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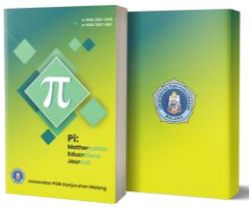

Computational Thinking Using *MathWay Software* On Algebra Material In The Era Of Technology-Based Learning

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ABSTRACT
Computational thinking ability is one of the important skills in the 21st century. The MathWay application offers interactive features that support mathematics learning, especially in algebra material. This study aims to systematically review the existing literature related to the effectiveness of using MathWay on students' computational thinking skills. The research uses the Systematic Literature Review (SLR) method, with data collection techniques carried out by studying relevant literature related to computational thinking, MathWay applications, and algebra. The article selection process is carried out by formulating research questions, conducting systematic literature searches, applying inclusion and exclusion criteria, and analyzing and summarizing findings, followed by making conclusions. The analysis uses the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyses) diagram method, with four relevant scientific articles obtained. The results of the study indicate that the use of MathWay is effective in improving students' computational thinking skills, especially in problem solving and algorithmic thinking patterns.

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1. Introduction

21st century education provides opportunities for students to develop their potential to compete in the era of development and rapid progress of science and technology [1]. The use of educational technology in learning in every school is very important, especially in its application to each subject [2]. By maximizing the use of technology in education, it is hoped that it can improve the quality of education and form students who are smarter, more productive, and more competitive in the current era of digital-based learning [3]. 21st century learning also emphasizes more on an approach that focuses on students and the learning process is designed, structured, and organized in such a way that students can learn effectively [4]. So it can be concluded that the concept of 21st century learning focuses on student-centered learning activities (student-oriented), by Z utilizing technology so that students can be active in class to develop knowledge, attitudes, and skills.

In addition to integrating technology into education, learning in schools also needs to improve various skills needed to prepare future generations to face future challenges. One step that can be taken is to create a strategy to develop relevant competencies. Thus, Computational Thinking can contribute to improving the quality and quality of learning in schools as one of the abilities that support the dimensions of 21st century education [5]. However, current learning methods can limit students in developing their computational thinking skills. In the process of solving problems in schools, educators tend to teach students to only use and copy formulas without much variation [6]. Also Nuraini added that this approach can cause boredom and less involvement of students in computational thinking, which ultimately reduces their computational thinking skills. In fact, computational thinking skills have become one of the most important and basic skills in today's era[6]. Given the rapid advancement of digital technology, computational thinking helps individuals solve problems systematically, think critically, and understand and design more efficient solutions to modern challenges [7].

Computational thinking skills are skills in designing problems and developing solutions or strategies effectively and efficiently, so that students' thinking skills can be optimized [8]. Marhadi and Fitria stated that in this case, computational thinking which includes problem solving, algorithmic thinking, and system understanding is very important [8]. Computational thinking involves the process of thinking about computer applications and their development, and supports the problem-solving process in various fields of science, including mathematics [7].

One of the fields studied in mathematics, besides numbers, geometry, statistics, and probability, is algebra. Algebra has a crucial role in solving various problems. In line with this, Putri & Nasution stated that algebra is one of the basics of mathematics that has many uses and applications in everyday life as a tool for generalizing and solving problems [9]. The importance of the role of algebra emphasizes that students need to learn it, because in everyday life, various problems are often found that require algebra to solve them [5].

One of the tools that is often used in solving mathematical problems in algebra material is MathWay. This application provides algebraic capabilities and techniques that help students find their own solutions and teach mathematical skills. Zahara & Salmina, also added that the use of educational technology, such as MathWay, can make a significant contribution to improving the teaching and learning process [10]. In line with this, application helps students understand mathematical concepts more deeply and interactively [11]. Based on the explanation, the use of educational technology, such as the MathWay application, plays an important role in improving the teaching and learning process. This application not only helps students find algebraic solutions, but also teaches mathematics skills independently and interactively, so that their understanding of mathematical concepts becomes deeper.

One of the previous studies that is considered relevant to this study is the study conducted stated that the mathematical computational thinking skills of junior high school students in the quadratic equation material have met the indicators determined by the researcher [12]. In addition, a similar study was also conducted by Zahra and Yahfizham, who studied the use of mathematical applications as a learning medium in improving students' computational abilities [13]. The MathWay application on students' critical thinking skills. Overall, this study differs from previous studies in several aspects, namely in the materials used and the learning media. In the previous study, the problem solving material used was quadratic equations, while this study used algebraic material, and the previous study used Photomath, while this study used MathWay. The study conducted by Nurbayeni, has strong relevance to this study, because they both use the Systematic

Literature Review (SLR) method and focus on computational thinking skills with mathematical software [14]. However, this study offers novelty in several aspects. This study is more specific in examining MathWay as one main software, using the SLR method, and focusing on algebraic material, while previous studies have discussed various software and mathematics topics at the high school level. In addition, this study highlights the role of AI in learning, helping to develop thinking patterns, and contributing to the integration of technology into the curriculum.

