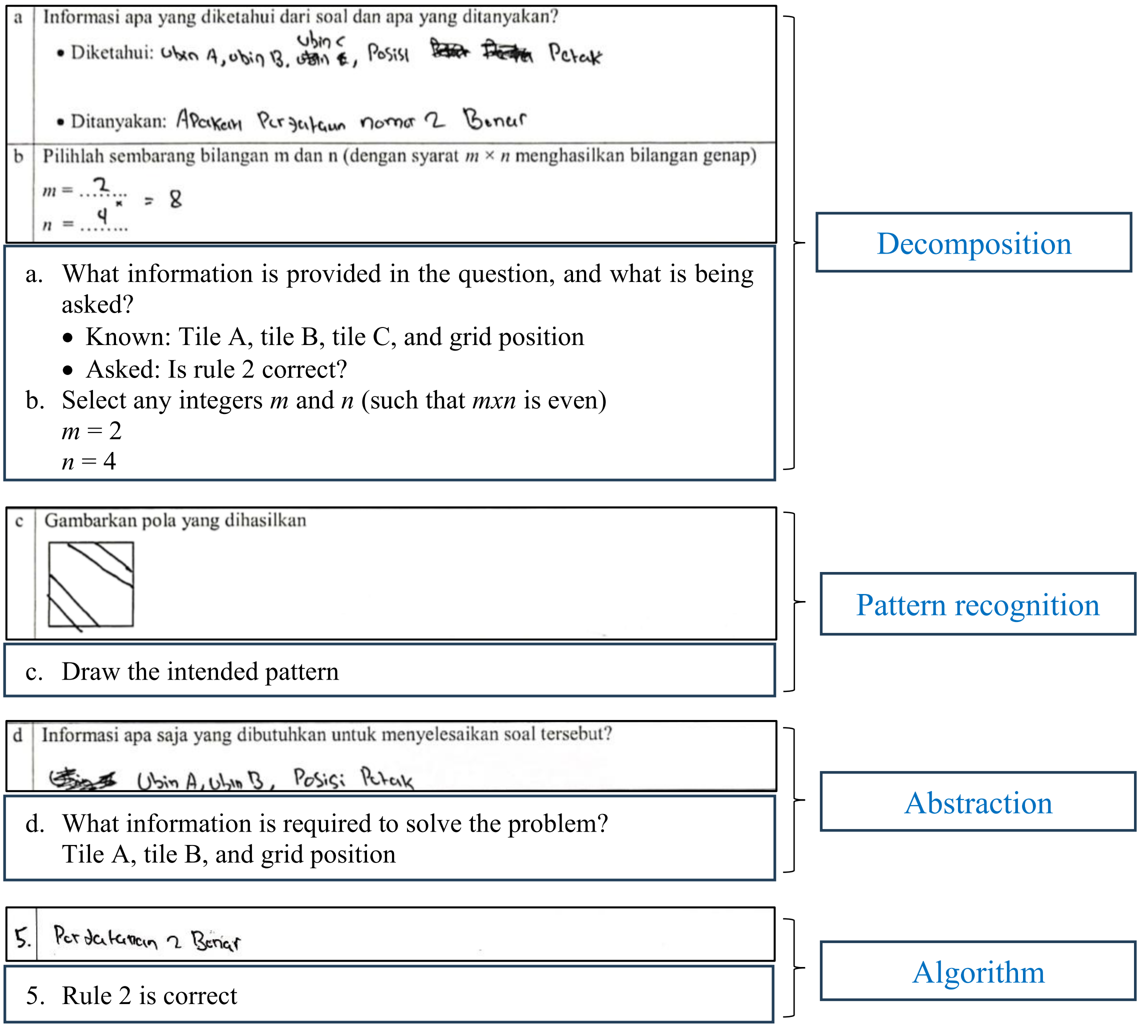


Figure 3. Subject LV's answer to Item 2

Thus, it can be concluded that Subject LV showed the ability to fulfill three of the four indicators of computational thinking in answering PISA questions in Rule 2. This inference is further supported by the interview findings between Researcher (R) and Subject LV, which are presented below.

