Effectiveness of Coding in Enhancing Computational Thinking among Elementary School Students: A Literature Review 2020–2025

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Abstract: Effectiveness of learning unplugged coding in improving the computational thinking abilities of elementary school students in 2020–2025. Computational thinking is an essential skill that needs to be instilled from an early age, but limited technological infrastructure in many schools is a challenge in implementing learning. Coding digital-based. For this reason, learning unplugged coding can be an alternative that can be used. This Research uses the method Systematic Literature Review (SLR) with the PRISMA model, analyzing 19 articles consisting of 9 national journals and 10 international journals obtained through the software Publish or Perish. The findings of previous Research show that learning unplugged coding is effective in developing algorithmic thinking skills, logical reasoning, pattern identification, and problem-solving in students. In addition, learning unplugged coding provides an innovative and enjoyable learning experience, thereby motivating students and preparing them to face future technological challenges. The implications of this Research encourage the integration of learning unplugged coding in the elementary school curriculum as an alternative solution, especially for schools with limited technological facilities, to support the development of 21st-century skills**.**

Abstrak: Penelitian ini bertujuan untuk mengkaji efektivitas pembelajaran *unplugged coding* dalam meningkatkan kemampuan computational thinking siswa sekolah dasar pada tahun 2020–2025. *Computational thinking* merupakan keterampilan penting yang perlu ditanamkan sejak dini, namun keterbatasan infrastruktur teknologi di banyak sekolah menjadi tantangan dalam pelaksanaan pembelajaran *coding* berbasis digital. Untuk itu, pembelajaran *unplugged coding* menjadi salah satu alternatif yang dapat digunakan. Penelitian ini menggunakan metode *Systematic Literature Review* (SLR) dengan model PRISMA, menganalisis 19 artikel terdiri dari 9 jurnal nasional dan 10 jurnal internasional yang diperoleh melalui perangkat lunak *Publish or Perish*. Hasil temuan penelitian terdahulu menunjukkan bahwa pembelajaran *unplugged coding* efektif dalam mengembangkan kemampuan berpikir algoritmik, penalaran logis, identifikasi pola, serta pemecahan masalah pada siswa. Selain itu, pembelajaran *unplugged coding* memberikan pengalaman belajar yang inovatif dan menyenangkan, sehingga mampu memotivasi siswa serta mempersiapkan mereka dalam menghadapi tantangan teknologi di masa depan. Implikasi penelitian ini mendorong integrasi pembelajaran *unplugged coding* dalam kurikulum sekolah dasar sebagai solusi alternatif, khususnya bagi sekolah yang memiliki keterbatasan sarana teknologi, guna mendukung pengembangan keterampilan abad ke-21.

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A. Introduction

Technological developments have been increasingly rapid in recent years, demanding that the world of education integrate technology-based learning wisely. One of the essential 21st-century skills that needs to be mastered by Students is basic coding skills. Coding teaching has been introduced since the elementary school (SD) level, as conveyed by the Vice President of RI, Gibran Rakabuming Raka, considering that technology plays a significant role in advancing education and the daily life of future children (Alindra et al., 2024). Introducing coding from an early age aims to develop logical thinking skills, problem-solving, creativity, and computational thinking (CT) in children (Mutoharoh & Diyah., 2023).

Computational thinking is a problem-solving approach that adopts computer science principles, such as problem decomposition, problem recognition patterns, abstraction, and algorithm design (Hartono et al., 2025). Although originating from the computer science discipline, CT is a universal skill. It is essential to teach this from an early age so that it becomes part of analytical skills. Students (Nurhopipah et al., 2021). In coding learning, the development of CT is implemented by solving problems algorithmically and systematically (Christina, 2024). To date, there is a consensus that computational thinking in children can be developed through the integration of unplugged coding learning with their daily lives. This approach is considered effective in facilitating children's understanding of the material. Applying learning that is relevant to children's routine activities is believed to provide a more meaningful learning experience and strengthen the absorption of information in children's memories (Fitriyah et al., 2023).

The implementation of coding learning in Indonesia still faces various problems: challenges, minimal access to devices, technological infrastructure, and information and communication technology (ICT). As a solution, a coding learning method without computer devices, or known as unplugged coding, is an alternative that allows children to understand programming and CT concepts without relying entirely on digital technology (Fitriani et al., 2022). This method can also be combined with the plugged coding method (using a computer) in the plugged-unplugged model to optimize learning (Ballard & Haroldson, 2022). The unplugged coding learning method allows students to understand computing concepts without the use of electronic devices, allowing them to apply logical thinking skills and similar strategies to solve problems related to scientific concepts (Rabbana et al., 2025).

