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Systematic Literature Review: The Importance of Computational Thinking Abilities in the Era of Society 5.0 in Mathematics Learning

*Corresponding author: nurrahmi.rizqi@gmail.com

Nur Rahmi Rizqi[1*], Kms. Muhammad Amin Fauzi[2*], Edi Syahputra[3]
[1] Universitas Alwashliyah Medan, Medan, Indonesia
[2 3]State University of Medan, Indonesia

ABSTRACT

This research aims to conduct a literature review regarding students' computational thinking abilities in facing the era of Society 5.0 in mathematics learning. The method used in the research is a Systematic Literature Review (SLR) which consists of the results of approximately 200 studies regarding students' computational thinking abilities, but only 10 research results were included. The sample consists of national and international indexed journals published in the period 2015 – 2023. Several studies regarding the meaning of computational thinking abilities, computational thinking in mathematics learning, indicators of computational thinking abilities, and theories about computational thinking abilities. The computational thinking capabilities used in mathematics learning are in line with the challenges of the Society 5.0 era, which emphasizes problem-solving and the application of technology. This helps students develop cognitive abilities to understand and solve mathematical problems. This ability helps students identify, formulate, and solve mathematical problems more effectively in the context of mathematics learning.

Keywords: Computational Thingking, Mathematics Learning, Society 5.0

1. Introduction

Computational Thinking (CT) skills have become extremely crucial in mathematics learning in the Society 5.0 age. CT is a problem-solving and analytical talent that entails identifying and applying relevant techniques and tools both digitally and in real life (Isharyadi & Juandi, 2023).

In an increasingly digital society, technical knowledge and abilities will become essential factors in the job development of today's pupils in an increasingly digital society (Isharyadi & Juandi, 2023). CT prepares students for future challenges by teaching them how to comprehend, evaluate, and solve complex problems.

Technology is quickly evolving in the Society 5.0 age. CT capabilities allow pupils to adapt to technological developments and effectively use them in math studies. Through modeling, simulation, and visualization, CT can assist students in understanding abstract mathematical concepts (Barcelos et al., 2018). Students can gain a better understanding of mathematical principles by applying them to real-world circumstances.

CT entails selecting and applying effective problem-solving strategies (S. Maharani et al., 2020). CT can assist students in identifying problems, developing problem-solving strategies, and evaluating the solutions that follow.

Mathematics learning with CT can be more engaging for students since it incorporates modeling, simulation, and problem-solving in real life (Barcelos et al., 2018). This can boost student interest and involvement in mathematics learning.

CT can be used in mathematics learning through a variety of activities such as mathematical modeling, programming, and the usage of educational games (Barcelos et al., 2018). In the Society 5.0 age, the use of CT in mathematics learning can give considerable benefits for students, such as increased mathematical knowledge, problem-solving abilities, and student involvement in learning (Isharyadi & Juandi, 2023).

According to a study on CT-based mathematics learning in the Independent Learning Curriculum era, this learning strategy proved beneficial in assisting students in finding mathematical solutions (Ni et al., 2022). Then, Ni et al., (2022) evaluated the appropriateness of CT-based learning methods with the Independent Learning Curriculum, discovering that this learning approach fulfilled students' needs in the face of technological changes.

Maharani, A.). (2020). Because it incorporates modeling, simulation, and problem solving in real world, CT-based mathematics learning can be more engaging for children. It was discovered in a study on the use of CT for slow learners in solving arithmetic sequence problems found that this learning strategy can boost student interest in learning.

Several studies demonstrate that using CT can help students enhance their mathematics knowledge (Ye et al., 2023). More in-depth research, however, is required to demonstrate openly and clearly how CT can enhance mathematical learning. This study may aid in the development of more effective learning strategies for enhancing students' mathematical understanding.

Students sometimes experience obstacles while solving mathematical problems using programming due to the distinctions between two forms of thinking, namely computational thinking and mathematical thinking (Park, 2023). More study is needed to discover and address these obstacles so that CT can be used more effectively in mathematics learning.

Several studies in the literature discuss the development of learning tools and ways to integrate CT with mathematics (Chan et al., 2023). More research, however, is required to determine the most effective learning tools and methodologies for boosting students' CT abilities and mathematical knowledge.

Mathematics learning with CT can be more engaging for children since it incorporates modeling, simulation, and problem-solving in real life (Ye et al., 2023). More research is needed, however, to understand the elements that drive student participation in CT-based learning and how to improve it.