R: "In the question about the tile pattern, what do you think was the intended pattern? If your drawing was meant to be Pattern A, why is the black drawing area not full?"

LV: "It was Pattern A. Yes, I intentionally did not draw the full black, but my intention is the same as in the question."

R: "In the last question, you wrote 'statement 2 is correct.' Can you explain what you meant?"

LV: "I meant that statement 2 is already correct. The student's steps and answer were right, so I didn't think anything needed to be fixed."

R: "Did you try to check the steps and the answer shown in the question?"

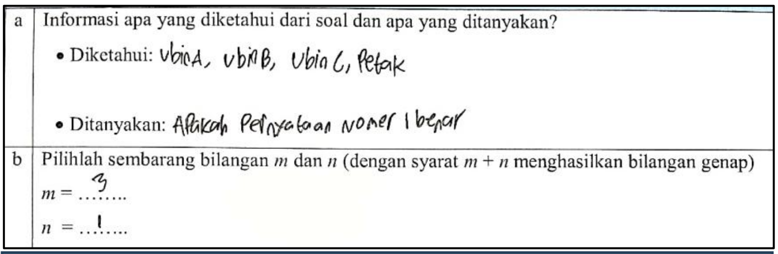
LV: "Yes, I did, but honestly, I still don't understand the steps and the answers in the question."

Based on the students' written responses and interview data, it can be concluded that students with linguistic-verbal intelligence type, in general, have shown a fairly good ability to fulfill each indicator of computational thinking ability, namely decomposition, pattern recognition, abstraction, and algorithm. Regarding the decomposition indicator, it can be seen that the subject provides additional information in the form of the operation result of the selected number as proof to make the answer written more clearly. This finding aligns with the study by Hartono et al. (2019), which reported that students with linguistic-verbal intelligence tend to include symbols or words when communicating their answers to clarify their explanations. Another study by Ismawati & Setianingsih (2019) and Iskandar et al. (2024) revealed that students with linguistic-verbal intelligence can accurately and completely identify the known and unknown elements in a problem. However, when planning and carrying out the problem-solving process, students tend to write the solution strategy and calculation steps accurately, but not always with complete detail. These findings are consistent with the results of the present case study, in which the subject with linguistic-verbal intelligence still required reinforcement in the algorithm indicator, as the formulation of the problem-solving steps was not yet fully aligned with the expected standard.

3.2 Subject LM's response

Subject LM's response to "Rule 1"

Based on Figure 4, it is evident that the subject can accurately and completely identify the known information. The subject also correctly stated what was being asked about the problem and selected appropriate numbers following the instructions. Additionally, the subject successfully drew the required pattern as requested in the task, although minor deviations from the expected pattern were observed. The subject can write down the information needed to solve the problem completely and correctly. However, in the final statement, the subject skipped the solution for the first point and proceeded directly to the second. Furthermore, at the fourth point, the subject did not complete the answer according to the steps that should have been followed, even though the final result was correct.

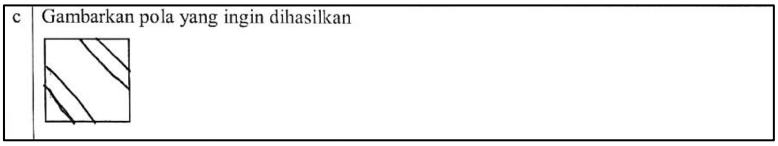


a Informasi apa yang diketahui dari soal dan apa yang ditanyakan?
- Diketahui: Ubin A, Ubin B, Ubin C, Petak
- Ditanyakan: Apakah Pernyataan nomer 1 benar

b Pilihlah sembarang bilangan m dan n (dengan syarat $m + n$ menghasilkan bilangan genap)
m = ...3...
n = ...1...

a. What information is provided in the question, and what is being asked?
   - Known: Tile A, tile B, tile C, and grid
   - Asked: Is rule 1 correct?
b. Select any integers m and n (such that $m + n$ is even)
   $m = 3$
   $n = 1$