Based on a literature review of Research in 2020-2025, Unplugged coding learning has proven to be an effective strategy for instilling and deepening the principles of CT in elementary school students. In a systematic review conducted by Hartono et al (2025), as well as Zia et al (2024). Research focuses more on analyzing the CT capabilities developed through coding learning using computer-based devices and applications like Scratch. However, neither study specifically addressed the effectiveness of the unplugged coding method, which is adapted to the characteristics and student abilities in elementary school.

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The novelty of this Research lies in the focus on synthesizing the results of experimental studies and quasi-experimental studies that specifically highlight the methods, challenges, and results of the Implementation of unplugged coding learning in Indonesia over the past five years. In addition, this study enriches the discussion with a comparative analysis based on the latest studies (2020-2025), which until now have not been the primary focus of previous studies. Unplugged coding learning is designed according to the abilities and characteristics of elementary school students. This approach provides insight into concrete and effective strategies in the field, especially in the context of technological access constraints that are still common in Indonesia.

Based on this background, this study aims to provide a comprehensive overview of the learning effectiveness *of unplugged coding* at the school level, as well as the challenges faced and relevant solutions. In addition to assessing the results of learning, this study also identifies implementation challenges and solutions, which can encourage the successful implementation of Unplugged Coding learning. The findings of this review are expected to contribute to the development of strategies for innovative inclusive education, as a basis for making educational policies and the development of coding learning theories and practices that are appropriate to the characteristics and needs of students in elementary schools in the digital era.

B. Method

The Research method used is a literature study using the Systematic Literature Review (SLR) method by using the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA). Systematic Literature Review (SLR) is a structured method used to collect, critically evaluate, integrate, and summarize various Research results related to a specific Research question or topic that you want to Research further. This article utilizes multiple types of sources, such as scientific journals, Research reports, and proceedings published in the period 2020 to 2025. The collection of these sources is carried out with the help of the application Harzing's Publish or Perish (PoP) to search databases such as Google Scholar, Crossref, and Elsevier (Scopus). The steps used in literature studies review, namely 1) Determining the topic and Research questions, 2) Searching for literature, 3) Reading and selecting literature, 4) Analyzing and synthesizing literature, and 5) Conclusion (Khasanah et al., 2025).

The first step taken is to formulate Research questions based on the needs of the topic. The questions in this Research are: 1) What type of Research has been done regarding the implementation of learning unplugged coding? 2) At what levels of education is unplugged coding learning implemented? 3) What are the results of implementing unplugged coding learning for students? Then, continue by collecting data, starting with a search. Keywords: "Learning Effectiveness "Unplugged Coding to increase Computational Thinking". After searching for the keywords, with the help of the PoP application, 526 types of literature related to the topic were found. Of the 526 articles, after analyzing the suitability of the title, 417 articles were found. Appropriate. Then, filter again according to the category

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of articles, Research reports, and proceedings, so the results obtained were 162 articles. Furthermore, from these articles, filtered again for relevance to the Research topic, so that only 19 articles were retained according to the topic. The articles come from national and international journals. Then the article was analyzed again in depth to identify main themes, conclusions, and implications. The filtering of the articles is clarified by using the PRISMA diagram as follows:

