Journal of Honai Math, 7(3), 451-468, December 2024
https://doi.org/10.30862/jhm.v7i3.759

Computational thinking skills in mathematics: a study of social arithmetic

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Received: 16 November 2024 | Revised: 19 December 2024 | Accepted: 29 December 2024 | Published: 30 December 2024

Abstract

Computational Thinking (CT) has emerged as a fundamental skill in mathematical problem-solving, fostering logical reasoning and structured approaches to tackling complex problems. Despite its significance, the integration of CT in mathematics education, particularly in secondary school curricula, remains insufficiently explored, leading to a gap in understanding students' proficiency in CT skills. This study aims to investigate the CT abilities of seventh-grade students in solving social arithmetic problems based on four key CT indicators: decomposition, pattern recognition, abstraction, and algorithmic thinking. Data were collected through a set of problem-solving tasks designed to assess each indicator comprehensively. The findings reveal that 25% of students demonstrate high CT proficiency (score >78.12), 52% exhibit medium proficiency (score between 17.78 and 78.12), and 23% fall into the low category (score <17.78). The mean scores for each CT indicator are as follows: decomposition (53), pattern recognition (46), abstraction (40), and algorithmic thinking (53), with abstraction emerging as the weakest area. These results indicate that the majority of students possess only a moderate level of CT competence, particularly struggling with abstraction, which involves identifying critical information and disregarding extraneous details. The study underscores the necessity of developing instructional strategies that enhance students' CT skills, particularly in pattern recognition and abstraction, to foster deeper mathematical understanding and problem-solving capabilities. The findings contribute to the growing body of research on CT in mathematics education and offer insights for curriculum development aimed at strengthening students' analytical and computational skills.

Keywords: Computational Thinking, Mathematics, Seventh-Grade Students, Social Arithmetic

Introduction

Computational thinking (CT) is a cognitive process essential for formulating problems and devising solutions that can function as effective information-processing agents (Wing, 2010). Furthermore, Kalelioğlu (2018) defines CT as an approach to understanding and addressing complex problems through computer science principles and techniques, including decomposition, pattern recognition, abstraction, and algorithmic thinking. Scholars widely acknowledge CT as a fundamental competency necessary for education in the 21st century. Mendrofa (2024) underscores its significance in equipping individuals for technological advancements, while Khenner (2024) emphasizes its role in fostering data analysis, task automation, and algorithm development. For instance, in the field of cybersecurity, CT facilitates the identification of cyber threat patterns and the creation of algorithms to enhance security systems. Similarly, in data science, CT enables efficient data processing and interpretation, thereby supporting informed decision-making. The integration of CT into education cultivates critical thinking, creativity, communication, and collaboration skills, which are essential for addressing real-world digital challenges.

Within the educational domain, CT is conceptualized as a cognitive process that enables individuals to formulate problems and generate solutions that are comprehensible to both humans and computers (Maharani, 2020). In the current era of 21st-century education, incorporating CT components into school curricula, particularly in mathematics, is increasingly regarded as imperative. The integration of key CT elements problem decomposition, pattern recognition, abstraction, and algorithmic thinking into mathematics instruction has demonstrated the potential to enhance students' problem-solving abilities (Junpho et al., 2022; Kallia et al., 2021). While CT is traditionally associated with computer science, its applicability extends across multiple disciplines, including mathematics, where it facilitates deeper conceptual understanding and more efficient problem-solving strategies. For example, in algebra, students can employ decomposition to break down complex equations into manageable steps, pattern recognition to identify variable relationships, abstraction to generalize problem-solving strategies, and algorithmic thinking to develop structured procedures for systematic solutions (Calao et al., 2018). In geometry, CT supports the identification of geometric patterns, the development of algorithms for constructing shapes, and the application of abstraction in analyzing transformations and symmetry properties.