Decomposition



c Gambarkan pola yang ingin dihasilkan

c. Draw the intended pattern

Pattern recognition

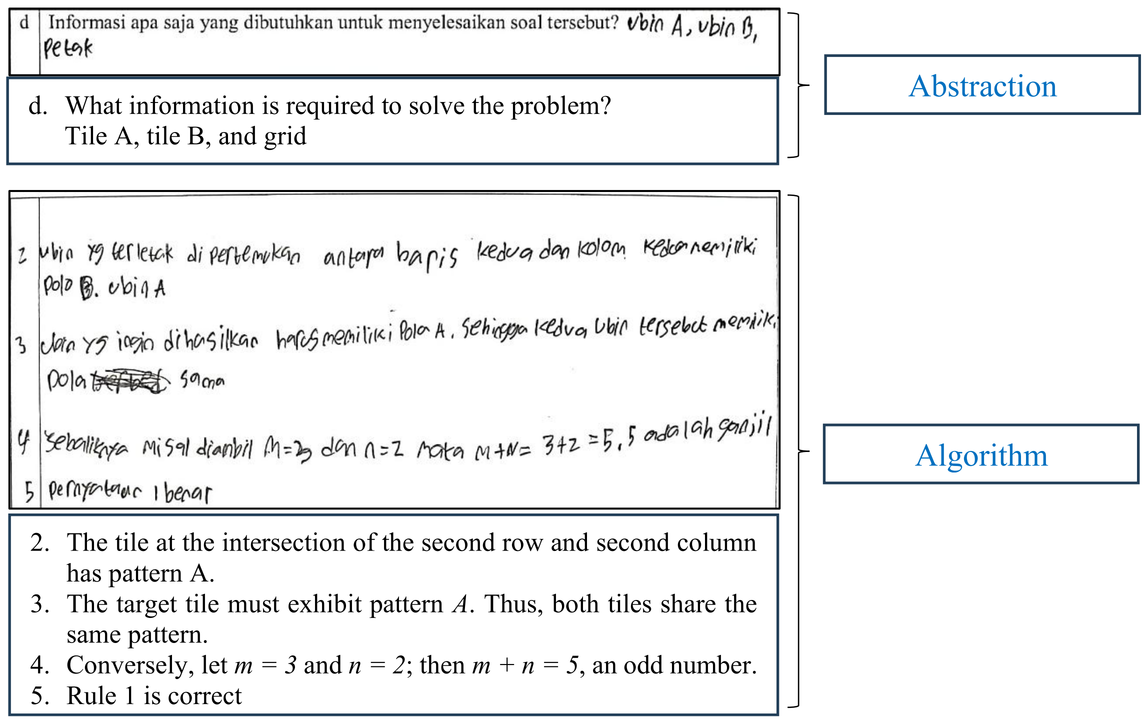


Figure 4. Subject LM's answer to Item 1

Thus, it can be concluded that Subject LM showed the ability to fulfill three of the four indicators of computational thinking in answering PISA questions in Rule 1. This inference is further supported by the interview findings between Researcher (R) and Subject LM, which are presented below.

R: "From the three statements in the question, do you think there are similarities and differences? Please mention them."

LM: "Yes, there are. The similarity is that they all ask to find numbers m and n so that the result is even or odd. The difference is in the operations used; some use addition and others use multiplication."

R: "In your opinion, what information helped you solve the problem?"

LM: "Tile A, Tile B, and the grid."

R: "In the last question, why didn't you write the answer for point 1?"

LM: "I thought the answer on point 1 was correct, and I didn't need to write it again. That's why I started from the part I wanted to correct."

Subject LM's response to "Rule 2"

Figure 5 indicates that the subject demonstrated a strong ability to identify the known information. The subject accurately formulated the question, selected the values of m and n by the problem, such as choosing the numbers 3 and 2, and correctly stated that 3×2=6 is an even number. The pattern drawn by the subject was generally appropriate, although there were minor inconsistencies compared to the expected pattern. The subject's response regarding the information required to solve the problem was accurate and complete. However, in the final question, the conclusion provided by the subject was incorrect and lacked supporting justification. This suggests that the subject's understanding of the question remains limited.