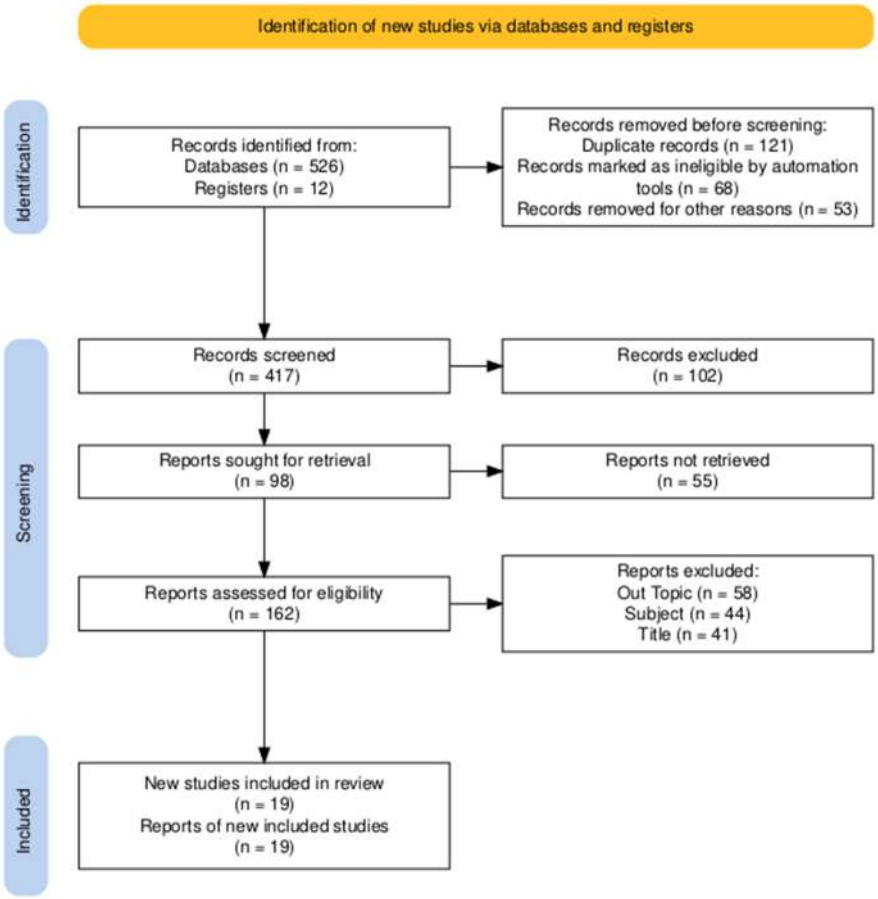

Figure 1. PRISMA Diagram

C. Result

1. Data Analysis

Study Systematic Literature Review. This Research was conducted to answer the established problem formulation, namely, regarding the role of unplugged coding learning in improving computational thinking skills in elementary school students. The literature search process focused on publications that discussed learning unplugged coding at the elementary school level, with a publication year coverage of 2020 to 2025. Source searches were carried out using the software "Publish or Perish," where relevant articles are selected based on specific keywords that reflect the Research topic being addressed. The search results revealed 526 articles related to the subject of unplugged coding in elementary

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schools. Then, further filtering was carried out to obtain 162 articles that explicitly discussed learning unplugged coding. The next stage is the selection of articles to ensure their relevance to the effectiveness of increasing computational thinking through learning unplugged coding, which resulted in 19 articles deemed most worthy of in-depth analysis. The process of selecting and identifying articles was carried out in stages, with a primary focus on empirical evidence of improved capabilities of computational thinking students as a result of the implementation of learning unplugged coding.

Based on the 19 articles obtained, the types of Research methods used varied widely. Some employed qualitative Research, some quantitative Research, and some even used mixed methods, as seen in Figure 2 below:

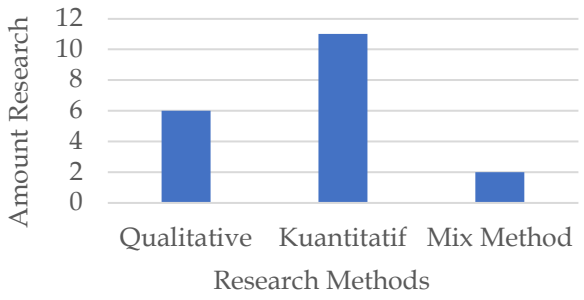

Figure 2. Research Methods Used

The type of Research method used is tailored to the objectives, characteristics, and kind of Research being studied. Qualitative Research, for example, uses data collected in natural conditions without any variable manipulation. In this Research, the researcher acts as the primary instrument in the data collection process (Safrudin et al., 2023). Qualitative Research is a Research method that seeks to answer Research questions based on numerical and statistical analysis (Waruwu et al., 2025). Meanwhile, mixed methods Research integrates both qualitative and quantitative approaches, particularly in methodological aspects such as the data collection stage. Furthermore, the mixed Research model comprehensively combines both approaches throughout all phases of the Research process, from planning to data analysis (Justan & Aziz, 2024). In the 19 articles reviewed, the use of Research methods varied widely, according to the objectives and needs of the Research.

