



# Junior High School Student's Computational Thinking Ability in Solving Mathematical Problems

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## ARTICLE INFO

### Article history:

Received February 08, 2024

Accepted April 10, 2024

Available online April 25, 2024

### Kata Kunci:

Berpikir Komputasi, Masalah Matematis, Memecahkan Masalah Matematis

### Keywords:

Computational Thinking, Mathematical Problems, Solving Mathematical Problems



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## ABSTRAK

Rendahnya kemampuan siswa dalam memecahkan masalah matematika melalui aspek-aspek kunci seperti dekomposisi, pengenalan pola, abstraksi, dan berpikir algoritma terjadi dikarenakan kurangnya strategi kreatif dalam pembelajaran. Penelitian ini bertujuan untuk memberikan pemahaman mendalam terkait kendala-kendala tersebut dan mengusulkan strategi pembelajaran yang lebih efektif. Penelitian ini merupakan penelitian deskriptif kualitatif. Subjek penelitian ini adalah 40 orang siswa kelas VII SMP. Subjek penelitian dengan kemampuan berpikir komputasi kategori rendah atau memperoleh skor total terendah sebanyak 5 orang siswa. Metode pengumpulan data yang digunakan dalam penelitian ini adalah dengan tes kemampuan berpikir komputasi dan wawancara mendalam. Tes kemampuan berpikir komputasi dilaksanakan dengan menggunakan soal hasil adaptasi dari soal Bebras Task yang sudah diuji validitas dan reliabilitasnya. Hasil penelitian ini adalah (1) kemampuan berpikir komputasi siswa kelas VII SMP tergolong sedang dengan persentase setiap komponen kemampuan berpikir komputasinya adalah 47,25% (dekomposisi), 35,25% (pengenalan pola dan generalisasi), 50,38% (abstraksi), dan 29,88% (berpikir algoritma); (2) kendala yang dihadapi siswa dalam memecahkan masalah matematis yang menyebabkan adanya siswa yang memiliki kemampuan berpikir komputasi kategori diantaranya siswa belum terbiasa memilah informasi sebagai aktifitas dalam komponen kemampuan abstraksi dan inti dari kemampuan berpikir komputasi. Implikasi dari temuan ini menunjukkan bahwa subjek penelitian dalam kemampuan berpikir komputasi kategori rendah memiliki kecenderungan untuk berjuang dalam menguasai komponen keterampilan abstraksi.

## ABSTRACT

The low ability of students to solve mathematical problems through key aspects such as decomposition, pattern recognition, abstraction, and algorithmic thinking occurs due to a lack of creative strategies in learning. This study aims to provide an in-depth understanding of these obstacles and propose more effective learning strategies. This research is qualitative descriptive research. The subjects of this study were 40 students of grade VII junior high school. Research subjects with low computational thinking skills or obtained the lowest total score of 5 students. The data collection method used in this study was by computational thinking skills test and in-depth interview. The computational thinking ability test was carried out using questions adapted from the Bebras Task questions that had been tested for validity and reliability. The results of this study are (1) the computational thinking ability of grade VII junior high school students is classified as medium with the percentage of each component of computational thinking ability is 47.25% (decomposition), 35.25% (pattern recognition and generalization), 50.38% (abstraction), and 29.88% (thinking algorithms); (2) Obstacles faced by students in solving mathematical problems that cause students who have computational thinking skills, categories including students who are not accustomed to sorting information as activities in the components of abstraction skills and the core of computational thinking skills. The implications of these findings suggest that research subjects in the lower category computational thinking skills have a tendency to struggle in mastering the abstraction skill component.