This distinguishes it from previous studies that are more general and focus on the challenges of implementing technology in education. Based on the background description above, this study carries the title "Computational Thinking Using MathWay Software on Algebra Material in the Era of Technology-Based Learning" with the aim of reviewing the literature on the effectiveness of using MathWay on students' computational thinking on algebraic material, as well as answering questions about the effectiveness of MathWay in improving students' computational thinking and its impact on thinking patterns in problem solving.

2. Methods

This type of research is a qualitative descriptive study using the Systematic Literature Review (SLR) method. Systematic Literature Review (SLR) is conducted to review existing research in order to identify trends, synthesize findings, find gaps, and support decision making. This study uses the method of collecting and analyzing existing literature, focusing on the theme taken [15]. Through this strategy, researchers review articles that are relevant to the research topic. The research to be conducted by researchers aims to determine how students' computational thinking skills use MathWay software on Algebra material. Research data collected from 2019 to 2024 was carried out through the Google Scholar database with the help of the Publish or Perish application and accredited journals using the keywords "Computational Thinking", "MathWay Application", and "Algebra".

Based on the results of the data source search, several literature studies were found which were then visualized in the form of a PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyses) flow diagram in Figure 1.

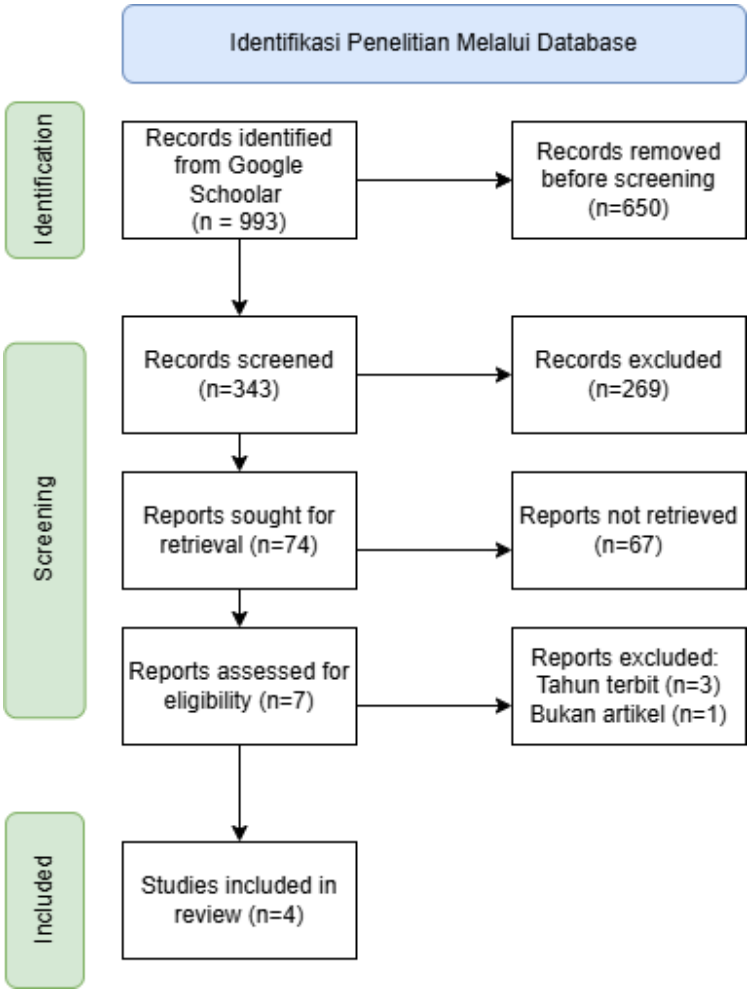

Figure 1. PRISMA Diagram

The literature search was conducted through the Publish or Perish 8 application, resulting in a total of 993 literatures. Of these, 650 literatures were automatically excluded based on the keywords used in the study, leaving 343 literatures. Furthermore, 269 literatures were eliminated based on the identification of research questions, leaving 74 literatures. A further screening stage was carried out to ensure the relevance of the literature to the study. A total of 67 literatures did not meet the inclusion and exclusion selection criteria, leaving 7 literatures to be evaluated based on research quality. From the results of further selection, it was found that 3 literatures did not match the year of publication and 1 literature was not a scientific article. Thus, the number of literatures that were successfully selected and used in this study was 4 scientific articles. From the search results, 4 literatures were found to be relevant to the research title to be analyzed. These four articles were selected because they met the criteria that had been determined at the beginning, namely articles with publication years between 2019-2024, articles published in journals that are indexed by Synta, and in accordance with the theme, namely about computational thinking using MathWay software on algebraic material. After obtaining some relevant data related to the research title, the articles were analyzed by looking for essential things, such as the importance of computational thinking and the correlation

between computational thinking using the MathWay application on algebraic material, then summarized to obtain research results.