The results of the analysis of 19 articles obtained, the Research subjects were spread from kindergarten to high school level, with the distribution as can be seen in Figure 3:

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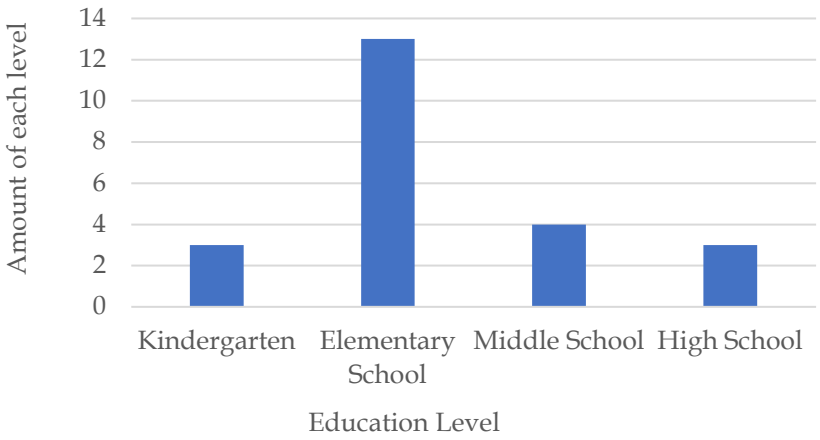

Figure 3. Levels of Education

The chart above shows that three articles used kindergarten as the Research subject, 13 articles studied elementary school, four articles studied middle school, and three articles studied high school. Of the 19 articles, the majority studied the influence of unplugged and plugged learning approaches at the elementary school level, with the study period of 2020–2024. In the Research period between 2020 and 2025, many studies focused on the development of computational thinking at the elementary school level. This is due to the importance of introducing computational thinking skills from an early age, as they can build foundational problem-solving skills. This opinion is supported by Wing (Widodo et al., 2023), who stated that computational thinking skills are not only for programmers but for everyone. Computational thinking is a way of thinking that can be used to solve problems in various fields of science and at all levels of education.

All existing Research concludes that learning approaches, whether using digital devices (plugged), without digital devices (unplugged), or a combination of both, are effective in improving students' computational thinking skills. The implementation of unplugged coding learning has proven effective in improving various aspects of students' thinking skills at the elementary school level. Students become better able to break down problems into structured steps, design solutions, and understand basic programming concepts without the aid of digital devices (Mutoharoh & Diyah, 2023). Students become more skilled at analyzing situations, formulating critical questions, and making fact-based decisions. Unplugged coding activities also help students identify problems, devise problem-solving strategies, and implement solutions effectively (Musfiati, 2023).). In addition to cognitive aspects, unplugged coding also encourages creativity and collaboration skills. Through physical activities and group games, students learn to communicate, collaborate, and develop innovative ideas in completing assignments (Akiba, 2022; Syamsiah et al., 2024). The implementation of unplugged coding learning has a positive impact on improving students' computational, logical, critical thinking, problem-solving, creativity, and collaboration skills at the elementary level. This approach is

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practical, inclusive, and relevant for building a foundation for 21st-century skills, even in environments with limited digital technology.

2. Critical Appraisal

This study focused on critically analyzing three Research questions: the type of Research, the level of Research, and the effectiveness of unplugged coding learning in improving students' computational thinking. The keywords used in analyzing the 19 articles were the Research method used, the age or educational level of the researchers, and the results. The reviewed studies collectively underscored the effectiveness of unplugged coding learning in improving computational thinking in elementary school students. With learning unplugged coding, students can gain a more comprehensive understanding of their computational abilities. This evaluation was conducted to ensure that the articles used as references in the Research met the criteria for valid scientific sources (Wulandari & Khusnul, 2020).

3. Literature Review Results

Based on an analysis of 19 selected articles, unplugged coding learning is efficacious in improving computational thinking skills in elementary school students. Various studies have shown that this learning method, without using digital devices, makes it easier for children to understand programming and logic concepts more engagingly and simply. Most studies emphasize that unplugged coding activities, such as card-based games, logic puzzles, and physical simulations, can help students gradually understand algorithm concepts, problem-solving, and critical thinking. Furthermore, this method also supports the development of collaboration and communication skills among students during the learning process.