## 1. INTRODUCTION

The Industrial Revolution 4.0 demands every individual to prepare to face every challenge (Lase, 2019; Zaharah & Susilowati, 2020). In this era, every individual must dig all sources of power humans have to be able to support performance, which significantly influences implementation tasks every day, one of which is human resources who can think innovatively and have the capacity to keep up with technological developments. To keep pace with technological developments closely related to computers, one of the abilities needed is the ability to think computationally (Achyadina, 2016; Arindiono & Ramadhani, 2013). Computational thinking is a human way of solving problems that involve abstraction and decomposition in describing significant complex problems. Computational thinking consists of several components: abstraction, decomposition, pattern recognition and generalization, and algorithmic thinking (Cahdriyana & Richardo, 2020; Lestari & Annizar, 2020). Abstraction determines which details to highlight and which to ignore underlying computational thinking. Decomposition is breaking down a complex problem or processing it into smaller, more manageable parts (Augie, 2021; Tresnawati et al., 2020). Pattern recognition is recognizing the same or different elements in the problem. At the same time, generalization is related to pattern recognition activities, namely recognizing patterns, similarities, and relationships and utilizing these parts in problem-solving. Algorithmic thinking is strategic thinking or step-by-step processing that involves a structured direction to solve a problem, achieve a goal, or complete a task (Hendriyani, 2020; Yahfizham, 2023).

Computational thinking provides knowledge to build critical thinking skills and creativity by studying the computational process (Fitriani et al., 2021; Mulyati, 2023). Experts state that computational thinking is one of the core abilities or is the 5th C in 5C (Critical Thinking, Collaboration, Communication, Creativity, Computational Thinking) as a 21<sup>st</sup>-century ability, an essential student competency. In the PISA 2022 framework, it is stated that students must be able to use computational thinking skills in mathematics as problem-solving exercises, along with the increase in the involvement of computers and computing tools in everyday life (Fauji et al., 2020; Kamil, 2021).

Based on this, it can be seen that computational thinking skills have a role in the context of problem-solving. Computational tasks that promoted computational thinking reflect the additional characteristics of problem-solving based on algorithmic thinking (Fauji et al., 2020; Mustafa, 2023). In the Regulation of the Minister of National Education of the Republic of Indonesia Number 22 of 2006, it is stated that the problem-solving approach is the focus of learning mathematics, so to improve problem-solving skills, it is necessary to develop skills in understanding problems, creating mathematical models, solving problems and interpreting solutions. NTCM states that problem-solving provides a framework for applying mathematics, and good mathematical problems provide students with opportunities to strengthen and expand their knowledge and stimulate their' mathematical learning (Grover, 2017; Harmini, 2020). In mathematics, a problem is any situation that must be solved using mathematical tools, but no strategy can be used immediately and clearly. Another opinion states that mathematical problems are problems/questions that cannot be immediately resolved based on routine steps/procedures that students already know (Cahdriyana & Richardo, 2020; Ginanjar, 2019).

However, conditions in the field prove that students in Indonesia do not have good problem-solving skills. This is proven by Indonesia's ranking in the 2018 PISA implementation, which shows that Indonesia is ranked in the bottom 10 of 79 participating countries, scoring 379 for mathematics ability (Harahap et al., 2021; Kamil, 2021). It was also stated that there are around 71% of Indonesian students do not reach the minimum level of competence in mathematics, or it can be concluded that there are still many Indonesian students who experience difficulties in dealing with situations that require problem-solving skills using mathematics (Cahdriyana & Richardo, 2020; Mustafa, 2023).

Based on this, it can be seen that Indonesian students are not yet accustomed to solving problems using appropriate methods, one of which is using computational thinking skills. Computational thinking is considered appropriate to help improve students' problem-solving abilities because computational thinking is characteristic of formulating problems by breaking them down into smaller and more manageable parts, enabling students to obtain more accessible and more efficient problem-solving strategy procedures (Kamil, 2021; Mustafa, 2023). There are various efforts that have been made. It is carried out by various parties to develop students' computational thinking skills, one of which is Bebras. This international organization aims to promote informatics (computer science or computing) and computational thinking for school students of various ages. Bebras is holding a challenge to complete a set of Bebras Task questions, which are the primary source for introducing informatics concepts (Kamil, 2021; Pamungkas et al., 2020).