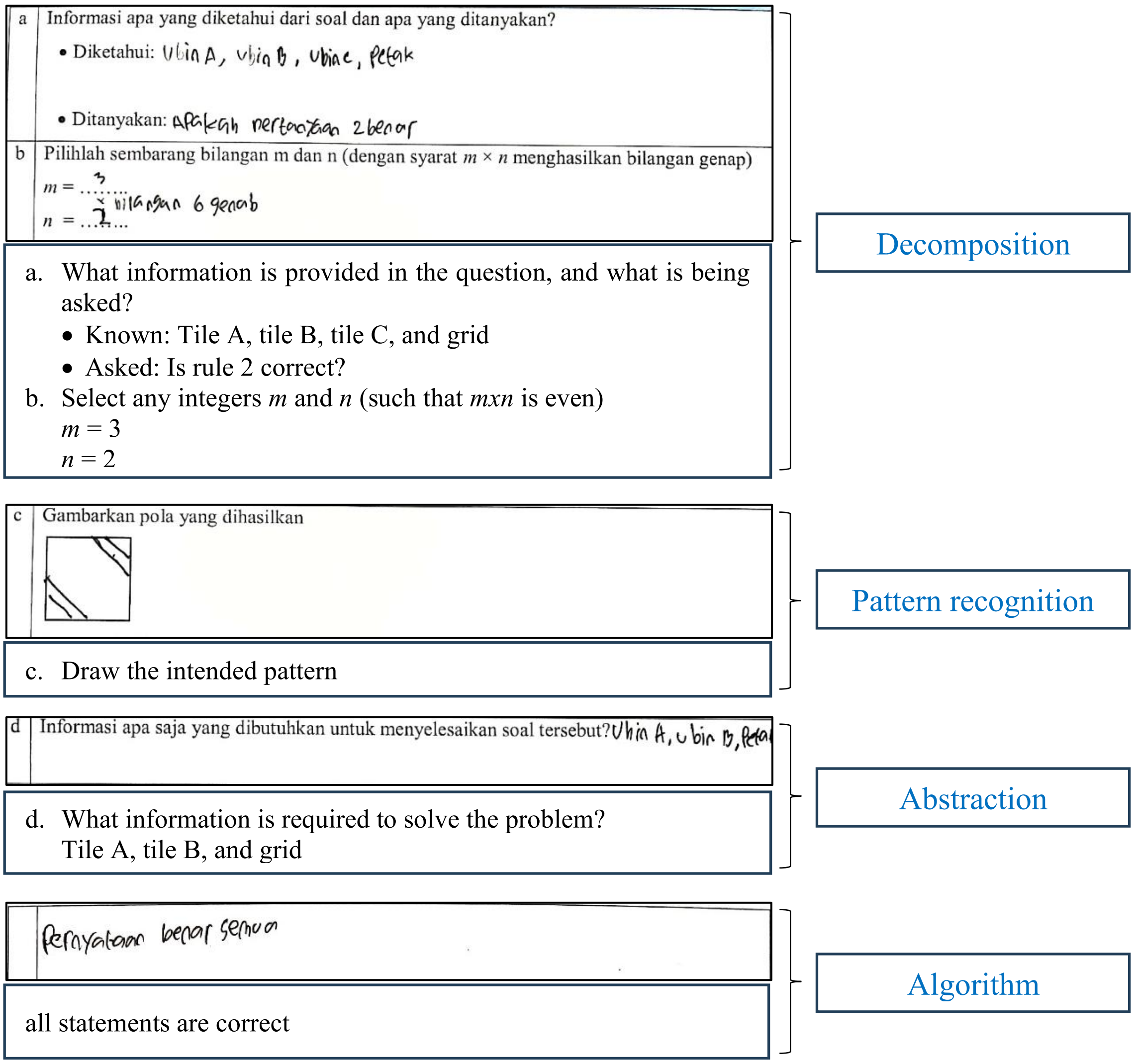


Figure 5. Subject LM's answer to Item 2

Thus, it can be concluded that Subject LM showed the ability to fulfill three of the four indicators of computational thinking in answering PISA questions in Rule 2. This inference is further supported by the interview findings between Researcher (R) and Subject LM, which are presented below.