Several studies have noted significant improvements in aspects of computational thinking, such as problem decomposition, pattern recognition, abstraction, and debugging, after implementing unplugged coding. This indicates that this approach not only facilitates understanding of the material but also fosters logical thinking patterns that are fundamental to technology and programming. However, several articles also emphasize the need for adequate teacher support for effective learning, as well as the need to adapt unplugged coding materials to suit the age and abilities of students. Overall, the findings from this literature review support the use of unplugged coding as an effective alternative strategy for enhancing computational thinking in elementary schools.

4. Matrix of Literature Data Analysis

This data analysis matrix summarizes the results of each article based on five main elements: author, article title, Research method, Research subject, and main findings. Using this matrix, the patterns of findings emerging from the literature review can be presented in a structured and transparent manner. To gain a deeper understanding of the effectiveness

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of unplugged coding learning in improving computational thinking skills, the analysis results of the 19 articles are summarized in Table 1 below:

Table 1. Results of Literature Review Article Analysis

Author	Tittle	Methodology	Subject	Result
(Akiba, 2022)	Computational Thinking and Coding for Young Children: A Hybrid Approach to Link Unplugged and Plugged Activities	Literature review and perspective analysis	Fifth-grade elementary school	Many coding programs for young children, such as ScratchJr and TangibleK, have been developed. Still, their implementation in regular classrooms is often hampered by teachers' lack of digital literacy and the complexity of the material.
(Syamsiah et al., 2024)	The Influence of Unplugged Coding Education on Coding Ability National calculations Thinking of School-Age Children Enhances Computational Thinking	Experiment with *a one-group pretest-posttest design*	Elementary School Students	Unplugged coding education is efficacious in improving computational thinking skills in elementary school-aged children, even in environments with limited access to digital devices.
(Ugur & Çakiroglu, 2024)	Implementing Reflective Thinking in Computer Science Unplugged to Enhance Computational Thinking	case study	5th-grade students elementary school	The unplugged coding activity significantly improved CT skills such as algorithmic thinking, logical reasoning, systematic thinking, identifying cause-and-effect relationships, abstraction, sequencing, generalization, and solution evaluation. Overall, the integration of CS-unplugged activities proved effective in improving students' computational thinking skills.
(Agustian et al., 2024)	Research on Binary Search	Action Research using Kurt Lewin's model with a quasi-	Student Grade VI Elementary School	Increased students' computational thinking skills after unplugged activity interventions based on the Binary Search Tree (BST) concept.

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Author	Tittle	Methodology	Subject	Result
	Trees Influence of Method ComputerScience	experimental design.		Distribution of post-test results: 14.29% of students are still not developing, 83.33% of students are starting to create, and 2.38% of students are developing according to expectations. Unplugged activities with a focus on BST can significantly improve students' computational thinking abilities.
(Mardiany et al., 2024)	The Influence of the Unplugged Computer Science Method and Learning Style on the Computational Thinking Ability of Class VII Students at SMP Negeri 3 Waru Sidoarjo	Quantitative with a quasi-experimental design	Class VII students at SMP Negeri 3 Waru Sidoarjo for the 2022/2023 academic year	The post-test results showed that 14.29% of students had not developed, 83.33% were starting to create, and 2.38% were developing as expected. Unplugged activities are effective in improving students' computational thinking skills, especially in environments with limited access to technology.
(Wulandari & Khusnul, 2020)	Implementation of Unplugged Coding in Playdate	Qualitative	early childhood	Unplugged coding is integrated into play activities with a flexible and child-centered learning approach. Activities are carried out interactively, funly, and according to the child's age development, for example, through guided games, circle time, and group activities. There are still several challenges in daily implementation, such as the need for further training for teachers and the need to adapt materials to suit the needs of young children.
(Mutoharoh & Diyah, 2023)	Unplugged Coding Activities to Improve Logical and Critical Thinking Abilities in	Classroom Action Research	Shafa Marwah Kindergarten, Serang-Banten	Cycle I: Increase in children's logical and critical thinking skills reaches 20%. Cycle II: Increase in children's logical and critical thinking skills reaches 80%, so that performance indicators are achieved.