There are satisfactory results based on the scores obtained by Sikecil participants (Primary Grades 1-3) who are ranked 19th at the national level and Siaga level participants (Primary Grades 4-6) who are

ranked 16 at the national level. However, the highest score obtained by Penggalang level (SMP) participants in answering the 2020 Bebras questions was 75. Meanwhile, in another study, That the highest score obtained by Siaga level (SMP) participants in answer to the 2019 Bebras question was 77.22. From these two studies, it can be seen that there is a decrease in the highest score obtained by *Siaga level* (SMP) participants from the Garut area. One of the challenges faced in implementing computational thinking skills is the lack of recognition of the concept of computational thinking skills (Juldial & Haryadi, 2024; Mustafa, 2023).

The novelty of this study lies in its more specific focus on the interaction between computational thinking skills and mathematical problem solving at the high school level. This research broadens the understanding of the importance of computational thinking in mathematics learning in the era of the Industrial Revolution 4.0, by relating it to the results of PISA 2022 and field conditions in Indonesia. In addition, the study identifies concrete challenges students face in developing computational thinking skills, providing guidance for curriculum improvements and instructional strategies at the secondary school level. With the special context of Indonesia, this research makes a significant contribution in understanding the reality of the field and supports efforts to improve students' computational thinking skills. As such, this research enriches the literature in this domain by providing new insights into the relationship between computational thinking and mathematical problem solving, as well as providing a foundation for the development of more effective learning strategies (Grover, 2017; Kallia et al., 2021).

This study highlights his contribution in deepening the understanding of the level of computational thinking ability of junior high school students in solving mathematical problems (Ginanjar, 2019; Pramono, 2017). In contrast to previous research, its more specific focus on the interaction between computational thinking skills and mathematical problem solving made a valuable contribution. This research reflects the relevance of computing in mathematics learning in the era of the Industrial Revolution 4.0, by relating it to the results of PISA 2022. Research also identifies concrete challenges students face in developing computational thinking skills, providing guidance for curriculum improvement and learning strategies at the junior high level. With the special context of Indonesia, this research makes a significant contribution to understanding the reality of the field and supports efforts to improve students' computational thinking skills. Based on the explanation above, it can be seen that the level of computational thinking ability of Indonesian students is still relatively low, so it is deemed necessary to carry out further research to determine the level of computational thinking ability of junior high school students in solving mathematical problems, the components of computational thinking ability that must be improved, the obstacles faced by students, as well as the causes.

## 2. METHOD

The type of research used in this research is descriptive qualitative research with a case study approach. In this research were students in class VII G of SMP Negeri 1 Seririt, which consisted of 40 students. The research subjects interviewed were selected with a specific purpose or are called purposefully selected individuals they consisted of 5 students who had the lowest total score on the test or were categorized as having low ability in computational thinking. The data collection methods used were computational thinking ability tests and in-depth interviews. The computational thinking ability test is a 5-item description of the results of adapting the Bebras Task questions, which are then tested for validity and reliability. The mathematical problems in this computational thinking ability test are related to integer material. The validity tests carried out are content validity tests and empirical validity tests. The content validity test was carried out based on testing by experts and all question items were declared valid (Pramuaji & Loekmono, 2018; Yusup, 2018). The empirical validity test was carried out using product moment correlation analysis on class VIII C students of SMP Negeri 1 Seririt consisting of 40 students, with the test results for all question items declared valid. Reliability testing was carried out on valid question items with the results obtained  $r_{11} = 0.72$  being stated to have a high level of reliability.

The data used in this research are the results of the computational thinking ability test with indicators of the computational thinking ability components according to Table 1.

**Tabel 1.** Computational Thinking Ability Indicator

Components	Indicators
Decomposition	<ul style="list-style-type: none"> <li>Students can determine the information obtained and the questions asked in the existing problem.</li> <li>Students can simplify/break down the problem into several smaller parts so that it is easy to solve.</li> </ul>

Components	Indicators
Pattern Recognition and Generalization	<ul style="list-style-type: none"> <li>Students can find similar patterns in a problem.</li> <li>Students can align solutions or parts of them so they can be used on similar problems.</li> </ul>
Abstraction	<ul style="list-style-type: none"> <li>Students can use ideas and solutions from one problem area to another.</li> <li>Students can simplify problems by paying attention to things that are necessary and ignoring things that are not necessary.</li> <li>Students can determine strategies that suit the problem to be manipulated practically.</li> </ul>
Algorithmic Thinking	<ul style="list-style-type: none"> <li>Students can determine algorithmic explanations of real-world processes to understand the problem-solving process better.</li> <li>Students can determine and describe the logical steps to find a solution to a problem.</li> </ul>

The analysis technique used is the analysis method according to Miles and Huberman, namely data collection, data reduction, data presentation, and conclusion. The level of computational thinking ability of research subjects is categorized according to Table 2.