R: "In the question about the tile pattern, what pattern do you think was supposed to be created? If you mean Pattern A, why wasn't the black part fully shaded?"
LM: It was Pattern A. Oh yes, I forgot to color it completely, but what I meant was the same as in the question."
R: "Can you explain how you solved the problem?"
LM: "I solved the problem in the same order as the questions, because the instructions were clearly stated."
R: "In the last part, are you sure the steps and the answer to the problem are all correct? Please explain your reasoning."
LM: "Yes, I'm sure, because I already read and understood it. And I think the steps and the answer to the problem are all correct."

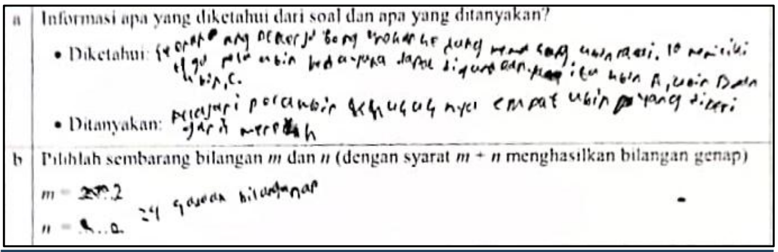
Based on the students' written responses and interview data, it can be concluded that students with logical-mathematical intelligence generally demonstrate a satisfactory level of competence to fulfill indicators of decomposition, abstraction, and pattern recognition.

However, concerning the algorithm indicator, the findings show that the subject has not been able to determine the steps for solving the problem in a clear and structured manner. In addition, some problem-solving steps were left incomplete, causing the solution process to be halted midway. This also indicates a lack of understanding on the subject regarding the appropriate steps required to solve the problem. These findings are consistent with previous studies by Natsir & Munfarikhatin (2021) and Fakhriyana et al. (2018), which revealed that subjects with logical-mathematical intelligence are generally capable of identifying relevant information from a given problem but still face difficulties in selecting appropriate strategies to solve it.

3.3 Subject VS' response

Subject VS' response to "Rule 1"

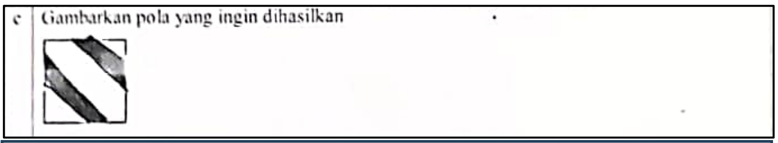
Based on Figure 6, it can be observed that the subject's responses in the sections concerning known and asked-for information tended to merely replicate the information provided in the problem, without further elaboration or decomposition. Nevertheless, the selection of the values for m and n was consistent with the conditions specified in the problem statement. Furthermore, the subject can accurately represent the pattern as required. Although the 'required information' is expected to align with the 'known information', the subject successfully identified the necessary information. In response to the final question, the subject predominantly reiterated the information already presented in the problem, without demonstrating any attempt at refinement. Additionally, the conclusion provided remained inaccurate and misaligned with the expected solution.



a. What information is provided in the question, and what is being asked?
- Known: Tiler is tiling the floor. He has three different tiles that he can use, tile A, tile B, and tile C.
- Asked: Study the tiling pattern and in particular, the four tiles highlighted with a red border

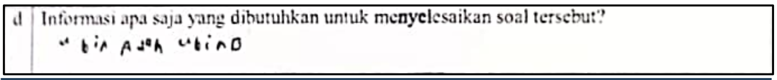
b. Select any integers m and n (such that $m + n$ is even)
$m = 2$
$n = 2$