2. Literature Review and Hypothesis

2.1 Computational Capabilities

A range of skills and concepts that aid in problem-solving and data analysis are included in computational thinking abilities (Monalisa, 2023). Some of the capabilities associated with computational thinking are as follows (Nuvitalia et al., 2022):

1. Decomposition: The capacity to divide large issues into smaller, more manageable chunks. This helps in gaining a better understanding of the situation.
2. Pattern Recognition is the capacity to identify patterns or similarities in data or problems. Pattern recognition helps in the discovery of more efficient solutions.
3. Abstraction: The capacity to simplify problems by removing extraneous elements and focusing solely on the most relevant aspects. This helps in the development of simpler and more efficient solutions.
4. Algorithmic Design: The capacity to create systematic methods or algorithms for issue

solving. This involves step-by-step reasoning.

5. Debugging and Error Handling: The capacity to find and fixing mistakes in algorithms or computer code. Fault detection is an essential aspect of developing computational solutions.
6. Iteration is the ability to repeat problem-solving processes or actions in order to refine and optimize solutions.
7. Algorithmic Efficiency: The capacity to evaluate and improve the efficiency of algorithms. This includes minimizing the waste of time and resources.
8. Logical Thinking: The ability to construct solutions rationally and methodically. Understanding logical and mathematical ideas is required.
9. Problem-solving: the ability to identify issues, devise solutions, and carry out the activities required to achieve objectives.
10. Data analysis: the ability to acquire, analyze, and evaluate data in order to make informed decisions.

This computational thinking capacity is applicable not only in the realm of programming or computer science, but also in many other fields such as physics, mathematics, engineering, economics, and others. It assists individuals in dealing with difficult problems and making better decisions based on a greater grasp of the issue at hand.

2.2 Computational Thinking Ability in Mathematics Learning

Computational thinking skills can be quite beneficial when learning mathematics. Here are some examples of how computational thinking skills might be used in mathematics learning (Kamil, 2021):

1. Mathematical Problem Solving: When faced with a complex mathematical problem, students can utilize computational thinking to solve it by breaking it down into smaller parts and inventing algorithms to solve it.
2. -
3. Data Analysis: In mathematics, data analysis is frequently required. Computational thinking requires the capacity to acquire data, analyze it, and recognize patterns or links in the data.

3. Use of Mathematical Software: Students can perform complex calculations and data analysis using mathematical software and spreadsheets. Computational thinking assists individuals in making efficient use of these tools.
4. Mathematical Models: Students must employ abstraction and conceptualization while modeling real-world problems in mathematics. Computational thinking abilities aid in the creation of accurate models.
5. Algorithm Development: When students encounter mathematical issues involving action sequences, they can apply computational thinking abilities to build systematic algorithms to solve the problem.
6. Computational thinking can assist students in managing measurement and statistical data, such as computing the mean, median, or standard deviation.
7. Pattern Recognition: Computational thinking can be used by students to spot patterns in a series of numbers, sequences, or mathematical formulas. It aids in the comprehension of

mathematical concepts.

8. Computational thinking can be used to solve mathematical games and puzzles, where students design methods based on mathematical patterns and logic.
9. Independent Learning: Computational thinking allows students to build independent mathematical problem-solving skills and gain confidence in addressing complicated mathematical problems.

Computational thinking in mathematics learning assists students in better understanding mathematical topics, improving problem-solving abilities, and integrating mathematics with modern technologies. This is also important in meeting the expectations of a more connected and data-driven world.

4. Research and methods

The SLR (Systematic Literature Review) method was employed in this study. They use this strategy by identifying, examining, evaluating, and interpreting all available research. Researchers use this strategy to systematically review and identify publications, with each procedure following predetermined steps (Triandini et al., 2019).

The research method employed was a Systematic Literature Review (SLR), which included the findings of about 200 studies on students' computational thinking ability but was decreased by 10 research findings. The sample includes national and international indexed journals published between 2015-2023. Several studies have been conducted on the meaning of computational thinking abilities, computational thinking in mathematics learning, computational thinking ability indicators, and computational thinking ability theories.

5. Result and Discussion

SLR demonstrates that CT is a critical skill in the Society 5.0 age. This epoch is defined by the advancement of digital technology, artificial intelligence, robotics, and general digital transformation. In dealing with these developments, the capacity to think computationally is becoming increasingly vital (Chahyadi et al., 2021).

The SLR findings also show that CT can play a crucial role in enhancing mathematics comprehension. CT assists students in better understanding abstract and difficult mathematical subjects through modeling, simulation, and visualization (Augie et al., 2023).