This study uses the following research steps or stages according to [16]:

1. Formulate research questions, by determining research questions that involve a description of how computational thinking skills use the MathWay application on algebra material.

Table 1. Research Questions

Population	Junior High and High School Students
Intervention	Learning using the MathWay application
Comparative	Learning without the help of learning media
Results	The influence of students' computational thinking skills
Context	Mathematics learning in junior high and high school on Algebra material

2. Conduct a systematic literature search, by searching for articles related to computational thinking skills using the MathWay application on algebra material from 2019-2024.
3. The third step involves the application of inclusion and exclusion criteria.

Table 2. Inclusion and Exclusion Criteria

Inclusion	Exclusion
Relevant nationally accredited articles related to computational thinking and MathWay applications	Non-relevant nationally accredited articles related to computational thinking and MathWay applications
Articles published between 2019 and 2024	Articles published outside the 2019 to 2024 period

4. Analyze, summarize and draw conclusions from the results that have been carried out.

3. Result and Discussion

Each selected article was analyzed in detail according to the main components to be reviewed in each article. The important components analyzed include the research objectives, methods applied, and the results obtained. Data from these articles were processed through the steps of [16]The following are the results of the analysis of the four articles that have been reviewed.

Table 3. Details of Analyzed Articles

No.	Article Title	Author, Year	Journal
1.	Berpikir Komputasi dalam Pembelajaran Matematika	(Cahdriyana et al., 2020)[17]	Jurnal Ilmu Pendidikan, 11, no. 1 (2020)
2.	Penelitian *Computational Thinking* dalam Pembelajaran Matematika	(Astuti et al., 2023) [18]	Aksioma: Jurnal Program Studi Pendidikan Matematika, 12, no. 1 (2023)
3.	Mengukur Perkembangan Keterampilan *Computational Thinking* Siswa SMAN 3 Medan Pada Materi Limit Fungsi Aljabar	(Situmeang et al., 2024) [18]	*Journal Innovation in Education,* 2, no.

4.	Penerapan Berpikir Komputasi dalam Pembelajaran Matematika	(Mardianto et al., 2024) [19]	2 (2024) *Journal of Student Research,* 2, no. 4 (2024)

The first journal "Berpikir Komputasi dalam Pembelajaran Matematika". This study examines the application of computational thinking in mathematics learning using qualitative methods. Computational thinking, which was originally developed in computer science, is a problem-solving process that includes decomposition, pattern recognition, algorithms, and abstraction and generalization. These skills are relevant in the Industrial Revolution 4.0 era because they train students to think logically, critically, and systematically in facing technological challenges. Mathematics, through problem-solving questions, is an effective discipline for developing computational thinking skills, which can ultimately increase students' competitiveness globally.

The algebra problem solving test was conducted on research subjects consisting of 3 people, who were selected using a purposive sampling technique. Data collection was carried out through tests and interviews, while data analysis techniques included data collection, presentation, analysis, and drawing conclusions. The research findings show that the Mathway application can be used by anyone and at any time to facilitate the learning process, especially in solving mathematics problems. Based on interviews, Mathway makes it easier for students to understand the steps to solve problems in detail, and Mathway can be an evaluation tool and help students improve their understanding of mathematics. In addition, research supports that with the help of computer simulations, abstract objects in mathematics become more concrete and easier to understand.

The second journal "Penelitian *Computational Thinking* dalam Pembelajaran Matematika". This article discusses the importance of computational thinking in mathematics education as one of the main competencies in the era of STEM-based education. Computational thinking has been integrated into the curriculum in many countries such as England, America, Japan, and Singapore, but its implementation in Indonesia is still optional. The Ministry of Education and Culture has begun to recognize the importance of computational thinking as part of the future curriculum to help students face complex problems. The findings show that computational thinking is widely used to overcome challenges in mathematics learning, such as improving logical, analytical, and problem-solving thinking skills. In addition, computational thinking can reduce students' anxiety about mathematics by creating a more interactive and technology-based learning approach. This study concludes the need for further integration of computational thinking into the Indonesian curriculum to improve students' competitiveness in the era of globalization.

The third journal "Mengukur Perkembangan Keterampilan *Computational Thinking* Siswa SMAN 3 Medan Pada Materi Limit Fungsi Aljabar". This study shows that most students improve their Computational Thinking skills after studying algebra material. There is a significant increase in students' ability to formulate mathematical problems, apply algorithms, and use programming to solve problems. The implication is that a learning approach is needed that focuses on the development of Computational Thinking in mathematics in high school, the use of computational tools by teachers, and curriculum updates to support these skills.