**Tabel 2. Computational Thinking Ability Category Criteria**

Categories	Value Range
High	$X \geq (\bar{X} + SD)$
Moderate	$(\bar{X} - SD) < X < (\bar{X} + SD)$
Low	$X \leq (\bar{X} - SD)$

Note:  $X$  =student scores;  $\bar{X}$  =average student scores;  $SD$  =the standard deviation

### 3. RESULT AND DISCUSSION

#### Result

on the research participants have been meticulously documented and are comprehensively showcased in the subsequent table. This tabulated presentation meticulously delineates the nuanced nuances and intricacies of the computational thinking abilities exhibited by the respondents, offering a detailed insight into their problem-solving skills, pattern recognition, algorithmic thinking, and other pertinent components. The systematically organized data in the table serves as a valuable resource for researchers, educators, and stakeholders interested in gaining a profound understanding of the computational thinking prowess demonstrated by the study's participants. Analyzing the data in this comprehensive manner not only enhances the transparency of the research outcomes but also facilitates a more in-depth exploration of the intricate interplay between various facets of computational thinking. As such, this table stands as a robust repository of information, poised to contribute significantly to the broader discourse on computational thinking skills and their implications for educational practices and curriculum development.

**Tabel 3. Computational Thinking Ability Test Results**

Lowest Score	Highest Score	Average	Standard Deviation
18	67	32.55	10.12

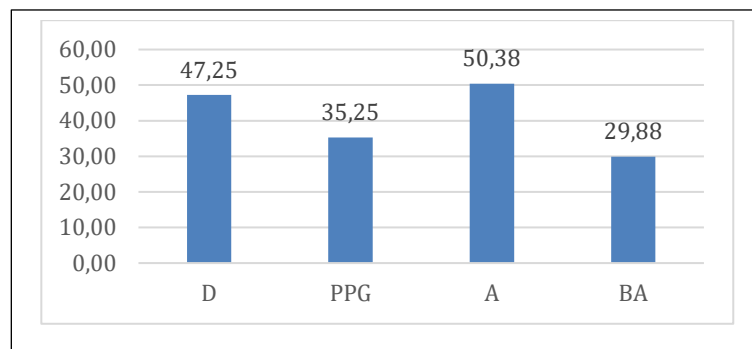
Based on Table 3, it can be seen that the categories of respondents' computational thinking abilities were obtained according to Table 4.

**Tabel 4. Categories Computational Thinking Skills**

Categories	Value Range
High	$X \geq 41.85$
Moderate	$22.02 < X < 41.85$
Low	$X \leq 22.02$

Based on Table 4, there are five respondents classified as having low computational thinking abilities, 30 respondents as having moderate computational thinking abilities, and five respondents as

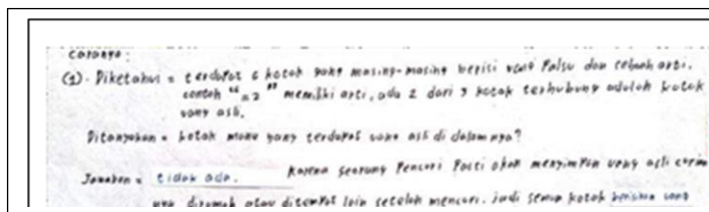
having high computational thinking abilities. This means that 75% of respondents are classified as having moderate computational thinking abilities. The percentage of computational thinking ability of students who took the comprehensive computational thinking ability test in terms of each component is as follows.