CT entails identifying and putting into action relevant problem-solving techniques. This ability helps students more effectively identify, formulate, and solve mathematical issues in the context of mathematics study (Ngaeni & Saefudin, 2017).

The SLR results suggest that CT is particularly relevant to mathematics learning objectives, such as problem-solving ability, conceptual comprehension, and applying mathematics in the context of everyday life (Anggrasari, 2021).

According to the literature, there are obstacles in integrating CT into mathematics learning. One of the most difficult issues is the distinction between computational and mathematical thinking, which necessitates the appropriate strategy to merge the two (Arzaki et al., 2023).

The importance of Computational Thinking (CT) skills in mathematics learning cannot be overstated in the Society 5.0 era. With rapid improvements in technology and digital transformation, students must be prepared to face future challenges with CT skills. CT helps children better understand mathematics, develop problem-solving skills, and connect mathematical concepts to the real world.

However, the use of CT in mathematics education is fraught with difficulties. It is critical for educators and curriculum authors to understand the distinctions between computational and mathematical thinking and how to effectively combine them in the classroom.

Furthermore, there is a lot of untapped research potential, such as the relationship between CT and in-depth mathematical comprehension, the development of effective learning tools and methodologies, and how to promote student involvement in CT-based learning.

The findings of this SLR contribute to a deeper understanding of the role of CT in mathematics learning in the Society 5.0 age, as well as a foundation for designing better learning strategies for incorporating CT into the mathematics curriculum.

Several literature sources include the following indications of Computational Thinking (CT) aptitude in mathematics learning:

- Decomposition is the ability to divide difficult issues into smaller, easier-to-solve portions (Astuti et al., 2023)
- Pattern recognition is the ability to recognize patterns and extract useful information from difficult challenges (Fikriyah, 2022).
- Abstraction is the ability to portray problems in an abstract manner through the use of models or simulations (Megawati et al., 2023).
- Algorithms are the capacity to design solutions using algorithms and computational steps (Ramanda et al., 2022).
- Generalization: The ability to apply solutions to a wide range of issues.
- Critical thinking: The ability to examine the resulting answer and, if required, modify it.
- Collaboration: The ability to collaborate with others to overcome difficult situations.
- Logical thinking is defined as the ability to solve problems in a systematic and logical manner (Christi & Rajiman, 2023).

These indicators can help teachers build CT-based mathematics learning and assist students in acquiring CT abilities. Several studies have found that improving pupils' CT abilities can enhance their mathematical understanding and problem-solving skills.

According to Jean Piaget's theory, computational thinking (CT) theory in mathematics learning focuses on improving human cognitive abilities through internal motivation and interaction with the environment (S. Maharani et al., 2020). Learning mathematics through a CT approach can help pupils develop cognitive structures for comprehending and solving mathematical problems. Moreover, the hybrid learning model, based on hybrid learning theory, integrates traditional and technological approaches in the learning process (Helsa et al., 2023). The CT technique can be combined with the hybrid learning model in the context of mathematics learning to improve students' knowledge of mathematical ideas and problem-solving skills.

6. Conclusion

The SLR identifies CT as a crucial ability for dealing with difficulties and changes in the Society 5.0 age. This epoch is defined by rapid digital change, the advancement of echnology such as artificial intelligence and robots, and overall digital transformation. The capacity to think computationally is critical in educating pupils for an increasingly linked and technologically-based world. SLR also demonstrates that CT can effectively aid in the understanding of complicated and difficult mathematical ideas. CT helps students grasp and absorb mathematical concepts by using modeling, simulation, and visualization. One of the most noteworthy discoveries from SLR is that CT assists pupils in developing problem-solving skills. It tests students' ability to design mathematical problems, select appropriate procedures, and assess the solutions. The integration of CT into mathematics education aligns with the objectives of mathematics education, which aim to enhance understanding of mathematical concepts, problem-solving ability, and mathematical skills that can be applied in daily life. Although crucial, incorporating CT into mathematics learning poses a number of obstacles. One of The most difficult issues is the distinction between computational and mathematical thinking, which necessitates a thorough and organized approach to be successfully incorporated into the mathematics curriculum. the importance of adding CT elements in mathematics study is to equip students with abilities relevant to the Society 5.0 age. The use of CT can help students better grasp mathematics, improve problem-solving skills, and prepare them for a more digital and connected future. However, for CT-based mathematics learning to be effective, implementation obstacles must be acknowledged and overcome.

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