The 2021 PISA framework characterizes CT as a structured mathematical approach to problem-solving, emphasizing the importance of real-life contexts in instructional practices. Among various mathematical topics, social arithmetic has broad practical applications in everyday life (Dila & Zanthy, 2020; Friantini et al., 2020; Marlina & Setiawan, 2021; Yunia & Zanthy, 2020). This topic holds particular relevance for students as it imparts essential mathematical skills applicable to financial transactions, pricing, and economic decision-making. However, many students encounter challenges in comprehending and applying social arithmetic concepts, particularly in interpreting problem statements, selecting appropriate mathematical operations, and connecting abstract concepts to real-world scenarios (Dila & Zanthy, 2020; Nuraeni et al., 2020). According to Marlina and Setiawan (2021), students' difficulties in solving social arithmetic problems stem from their struggles with understanding word problems, expressing mathematical models, and following systematic problem-solving procedures. In this context, CT plays a crucial role in facilitating structured problem-solving by enabling students to systematically analyze problems, organize information effectively, and design logical solution strategies.

A considerable body of research has examined student performance, difficulties, and mathematical competencies in social arithmetic (Dila & Zanthy, 2020; Mali et al., 2021; Marlina & Setiawan, 2021; Pratama et al., 2021; Wahyuni, 2020; Yunia & Zanthy, 2020). Several studies have explored problem-solving abilities in social arithmetic based on students' mathematical proficiency levels (Azhar et al., 2022) and examined reasoning skills within this domain (Ardhiyanti et al., 2019). Furthermore, researchers have investigated students' representational abilities in relation to self-efficacy in social arithmetic (Nurbayan & Basuki, 2022) and analyzed epistemological barriers in problem-solving based on learning styles (Parawansa & Siswanto, 2021). While these studies provide valuable insights into various cognitive aspects of social arithmetic, they have not explicitly addressed the role of CT in this mathematical domain. A review of existing literature indicates that CT has been explored in broader mathematical problem-solving contexts (Junpho et al., 2022; Kallia et al., 2021) but has not been specifically linked to social arithmetic. Given the significance of CT in structuring problem-solving strategies, further research is needed to investigate how students apply CT skills such as decomposition, pattern recognition, abstraction, and algorithmic thinking when solving social arithmetic problems.

This study aims to bridge this research gap by analyzing students' application of CT in solving social arithmetic problems. Unlike previous studies that primarily focus on general problem-solving difficulties or mathematical reasoning, this research provides a comprehensive examination of students' CT competencies within the context of social arithmetic. By assessing students' strengths and challenges in decomposition, pattern recognition, abstraction, and algorithmic thinking, the study seeks to offer valuable insights into the effective integration of CT into mathematics instruction. The findings have significant implications for educators, curriculum designers, and policymakers in developing instructional strategies that enhance students' computational thinking skills and overall mathematical proficiency.

Methods

This study employs a descriptive research design with a quantitative approach to analyze students' computational thinking skills based on test scores. The primary objective is to examine students' computational thinking abilities through four key indicators: decomposition, pattern recognition, abstraction, and algorithmic thinking. The study was conducted during the first semester of the 2024/2025 academic year.

The research participants comprised 60 seventh-grade students from a junior high school in Palembang. The selection of participants was based on the consideration that the topic of social arithmetic is included in the curriculum for this grade level.

Data were collected through a structured test designed to assess students' computational thinking skills. Prior to implementation, the test instruments underwent a rigorous validation process involving three expert validators specializing in mathematics education and educational assessment. The validation procedure consisted of content validation and expert judgment to ensure alignment with the indicators of computational thinking and the learning objectives of social arithmetic. Additionally, a reliability analysis was conducted to determine the internal consistency of the test instrument.

Before administering the test, students participated in instructional sessions integrating computational thinking principles. These sessions, conducted over four meetings of 90 minutes each, introduced students to decomposition, pattern recognition, abstraction, and algorithmic thinking through guided problem-solving activities. Students engaged with computational thinking worksheets designed to scaffold their understanding of these concepts before their skills were formally assessed.