**Figure 1.** Percentage of Student's Computational Thinking Ability

Based on [Figure 1](#), it can be seen that the percentage of respondents' computational thinking abilities in solving mathematical problems is 50.38% for the abstraction ability (A) component, 47.25% for the decomposition ability (D) component, 35.25% for the pattern recognition and generalization (PPG) component, and 29.88% for the algorithmic thinking (BA) component.

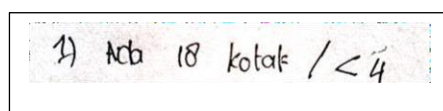
The following illustrates answers from research subjects who had the lowest total score on the test or had low ability in computational thinking.



Transcript: It is known there are six boxes, each of which contains fake money and a sign that means for example " $=2$ " which means that 2 of the 3 connected boxes are real money  
 Asked: which box contains real money in it?  
 Answer: none. Because a thief will keep the real money he stole at home or somewhere else after stealing. So, all the boxes contain fake money.

**Figure 2.** Answers of Research Subject S5 with Low Computational Thinking Ability

Research subject S5 demonstrated only mastery of the components of abstraction and pattern recognition abilities. Based on [Figure 2](#), it can be seen that research subject S5 has not been able to focus on important information and understand it well and has only demonstrated mastery of the components of pattern recognition ability. The inability of S5 research subjects to understand and use the important information found affected their performance in other components of computational thinking abilities. In the answers of research subjects with other low categories of computational thinking abilities, researchers encountered obstacles in solving problems on test questions because their mathematical abilities were still lacking.

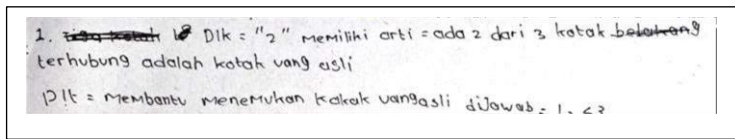


Transcript:  
 There are 18 boxes/  $<4$

**Figure 3.** Answers of Research Subject S7 with Low Computational Thinking Ability

Overall, the S7 research subjects began to show components of abstraction ability, although not yet optimal. Based on [Figure 3](#) and the interview results, it can be seen that the research subject only multiplied the number of boxes in the illustration of question number 1, namely 6, with the number listed in one of the boxes, namely 4. Regardless of the solution steps that were still incorrect, the research subject should have obtained a result of 24 boxes, but the research subject answered that the result was 18. This

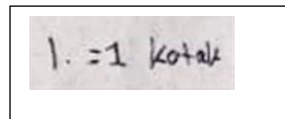
shows that the research subject's multiplication calculation operation skills still need to be improved. Apart from that, looking at the way the research subjects solve problems using only multiplication, it can be seen that they have not been able to determine the steps or strategies for solving the problem correctly.



Transcript:  
It is known that "2" has the meaning of 2 of the 3 connected boxes are real money boxes.  
Asked: help to find the real money boxes.  
Answer: 1, =3

**Figure 4.** Answers of Research Subject S28 with Low Computational Thinking Ability

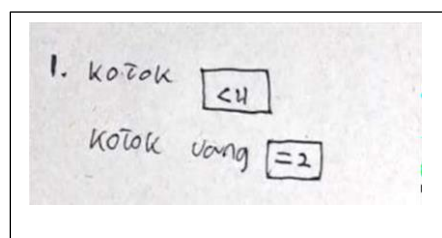
Overall, the S28 research subjects mastered the components of abstraction and decomposition. Based on Figure 4, it can be seen that research subject S28 mastered the components of abstraction and decomposition abilities. In the interview process, research subject S28 said that he had problems recognizing and understanding the meaning of the sign of inequality which forms the pattern in question number 1. This means that students' mathematical abilities can influence their performance in solving the mathematical problems they face.



Transcript:  
= 1 box

**Figure 5.** Answers of Research Subject S36 with Low Computational Thinking Ability

Overall, the S36 research subjects were not able to master all components of computational thinking abilities. Based on Figure 5 and interview results, it can be seen that research subject S36 experienced difficulty in understanding important information in the questions and this affected his performance in terms of other components of computational thinking abilities. Research subject S36 also tends to dislike mathematics, which affects his performance in answering questions and solving mathematical problems.