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Author	Tittle	Methodology	Subject	Result
	Early Childhood			
(Wahyudin et al., 2021)	The Effect of Learning Through Unplugged Based on Team-Assisted Individualization to Improve Computational Thinking Abilities	Quasi experiment	Class X student majoring in Computer and Network Engineering	Unplugged learning media based on Team Assisted Individualization was declared very suitable for use with a media expert validation score of 94.23% (category "Very Good"). The increase in students' computational thinking skills after treatment using the developed media, with an average gain value of 0.49, and the effectiveness criteria being "medium". Student responses to the use of BoCaGa (Double Branch Board Game) media were very positive, with a percentage score of 97.87% (category "Very Good").
(Adorni et al., 2024)	Development of algorithmic thinking skills in K-12 education: A comparative study of unplugged and digital assessment instruments	Comparative study	Elementary and middle school students	Algorithmic thinking skills develop with age and education level. The methods (unplugged and digital) are effective for measuring AT skills, but the digital version (iPad) is more efficient at scale and provides instant feedback. Age, school characteristics, and individual factors influence students' AT skill outcomes.
(Erümit, 2024)	Collaboration of Unplugged and Plugged Activities for Primary School Students: Developing Computational Thinking with	Quasi-Experimental	Primary school students	The results showed that the combination of plugged and unplugged activities significantly helped improve elementary school students' computational thinking skills.

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Author	Tittle	Methodology	Subject	Result
	Programming			
(Threekunprapa & Yasri, 2020)	Unplugged Coding Using Flowblocks for Promoting Computational Thinking and Programming among Secondary School Students	Quantitative	Secondary school students	There was a significant increase in students' understanding of programming and CT concepts after participating in unplugged coding activities with flowblocks.
(Song, 2019)	The Effectiveness of an Unplugged Coding Education System that Enables Coding Education without Computers	Quasi-Exsperiment	Elementary students in grades 3 to 6 at five elementary schools in Chungcheongnam-do, South Korea	The unplugged block coding system is effective for improving students' computational thinking skills and interest in learning software, especially for beginners who have no programming experience or computer equipment.
(Namli & Aybek, 2022)	An Investigation of The Effect of Block-Based Programming and Unplugged Coding Activities on Fifth Graders' Computational Thinking Skills, Self-Efficacy, and Academic	Mixed method	5th-grade student	Block-based programming learning is more effective in improving students' computational thinking skills and academic performance compared to unplugged coding and conventional learning.

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Author	Tittle	Methodology	Subject	Result
	Performance			
(Jaratsaeng et al., 2023)	Unplugged Coding Learning Package and A.I. Assisted Learning Tool to Support Computational Thinking for Elementary School Students	Quantitative	Second-grade students	The Research results show that the unplugged programming learning package and AI-based learning tools developed can support elementary school students' computational thinking abilities. This package is designed based on the principles of constructivist theory and a computational thinking framework. It consists of five main components: problem situations, learning resources, intellectual tools, scaffolding, and mentoring.
(Dağ et al., 2023)	The effect of an unplugged coding course on primary school students' improvement in their computational thinking skills.	Quasi-Experimental	Third and fourth-grade students from a public elementary school in Türkiye	Learning unplugged coding significantly improves students' computational thinking skills, especially in the aspects of algorithm design, abstraction, evaluation, decomposition, and generalization. No significant relationship was found between computational thinking ability and sociodemographic factors such as gender, computer ownership, daily computer use, and internet access at home.
(Hartono et al., 2025)	Efektivitas Pembelajaran Plugged dan Unplugged dalam Meningkatkan Kemampuan Berpikir Komputasional Siswa	Systematic Literature Review	Kindergarten-High School	There is no significant difference between the effect of the plugged and unplugged methods on improving students' computational thinking skills. The level of effectiveness of this learning method is influenced by the level of education and stage of students' cognitive development according to Jean Piaget's theory. The unplugged method is very suitable for early education levels (kindergarten and elementary school) because it involves multisensory and concrete activities that are appropriate to children's cognitive development.