The test instrument consisted of three structured problem-solving questions designed to evaluate students' computational thinking skills. The test questions were developed based on established computational thinking frameworks and encompassed the following core components:

1. Decomposition: Identifying given information and breaking down the problem into smaller, manageable parts.
2. Pattern Recognition: Identifying patterns and connections based on prior knowledge and problem context.
3. Abstraction: Extracting essential information while disregarding irrelevant details.
4. Algorithmic Thinking: Developing systematic, step-by-step solutions to the given problems.

Each question required students to analyze a real-world mathematical scenario and apply computational thinking skills to derive a solution. The test items were adapted from prior research on computational thinking in mathematics education and were refined based on expert evaluations. The validation process involved two stages: expert consultation to establish content validity and a small-scale pilot study to assess item clarity and reliability. Necessary revisions were made based on feedback obtained from these evaluations.

The following are the problem-solving tasks included in the test:

1. Kiel purchased two mobile phones at a 20% discount per item. The first phone was originally priced at Rp 5,000,000, while the second phone cost Rp 8,000,000 after the discount. After a few years, he resold the first phone at a 25% loss from its purchase price and the second phone at a 10% loss. Determine the total percentage loss incurred.

a. Based on the problem above, write down the information you know from the problem Kiel is facing
b. Then, write down what the main problem Kiel is facing.
c. Write down what you need to do to solve the problem Kiel is facing.
d. Write down the methods you can use to solve the problem Kiel is facing.
e. Based on the methods you have chosen, what important information can be used to solve Kiel's problem, and what information is not important?
f. Write down the steps to solve Kiel's problem based on the methods you have chosen!

2. Nathan bought a novel online for Rp 70,000 after receiving a 30% discount. After reading the novel, he plans to resell it at a 10% profit based on the purchase price and use the proceeds to buy a new novel priced at Rp 75,000. Determine whether the amount he receives from selling the novel is sufficient to purchase the new one.

a. Based on the problem above, write down the information you know from the problem Nathan is facing.
b. Then, write down what the main problem Nathan is facing.
c. Write down what you need to do to solve the problem Nathan is facing.
d. Write down the methods you can use to solve the problem Nathan is facing.
e. Based on the methods you have chosen, what important information can be used to solve Nathan's problem, and what information is not important?
f. Write down the steps to solve Nathan's problem based on the methods you have chosen.

3. A clothing store offers a 20% discount to new customers who register as members. Additionally, an end-of-year promotion provides an extra 15% discount for purchases exceeding Rp 1,000,000. An existing customer purchases clothing items priced at Rp 400,000, Rp 500,000, and Rp 700,000 before any discounts. Determine the total amount payable after applying all applicable discounts.

a. Based on the problem above, write down the information you know from the problem the existing customer is facing.
b. Then, write down what the main problem the existing customer is facing.
c. Write down what you need to do to solve the problem the existing customer is facing.
d. Write down the methods you can use to solve the problem the existing customer is facing.
e. Based on the methods you have chosen, what important information can be used to solve the existing customer's problem, and what information is not important?
f. Write down the steps to solve the existing customer's problem based on the methods you have chosen.

The study assesses computational thinking skills using four key indicators, as detailed in Table 1.

Table 1. Computational Thinking Indicators and Their Descriptors

Skills Component	Indicator	Aspect
Decomposition	Students can simplify complex problem contexts.	Identifying and simplifying relevant information.
Pattern Recognition	Students identify similarities, patterns, and relationships to solve problems efficiently.	Recognizing patterns and connections, formulating problem-solving strategies.
Abstraction	Students generalize and extract key problem characteristics while ignoring extraneous details.	Analyzing and distinguishing between necessary and unnecessary information.

Algorithm	Students develop structured, step-by-step problem-solving approaches.	Implementing systematic procedures to arrive at solutions.