Transcript:  
Box < 4  
Box = 2

**Figure 6.** Answers of Research Subject S38 with Low Computational Thinking Ability

Overall, the S38 research subjects began to show components of abstraction ability, although not yet optimal. Based on Figure 6 and the interview results, it can be seen that research subject S38 did not write any explanation and only provided a summary answer because he could not sort and understand the important information in the question even though he had succeeded in finding it. Apart from that, research subjects S38 also had problems in understanding the signs of dissimilarity that form the pattern in the questions. This affects performance in other components of computational thinking abilities.

### Discussion

Research subjects with computational thinking abilities in the low category could not understand all the information and problems in the questions. Research subjects have difficulty distinguishing which information is essential and which is not necessary for problem-solving and finding and understanding the problem to be solved. The research subject will only explain the things presented in the question without understanding further. Research subjects also tend to focus on inappropriate information, leading to

inappropriate problem-solving. This is to research results which state that students tend to be unable to determine which information should be kept or discarded in the abstraction ability component. The inability of research subjects to sort information also affects their performance in carrying out other computational thinking ability component activities. In pattern recognition and generalization abilities, research subjects are also unable to understand the instructions or patterns in the questions, which leads to their inability to determine problem-solving steps and not obtain the correct answer results. In the algorithmic thinking ability component, research subjects have not been able to determine problem-solving steps. However, they still need to be careful in using clues or patterns that have been discovered previously. Research subjects tend to be confused because they feel the questions they are working on are challenging (Ansori, 2020; Fitriani et al., 2021).

This research delves into the phenomenon associated with research subjects exhibiting low computational thinking abilities. This phenomenon is manifested in the subjects' difficulties comprehending the entirety of information and issues encompassed within posed questions. The study provides an overview that these subjects encounter significant challenges in identifying information deemed essential, hindering their ability to holistically solve problems and unearth the root causes that need addressing. The responses provided by the research subjects appear confined to explanations of aspects directly presented in the questions, without making efforts to attain a deeper understanding of the context and implications of these inquiries. These findings align with previous research indicating that students with low computational thinking abilities tend to struggle in discerning which information to prioritize or neglect, particularly in the context of abstraction skills. Consequently, this situation influences the subjects' focus primarily on irrelevant information, yielding suboptimal or incongruent problem-solving solutions. Furthermore, the constraint in organizing information adversely impacts the subjects' performance in executing activities related to other components of computational thinking abilities (Grover, 2017; Harmini, 2020).

In the context of pattern recognition and generalization abilities, research subjects exhibited an inability to comprehend instructions or patterns within posed questions, resulting in their incapacity to determine appropriate problem-solving steps. This difficulty is also evident in algorithmic thinking, where the research subjects have not effectively determined well-structured problem-solving steps. Despite the potential utilization of hints or patterns identified beforehand, these limitations lead the subjects to feel confused, perceiving the questions as challenging obstacles to overcome (Fauji et al., 2020; Kallia et al., 2021). The findings not only contribute to our understanding of the challenges faced by individuals with low computational thinking abilities in addressing problem-solving tasks but also provide a crucial foundation for the development of learning strategies and intervention approaches to enhance computational thinking skills within this group. The implications of these findings can be integrated into the design of a more responsive curriculum, making a positive contribution to the cognitive development of the research subjects and potentially similar groups. As a result, this research opens opportunities for further exploration and efforts to improve the quality of learning and teaching in the context of low computational thinking abilities. Based on the interview findings, the researcher gained a profound understanding that research subjects with low computational thinking abilities still encounter challenges in filtering essential and non-essential information, an activity inherent to the abstraction ability. This condition also influences the research subjects' activities in other components of computational thinking abilities. The heightened awareness indicates that the research subjects' inability to master the abstraction ability component impacts all aspects of their computational thinking abilities. This point is pivotal, emphasizing that research subjects with low-category computational thinking abilities need to rectify the abstraction ability component to enhance the likelihood of mastering other components of their computational thinking abilities (Chan et al., 2023; Rodríguez-Martínez et al., 2020).