The fourth journal "Penerapan Berpikir Komputasi dalam Pembelajaran Matematika". The results of this study indicate that computational thinking is not only developed and studied with computer lessons but can be used in various disciplines. One of

them is mathematics learning using MathWay. Thinking skills in mathematics learning describe a structured process that involves stages, clear steps or algorithms, calculations (computing), determining the right strategy, and solving problems. Of course, all aspects are in computational thinking.

The four articles have different focuses. The first and third articles use a qualitative approach to assess the impact of MathWay on mathematics learning, especially on algebra material. The second journal highlights the importance of computational thinking in the context of global education policy and integration into the curriculum in Indonesia. On the other hand, the fourth article provides an in-depth analysis of the direct application of computational thinking in mathematics learning using MathWay software, highlighting structured steps such as algorithms and problem-solving strategies. In conclusion, all four articles emphasize the relevance and benefits of computational thinking in mathematics learning with a technology approach. Although they have differences in scope and method, all underline the need for further integration of computational thinking skills in education to face global challenges.

The four articles also have similarities in emphasizing the importance of computational thinking skills as one of the main competencies in the Industrial Revolution 4.0 era. All articles agree that mathematics is a very effective discipline for developing computational thinking because it involves decomposition, algorithms, pattern recognition, and abstraction and generalization. In addition, all four also show that technology, such as the MathWay application, plays a significant role in helping students understand abstract mathematical concepts to be more concrete and improve problem-solving abilities. These articles also support the integration of computational thinking into the Indonesian education curriculum to improve students' global competitiveness.

The results of these four articles show that technology-based learning such as utilizing the MathWay application has a significant impact on students' computational thinking skills, in line with previous studies. Previous studies have shown that computational thinking skills can be carried out by using the MathWay application on algebra material in mathematics learning. This finding is consistent with research by Perkovic, which shows that technology-based tools can make it easier for students to master computational thinking skills with a structured and interactive approach [20]. Which underlines the importance of computational thinking in equipping students to face global challenges through a STEM-based approach that has been adopted in several developed countries, such as Singapore and Japan. Noted that the integration of computational thinking into the curriculum helps students develop analytical and logical skills since special attention is paid to the computational thinking-based learning process, such as algorithms and problem-solving strategies. This is reinforced by research by Nasir, which found that computational thinking-based learning improves students' ability to design systematic solutions to complex problems, especially when applied to disciplines such as mathematics in algebra material [21]. The main differences between this study and previous studies related to computational thinking in mathematics learning can be described based on its focus, research method, and contribution to the existing literature.

Previous studies tend to provide a theoretical basis for computational thinking in mathematics education without a specific focus on specific technology applications, such as MathWay. For example, study examined the effectiveness of computational thinking-based approaches in general without utilizing specific tools [21]. Emphasized the importance of developing a global computational thinking-based STEM curriculum rather than measuring the impact of specific applications such as MathWay. Therefore, this study provides a more specific contribution by linking aspects of computational thinking to

practical applications, such as MathWay, that are relevant to the needs of technology in mathematics learning.

One interesting aspect of this study is that it highlights the integration of MathWay in the context of technology-based learning. Unlike previous studies that focused more on aspects of problem-solving flows or students' thinking styles, this study explicitly links computational thinking to modern learning trends that rely on digital technology. This focus not only sees MathWay as a problem-solving tool, but also as a medium that prepares students to face the demands of digital skills, technology adaptation, and interactive learning. In other words, this study emphasizes the importance of computational thinking skills as an essential element in the era of digitalization of education, making MathWay not just a mathematical tool, but a means to build technological skills that are relevant to the future of education.

Overall, it shows that computational thinking is an important element in modern mathematics learning. Recent research supports the claim that technologies such as MathWay not only facilitate the learning process, but also strengthen higher-order thinking skills in students. To support this development, more progressive education policies are needed, including the integration of computational thinking in the Indonesian curriculum, so that students are able to compete at the global level.

4. Conclusion

These four journals underline the role of the MathWay application effectively in supporting mathematics learning, especially algebra, through the development of computational thinking skills including decomposition, pattern recognition, abstraction, and algorithms. Each article found that MathWay facilitates students to understand and solve mathematics problems more effectively, while providing a foundation for a technology-based learning approach. The use of technology, such as the MathWay application, not only helps students understand abstract concepts more concretely, but also improves logical, analytical, and problem-solving thinking skills. The integration of computational thinking into the national education curriculum is needed to prepare students to face global challenges and increase their competitiveness at the international level.

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