The collected test data were analyzed using a classification system based on students' computational thinking performance. Students were categorized into three proficiency levels: high, medium, and low. The classification was determined using a statistical approach based on the mean ($\bar{x}$) and standard deviation (σ) of the test scores, as shown in Table 2.

Table 2. Categorization of Computational Thinking Skills

Score	Category
$N \geq \bar{x} + \sigma$	High
$\bar{x} - \sigma < N < \bar{x} + \sigma$	Middle
$N \leq \bar{x} - \sigma$	Low

Note:

N : Student's Score

$\bar{x}$: Ideal Average

σ : Standard Deviation

This categorization method provides an objective framework for evaluating students' computational thinking abilities, ensuring consistency with prior studies employing similar statistical classification approaches.

Results and Discussion

The test data obtained from students' responses to the three given questions are summarized in Table 3. Additionally, the test results categorized based on students' ability levels high, medium, and low are presented in Table 4.

Table 3. Maximum and minimum scores achieved by students

Number of Students	Minimum Score	Maximum Score	Mean	Standard Deviation
60	0	100	47.95	30.17

Table 4. Percentage of students for each category of computational thinking skill

Score	Category	Number of Students	Percentage
$N \geq 78.12$	High	15	25
$17.78 < N < 78.12$	Middle	31	51,67
$N \leq 17.78$	Low	14	23,33

The test results for each component of computational thinking are illustrated in Figure 1.

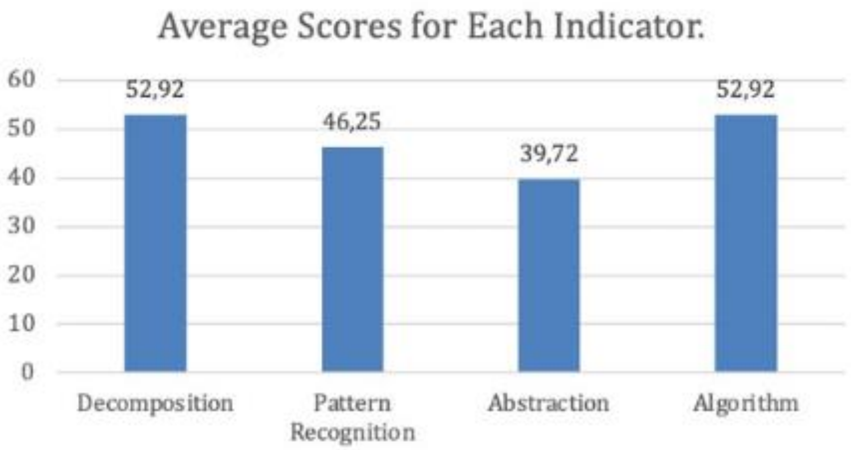

Figure 1. Average scores for each computational thinking indicator

Each student's responses were assessed using a rubric specifically designed to evaluate the four key components of computational thinking: decomposition, pattern recognition, abstraction, and algorithm design. This rubric was developed based on established computational thinking indicators and underwent validation by experts in mathematics education. Each response was classified as either aligned or not aligned with the corresponding computational thinking component.

The findings reveal that students' computational thinking abilities in solving social arithmetic problems exhibit several errors across the four computational thinking components, as detailed below:

Decomposition

The students' responses in the decomposition component, categorized based on alignment with computational thinking indicators, are presented in Table 5.

Table 5. Student responses aligned and not aligned with CT indicators in the decomposition component

No	Answer
1	**Answers from Students Aligned with the Indicator:** • Calculate the total percentage of loss Kiel incurred from selling both handphones. • Calculate the total cost of purchasing from the sale of both handphones. • Calculate the selling price of Handphone A. • Calculate the selling price of Handphone B. • Calculate the total revenue from selling both handphones. • Calculate the total loss from selling both handphones. • Calculate the total percentage of loss from selling both handphones. **Answers from Students Not Aligned with the Indicator:** • It would be better to sell the handphones at a higher profit so there is no loss in trading.