The researcher also noted that research subjects with low computational thinking abilities tend to convey their knowledge in response to questions by re-reading the text, without providing explanations based on their understanding and language. The implications of this finding indicate that research subjects in the low-category computational thinking abilities tend to struggle in mastering the components of abstraction skills. This condition is evident in the research subjects' inability to comprehend crucial information in each problem, leading to their incapacity to communicate it using their own language. In this context, it can be concluded that efforts to improve abstraction skills are imperative for research subjects with low computational thinking abilities. These findings underscore the need for more focused and holistic learning approaches and interventions that guide these subjects in enhancing their understanding and expression in computational problem-solving. This conclusion explores crucial dimensions in the development of inclusive learning strategies, supporting the enhancement of computational thinking capacity and making a positive contribution to their cognitive development in the future (Ansori, 2020; Saâ et al., 2021).

Several factors play a role in influencing students' computational thinking skills, including mathematical ability, language proficiency, gender, as well as information, communication, and technology literacy. Based on conducted research, the factor that predominantly affects students' computational thinking skills is mathematical ability. Mathematical proficiency is closely linked to fundamental concepts in computer programming, such as understanding logic, patterns, sequences, and problem-solving. Students with strong mathematical skills tend to excel in identifying patterns, formulating algorithms, and solving problems more effectively in the context of computer programming (Anistyasari et al., 2019; Kallia et al., 2021). The mathematical ability of the subjects in this study plays a significant role in the problem-solving process. Their lack of understanding of the concept of inequality signs in integers and their insufficient mastery of multiplication have implications for their difficulty in understanding key information in the problems. According to interviews with mathematics teachers at the research site, the term "computational thinking ability" is not yet fully understood, and school learning has not yet integrated this component. The focus of learning is still more on improving students' mathematical skills. This indicates that the learning approach in schools has not fully recognized the importance of computational thinking ability in the context of developing mathematical skills and problem-solving. Therefore, further efforts are needed to introduce and integrate computational thinking concepts into the mathematics curriculum so that students can be better prepared to meet the demands of evolving technology in this digital era.

The findings of this research have significant implications for the development of computational thinking skills, particularly among individuals with lower proficiency. The challenges faced by subjects in understanding essential information emphasize the need for a more focused learning approach in cultivating abstraction skills. The observation that subjects tend to convey knowledge solely through text re-reading underscores the necessity for enhanced verbal expression skills and conceptual comprehension. Moreover, difficulties in pattern recognition, generalization, and algorithmic thinking highlight the requirement for specialized training and intensive guidance. Broader implications encompass the development of an adaptive curriculum to support individuals with lower computational thinking abilities. Overall, these findings provide guidance for curriculum developers and practitioners to create an inclusive and effective learning environment for advancing computational thinking skills. While this research offers valuable insights, several limitations need consideration. The potentially limited sample size may restrict the generalizability of the findings. The subjects' inclination to convey knowledge solely through text re-reading may be influenced by other factors such as anxiety or a lack of verbal communication skills. In addressing these limitations, future research could consider a more quantitative methodological approach or expand the research sample for a more comprehensive understanding.

#### 4. CONCLUSION

The conclusion of this study indicates that research subjects with low computational thinking abilities face difficulties in comprehending essential information, identifying problems, and formulating holistic solutions. These findings align with previous research results, revealing subjects' challenges in determining crucial information in the context of abstraction skills. Therefore, subjects tend to focus on irrelevant information, resulting in problem-solving solutions that are not suitable. This limitation also influences the subjects' performance in other components of computational thinking abilities. Therefore, the enhancement of abstraction skills is crucial for subjects with low-category computational thinking abilities. The other factor that influences students' computational thinking is mathematical ability. This conclusion provides a foundation for the development of more focused learning strategies and interventions, supporting cognitive development and improving the quality of learning for this group. Nevertheless, attention should be given to research limitations, such as the limited sample size and the influence of other factors on subjects' behaviour, to ensure the generalizability of the findings. Future research should consider more quantitative methodological approaches or sample expansion to gain a more comprehensive understanding.

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