Decomposition



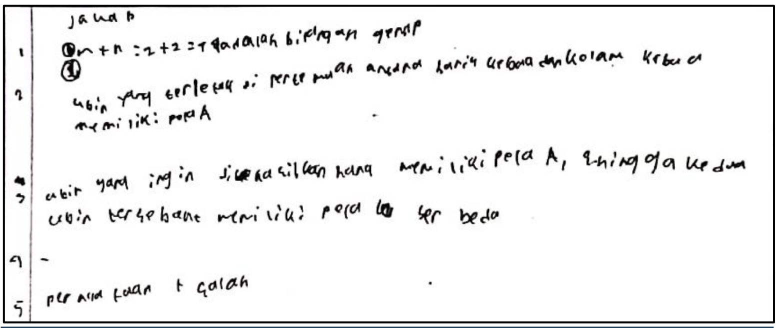
c. Draw the intended pattern

Pattern recognition



d. What information is required to solve the problem?
Tile A and tile B

Abstraction


Jawab
1 ① m + n = 2 + 2 = 4 adalah bilangan genap
2 ② ubin yang terletak di perpotongan antara baris kedua dan kolam kedua memiliki pola A
3 ubin yang ingin dihasilkan hanya memiliki pola A, sehingga kedua ubin tersebut memiliki pola ber beda
4 -
5 peraturan 1 salah

Answer:
1. $m + n = 2 + 2 = 4$, which is an even number.
2. The tile at the intersection of the second row and second column has pattern A.
3. The expected tile also follows pattern A, so the two tiles have different patterns.
4. –
5. Rule 1 is incorrect.

Algorithm

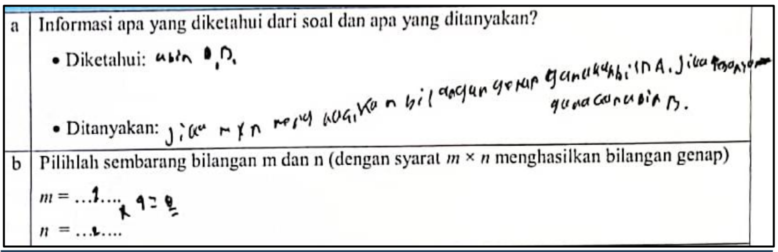
Figure 6. Subject VS' answer to Item 1

Thus, it can be concluded that Subject VS showed the ability to fulfill two of the four indicators of computational thinking in answering PISA questions in Rule 1. This inference is further supported by the interview findings with Subject VS, which are presented below.

R: "Based on the previous question, what information is given, and what is being asked? Please mention them."
VS: "It's about a worker who wants to install tiles, and the tiles have patterns A, B, and C. What's being asked is the pattern of the tiles that will be installed."
R: "Why is your answer in the 'known information' section different from the 'required information' section?"
VS: "From what I understand, the given information is what's written in the question, but the needed information is only about tiles A and B."
Rr: "In the last question, can you explain the sentence you wrote in the third point?
VS: I didn't really understand it."

Subject VS' response to "Rule 2"

Based on Figure 7, it was known that the subject could correctly identify the known information, although the information provided was still incomplete. Responding to the question posed, the subject's answer was considered inaccurate, as it primarily restated the problem statement without further elaboration. The selection of the values for m and n was consistent with the criteria outlined in the problem. Furthermore, the subject demonstrated an adequate understanding of the task instructions, enabling them to draw the intended pattern accurately. The response regarding the information required to solve the problem was correct, though not fully comprehensive. In the final question, it is known that the solution written by the subject is still incomplete. Specifically, in the first point, the subject chose a number that did not meet the conditions provided in the problem, and the justification given in the third point was also deemed inappropriate.



a Informasi apa yang diketahui dari soal dan apa yang ditanyakan?
• Diketahui:
• Ditanyakan:
b Pilihlah sembarang bilangan m dan n (dengan syarat $m \times n$ menghasilkan bilangan genap)
m = ...1....
n = ...2....

a. What information is provided in the question, and what is being asked?
- Known: Tile A, B
- Asked: If $m \times n$ is even, use tile A. Otherwise, use tile B.