	• Kiel plans to resell both handphones. • Kiel experienced a loss after selling the first handphone. • The problem Kiel is facing is a loss. • He should sell the handphone for a higher price, or else he will face a significant loss.
2	**Answers from Students Aligned with the Indicator:** • Calculate the 10% profit from the sale of the novel. • Calculate the selling price after the 10% profit. • Calculate whether the money is enough to buy a new novel priced at Rp75,000. **Answers from Students Not Aligned with the Indicator:** • What I should do is add a small discount. • There is no problem that Nathan is facing. • Nathan bought the novel for Rp 70,000. • Use the discount and percentage formula. • Calculate the loss from buying the novel. • The novel is a thriller and consists of 30 chapters.
3	**Answers from Students Aligned with the Indicator:** • Calculate the total cost of the clothing. • Compare the total cost with the minimum purchase required to get the additional discount. • Calculate the total cost after applying the 15% end-of-year discount. **Answers from Students Not Aligned with the Indicator:** • Experience a loss and need to add a discount. • Related to the end-of-year promotion. • Solve the problem by adding the prices before the discount. • Get a total discount of 15%. • Why buy clothes before the discount. • Use addition to calculate the total cost. • Use comparisons of greater than and less than.

Pattern Recognition

The students' responses in the pattern recognition component, classified according to their alignment with computational thinking indicators, are provided in Table 6.

Table 6. Students' answers aligned and not aligned with CT indicators in the pattern recognition component

No	Answer
1	**Answers from Students Aligned with the Indicator:** • Use addition to calculate the total purchase cost by adding the purchase prices of both phones. • Use the loss percentage formula to calculate the selling price of Phone A. • Use the loss percentage formula to calculate the selling price of Phone B. • Use addition to calculate the total revenue from the sale of

	both phones. • Use subtraction to find the total loss by subtracting the total purchase costfrom the total revenue. • Use the loss percentage formula to calculate the percentage of total loss fromthe sale of both phones **Answers from Students Not Aligned with the Indicator:** • Solve Kiel's problem with the phone price of Rp 5,000,000. • Add the profits of Phone A and Phone B. • The solution is to sell for a price higher than the loss.
2	**Answers from Students Aligned with the Indicator:** • A Use the profit percentage formula to calculate the profit from the originalprice of the novel. • Use addition of the original price and profit to calculate the selling price ofthe novel with a 10% profit. • Use subtraction to subtract the money from the sale proceeds with the priceof the new novel. **Answers from Students Not Aligned with the Indicator:** • The method is like Step C, but you need to add a higher profit to be able tobuy the new novel.
3	**Answers from Students Aligned with the Indicator:** • Use addition to calculate the total spending on the clothes purchased. • Use comparison (greater than or less than) to determine if an additional discount can be applied. • Use the discount formula to calculate the total amount to be paid after applying the 15% year-end discount. **Answers from Students Not Aligned with the Indicator:** • The method is like step B, where the student experiences a loss.

Abstraction

The students' responses in the abstraction component, categorized based on their alignment with computational thinking indicators, are shown in Table 7.

Table 7. Students' answers aligned and not aligned with computational thinking indicators in the abstraction component

No	Answer
1	**Answers from Students Aligned with the Indicator:** Important Information: • Purchase price of Handphone A = Rp 5,000,000 • Purchase price of Handphone B = Rp 8,000,000 • Loss Percentage for Handphone A = 25% • Loss Percentage for Handphone B = 10% Unimportant Information: • Purchasing two handphones at the same time • 20% discount for each handphone **Answers from Students Not Aligned with the Indicator:** • The total in step a includes a 20% discount per item.

	• The total in step D is sold with a 25% loss from the purchase price. • 5,000,000 × 25% • 8,000,000 × 10% • Finding the percentage for both handphones sold. • Percentage multiplied by the purchase price. • Adding both totals together.
2	**Answers from Students Aligned with the Indicator:** Important Information: • Purchase price of the novel: Rp 70,000 • Profit from sale: 10% of the original price • Price of the new novel: Rp 75,000 Unimportant Information: • 30% discount on the novel purchase • The novel consists of 30 chapters • The novel is a thriller **Answers from Students Not Aligned with the Indicator:** • Comparing the selling price and purchase price • The important information is that he wants to buy a new novel • Finding the percentage of profit from selling the novel • U = % x Purchase Price • Calculating the 10% profit from the original price of the novel
3	**Answers from Students Aligned with the Indicator:** Important Information: • Year-end promotion of 15% off from the price after discounts with a minimum purchase of Rp 1,000,000 • Initial price of clothing A: Rp 400,000 • Initial price of clothing B: Rp 500,000 • Initial price of clothing C: Rp 700,000 Unimportant Information: • 20% discount for new customers • Special year-end discount promotion **Answers from Students Not Aligned with the Indicator:** • A store offers a discount • Calculating the total shopping amount by adding up all purchases • The way is that clothing that receives a 20% discount is already fortunate • Discount size = % discount x initial price

Algorithm

In this component, students were required to formulate a problem-solving strategy using the information obtained from the previous steps. Algorithm design involves a structured approach wherein students systematically solve a problem based on their prior decomposition, pattern recognition, and abstraction. Errors identified in this component were analyzed to determine common misconceptions and challenges faced by students. Table 8 presents the most frequently occurring errors in the algorithm component. Further analysis of these errors highlights several key factors contributing to students' difficulties:

1. Conceptual misunderstanding – Many students misapplied mathematical operations, such as incorrectly summing percentage losses instead of computing their respective amounts first.
2. Lack of procedural fluency – Some students did not correctly follow algorithmic steps, leading to calculation errors.
3. Misinterpretation of problem statements – Some students focused on irrelevant details, affecting their ability to develop an appropriate algorithm.
4. Insufficient practice – Students with lower computational thinking skills tended to struggle with translating abstract mathematical principles into step-by-step solutions.

The findings suggest that students require additional structured practice in computational thinking, particularly in formulating and implementing algorithmic problem-solving strategies. Future instructional approaches should emphasize systematic guidance and targeted support to enhance students' proficiency in algorithmic reasoning.

Table 8. Errors in the Algorithm Component

No	Student Responses Not Aligned with the Indicator
1	• Some students calculated the loss per handphone incorrectly by dividing the percentage of loss by the purchase price, instead of multiplying the percentage of loss by the purchase price to determine the amount of loss. • Certain students merely restated the information provided in the question withoutperforming any calculations. • Some students calculated the total percentage of loss experienced by summing thepercentage losses of Handphone A and Handphone B. • Several students made errors in the calculation process, particularly during multiplication and division steps.
2	• Some students directly subtracted the purchase price of the new novel from thepurchase price of the previously bought novel to calculate the profit. • A few students calculated the percentage of profit from selling the novel, even though the question only asked for the selling price of the novel and whether the money was sufficient to buy the new novel. • Some students responded using only a sentence, such as "Made a profit."
3	• Some students added the two discounts offered by the store without considering theconditions required to determine the total discount received by the customer. • Some students calculated the amount to be paid using the discount listed in the irrelevant information, namely the discount for new customers, even though the customer in the problem is a returning customer. • There are still some students who made calculation errors during multiplication anddivision. • Some students only answered up to comparing the total shopping amount with the minimum requirement to receive the year-end discount.

The computational thinking abilities of students in solving social arithmetic problems were generally classified as moderate. Among the 60 participants, 25% demonstrated high proficiency, 51.67% exhibited moderate competency, and 23.33% fell into the low category. The students' scores ranged from a minimum of 0 to a maximum of 100, with a standard deviation of 30.17. The presence of students who scored 0 indicates a lack of comprehension of the problem, as they failed to exhibit any computational thinking components, whereas some students achieved perfect scores. The relatively high standard deviation suggests a considerable variation in students' computational thinking abilities concerning social arithmetic concepts, with the majority positioned at a moderate level.