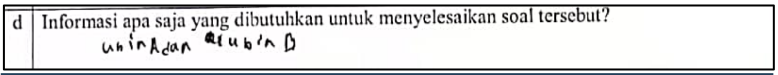
b. Select any integers m and n (such that mxn is even)
$m = 1$
$n = 2$

Decomposition

c Gambarkan pola yang dihasilkan

c. Draw the intended pattern

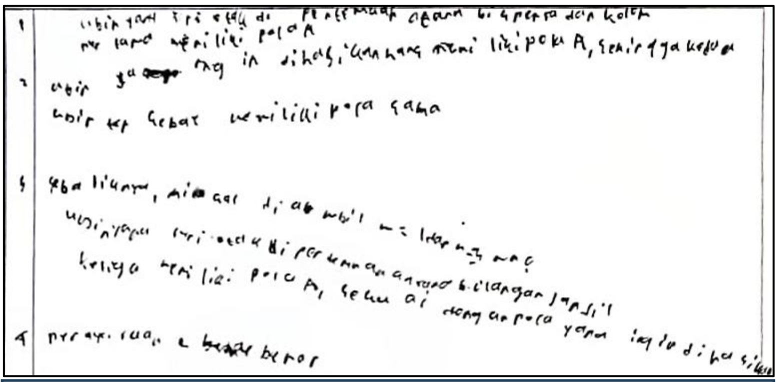
Pattern recognition



d Informasi apa saja yang dibutuhkan untuk menyelesaikan soal tersebut?

d. What information is required to solve the problem?
Tile A and tile B

Abstraction



1. The tile at the intersection of the first row and first column has pattern A.
2. The expected tile also follows pattern A, indicating a match.
3. Conversely, let m = 1 and n = 3, an odd sum. The tile at the intersection of the first row and third column has pattern A, which differs from the target.
4. Rule 2 is correct

Algorithm

Figure 7. Subject VS' answer to Item 2

Thus, it can be concluded that Subject VS showed the ability to fulfill two of the four indicators of computational thinking in answering PISA questions in Rule 2. This inference is further supported by the interview findings with Subject VS, which are presented below.

R: "From the three statements in the question, do you think there are similarities and differences? Please mention them."

VS: "The similarities are tile A and tile B, and the odd and even numbers, Miss. The differences are in addition and multiplication."
R: "In the last statement, can you explain the answer you wrote in point three?
VS: I didn't really understand that part either."

Based on the students' written responses and interview data, it can be concluded that students with visual-spatial intelligence generally show a fairly good ability to fulfill the indicators of pattern recognition and abstraction. However, about the decomposition indicator, the subject encountered difficulties in both identifying the known and required information in the problem and selecting numbers that aligned with the given conditions. Data obtained from students' responses and interviews revealed incomplete and inaccurate answers, indicating that the subject's decomposition ability in problem-solving was not yet optimal. This finding is consistent with the study by Pradini (2019), which also reported that a fundamental error in problem comprehension stemmed from students' inability to identify relevant information in word problems, making it difficult to specify what was known and what was being asked. Similarly, research conducted by Duffy et al. (2024) and Indahyani et al. (2022) found that during the planning phase, students with visual-spatial intelligence tended to develop ineffective problem-solving strategies, which negatively impacted their final solutions. These prior findings align with the results of the present case study, where the subject is considered unable to determine appropriate steps for problem-solving. This is evident from the analysis of both responses and interview data, which indicate persistent errors and an incomplete understanding of the procedures necessary for solving the problem correctly.

4. Conclusion

Considering the research findings and data analysis presented in the previous section, it can be concluded that students with linguistic-verbal intelligence were able to fulfill all four indicators of computational thinking: decomposition, pattern recognition, abstraction, and algorithm, although reinforcement is still needed around algorithm. Meanwhile, students with logical-mathematical intelligence demonstrated proficiency in three of the four computational thinking indicators, namely decomposition, pattern recognition, and abstraction. In contrast, students with visual-spatial intelligence were able to fulfill only two indicators: pattern recognition and abstraction.

This study offers valuable insights for teachers to be more attentive to the diverse intelligence of their students, enabling them to design more effective learning tools, particularly in fostering computational thinking skills. Future research is recommended to explore PISA problems in different content areas, focus on other types of multiple intelligence, or investigate other thinking skills beyond CT.

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