The average scores for each computational thinking component were as follows: 52.92 for decomposition, 46.25 for pattern recognition, 39.72 for abstraction, and 52.92 for algorithmic thinking. Among these, the lowest mean score was recorded in abstraction, indicating that students struggled the most with structuring their responses and differentiating between essential and non-essential information. This finding suggests that students are not yet accustomed to computational thinking approaches. The present study's results, which identify abstraction as the most challenging component, align with the conclusions of Bilbao et al. (2021) and also Çakiroğlu and Çevik (2022), who emphasized the difficulty students face in developing abstraction skills. However, research conducted by Fitrisyah et al. (2024) reported that, following video-based instructional interventions, abstraction was not the lowest-performing component; instead, decomposition and algorithmic thinking were identified as the weakest areas. Similarly, Hapizah et al. (2024) found that pattern recognition was the most problematic component when dealing with integer addition and subtraction. Given that abstraction plays a crucial role in computational thinking, it is imperative to prioritize its development in mathematics education.

Although abstraction emerged as the most challenging aspect, students also encountered difficulties in other computational thinking components. In the decomposition component, students were expected to outline operational steps pertinent to solving the problem. Errors were primarily observed in the students' use of language, which lacked operational clarity and failed to reflect a structured understanding of problem-solving stages. This finding suggests that students' comprehension of social arithmetic remains inadequate, consistent with the observations of Marlina and Setiawan (2021). Additionally, the linguistic challenges students faced when articulating their problem-solving strategies corroborate the findings of Pratama et al. (2021), who identified language comprehension as a major barrier in solving social arithmetic problems.

Students' performance in pattern recognition was suboptimal, with an average score of only 46.25. The expected patterns in social arithmetic problems involve identifying strategic approaches to solving the given tasks. However, errors were frequently observed in students' responses, particularly concerning real-world aspects of the problems. For instance, in response to question number 2, one student wrote: "The method is like step C, but you need to add a large profit to buy the new novel." This statement reflects a practical purchasing strategy rather than a mathematical approach to solving the problem. These findings indicate the need for instructional strategies that guide students in recognizing patterns and systematically applying them too mathematical problem-solving.

The errors identified in the algorithmic thinking component, as presented in Table 8, predominantly stemmed from miscalculations and procedural mistakes in solving social arithmetic problems. These findings corroborate the study by Marlina and Setiawan (2021), which highlighted students’ struggles with executing the necessary problem-solving steps. Similarly, research by Dila and Zanthy (2020) reported that students face significant challenges in performing accurate calculations. Furthermore, Pratama et al. (2021) noted that students frequently failed to follow a systematic sequence in solving social arithmetic problems, indicating a lack of conceptual understanding in this domain.

The observed errors largely stem from students' difficulties in comprehending the given problems. Several previous studies have consistently reported that students struggle with problem comprehension in social arithmetic, as documented by Dila and Zanthy (2020), Mali et al. (2021), Marlina and Setiawan (2021), Pratama et al. (2021), Wahyuni (2020), and Yunia and Zanthy (2020). Effective problem comprehension is essential for accurate problem-solving. Given the word-intensive nature of social arithmetic problems, which often involve lengthy narratives, structured interventions are necessary to assist students in systematically deconstructing and solving these problems.

The findings of this study highlight the need for a structured approach to developing students’ computational thinking skills. To address these challenges, the following recommendations are proposed:

1. Enhancing Abstraction Skills: Teachers should integrate targeted exercises that help students differentiate between essential and extraneous information. This can be facilitated through guided practice sessions and worked examples.
2. Improving Decomposition Strategies: The use of structured problem-solving frameworks, such as graphic organizers, may assist students in breaking down complex problems more effectively.
3. Strengthening Pattern Recognition: Teachers should provide explicit instruction on identifying mathematical patterns in real-world contexts, supported by diverse problem scenarios.
4. Reinforcing Algorithmic Thinking: Step-by-step scaffolding of solution processes should be implemented to help students develop systematic problem-solving skills.

Additionally, incorporating student worksheets aligned with computational thinking components may further enhance learning outcomes. According to Sari and Hapizah (2020), educational worksheets should integrate technological advancements to support the development of computational thinking skills relevant to the digital era. Encouraging students to engage with structured problem-solving strategies within social arithmetic contexts can ultimately lead to improved mathematical reasoning and performance. Familiarizing students with computational thinking stages in solving social arithmetic problems will enhance their ability to approach problem-solving in a structured and methodical manner.

Conclusion

Students' computational thinking abilities in social arithmetic are generally at a moderate level. Specifically, 25% of students demonstrated high computational thinking skills, 51.67% fell into the moderate category, and 23.33% exhibited low computational thinking abilities. Analyzing the four key components of computational thinking, decomposition and algorithmic thinking yielded the highest average scores (52.92), followed by pattern recognition (46.25), while abstraction had the lowest average score (39.72). The challenges identified in each component highlight students' difficulties in computational problem-solving. In abstraction, students struggled to differentiate essential information from irrelevant details, which hindered their ability to conceptualize mathematical problems effectively. Within decomposition, errors stemmed from misunderstandings related to non-operational language, reflecting a gap in problem comprehension. Pattern recognition deficiencies were marked by students' inability to recognize and apply relevant strategies for solving mathematical problems. Meanwhile, difficulties in algorithmic thinking were primarily associated with operational errors and inefficiencies in executing problem-solving steps. These findings suggest the need for targeted interventions to enhance students' computational thinking across all four components.

Despite its valuable contributions, this study has several limitations. The research focused solely on students' computational thinking skills in the context of social arithmetic, which may limit the generalizability of the findings to other mathematical topics. Additionally, the study did not examine external factors such as students' prior knowledge, instructional methods, or digital literacy, all of which could influence computational thinking development. Another limitation is that the assessment relied on performance-based indicators without incorporating in-depth qualitative analysis, such as interviews or observations, which could provide a more comprehensive understanding of students' reasoning processes. Moreover, the study was conducted within a specific educational setting, and differences in curriculum design, teacher approaches, or learning environments may impact the applicability of these findings to other contexts. Addressing these limitations in future research could provide deeper insights into the multifaceted nature of computational thinking in mathematics education.

Finally, future research should explore the integration of computational thinking more comprehensively within mathematics curricula to enhance students' problem-solving abilities. One promising avenue is the development of instructional materials explicitly designed to reinforce computational thinking through structured, step-by-step guidance. Additionally, further studies should investigate the impact of different pedagogical strategies, such as inquiry-based learning or digital tools, in fostering computational thinking skills across various mathematical domains. Expanding the scope of research to include longitudinal studies could offer valuable insights into the long-term effects of computational thinking interventions on students' mathematical proficiency. Furthermore, incorporating qualitative methods, such as think-aloud protocols or student interviews, may provide a deeper understanding of how learners engage with computational thinking processes. By addressing these research directions, future studies can contribute to the development of more effective instructional practices that cultivate students' computational thinking skills, thereby enhancing their mathematical understanding and problem-solving competencies in real-world contexts.

Acknowledgment

We extend our sincere gratitude to Universitas Sriwijaya for its support and funding through the Penelitian Unggulan Kompetitif 2024 research grant. The research and publication of this article were financially supported by the DIPA of the Public Service Agency of Universitas Sriwijaya 2024, under Grant Number SP DIPA 023.17.2.677515/2024, issued on November 24, 2023. This funding was provided in accordance with the Rector's Decree Number 0013/UN9/LP2M.PT/2024, dated May 20, 2024.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been covered completely by the authors.

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