https://doi.org/10.51276/edu.v6i3.1299

Author	Tittle	Methodology	Subject	Result
(Lim et al., 2021)	Computational Thinking (Algorithms) Through Unplugged Programming Activities: Exploring Upper Primary Students' Learning Experiences	mixed method	upper-grade elementary	The pre-test and post-test results show an increase in students' understanding of algorithm concepts after participating in unplugged programming activities.
(Chongo et al., 2021)	The Impact of the Plugged-in and Unplugged Chemistry Computational Thinking Modules on Achievement in Stoichiometry	Quasi-Experimental	high school students) at Amerika Serikat	The results showed that both the plugged-in and unplugged groups made significant improvements in academic achievement in stoichiometry topics compared to the control group. There were no significant differences between the plugged-in and unplugged groups, indicating that Computational Thinking (CT)-based learning, both with and without digital technology, was equally effective in increasing understanding of chemical concepts.
(Of & Education, 2024)	Promoting Algorithmic Thinking Through Unplugged Primary Science Activity in Rural Schools	Exploratory Descriptive	11-year-old children in elementary school	Research shows that science-based unplugged activities such as the "Algorithm Sequence" and "Atom Sorting Relay" games are effective in improving algorithmic thinking skills in elementary school students. Improve logical and systematic thinking skills. Encourage scientific exploration in accordance with the curriculum. As well as preparing students to understand the concepts of artificial intelligence (AI) and technology through an approach that is contextual, cost-effective, and does not depend on digital devices.

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D. Discussion

The implementation of unplugged coding learning is effective because it allows students to integrate basic programming concepts through physical activities and social interactions, which is in line with Piaget's constructivist theory and Vygotsky's sociocultural approach. According to Piaget, children learn optimally when they actively construct knowledge through concrete experiences, so unplugged activities involving the manipulation of real objects help children understand abstractions in programming. While Vygotsky emphasized the importance of social interaction and scaffolding, group activities in unplugged coding provide a medium for students to learn through dialogue and collaboration with peers, accelerating cognitive development (Bustomi et al., 2024).

While some studies demonstrate the effectiveness of unplugged coding, several studies suggest that digital-based learning is superior in enhancing students' computational thinking. This may be influenced by several factors, such as the school's level of technological readiness, teachers' ability to integrate digital media, or the characteristics of the students themselves. This indicates the need for a hybrid approach that combines unplugged and plugged coding to achieve more optimal results.

Most of the synthesized articles suffer from limitations such as relatively small sample sizes, short intervention durations, and a lack of long-term measurement to assess the impact of sustainable unplugged coding implementation. Furthermore, students' socioeconomic backgrounds are rarely analyzed. Therefore, these findings require careful interpretation and more comprehensively designed follow-up Research.

Research abroad, particularly in countries with better access to technology, shows that a combination of unplugged and plugged learning delivers the best results in improving students' computational thinking. However, in Indonesia, with limited facilities and infrastructure, especially in remote areas, the unplugged coding approach is highly relevant and practical. This difference in context must be an essential consideration in designing policies and curricula so that coding learning methods can be implemented effectively according to needs.

E. Implication

The results of this study provide essential theoretical, practical, and social implications. Theoretically, these findings strengthen the argument that unplugged coding learning is efficacious in improving computational thinking in elementary school students, especially those in environments with limited access to technology. For example, a study by Syamsiah et al (2024) using a single-group pretest-posttest experimental design showed that unplugged coding learning significantly improved elementary school students' computational thinking skills. This supports constructivist learning theory, which emphasizes the need for concrete experiences to build knowledge.

Practically, these results serve as a reference for teachers and policymakers in designing inclusive coding learning strategies that can be implemented without the need for

https://doi.org/10.51276/edu.v6i3.1299

digital devices. For example, a study conducted by Erümit (2024) suggested that collaboration between unplugged and plugged activities can develop computational thinking skills in elementary school students more effectively than single methods. Furthermore, Akiba (2022), through a literature review and perspective analysis, stated that a hybrid approach between unplugged and plugged activities can increase elementary school students' understanding and interest in coding learning.

From a social perspective, this Research supports equitable access to technology education and the development of 21st-century skills for all students. For example, Song (2019), who conducted a quasi-experimental study on students in grades 3 to 6 in five elementary schools in Chungcheongnam-do, South Korea, showed that an unplugged coding learning system without computers was able to motivate students and improve their basic programming skills, especially in areas with limited technology access. Therefore, these findings are expected to form the basis for developing educational policies and curricula that are more responsive to the challenges and needs of today's learning, particularly in creating adaptive and inclusive coding learning methods.

F. Limitation and Suggestion for Further Research

This study has several limitations that should be considered. It only used sources from 2020 to 2025, so it's possible that relevant Research from other periods was missed. Most of the studies are from specific regions, so the results cannot be broadly generalized. This study is a literature review that relies on secondary data without direct testing in real classrooms. Furthermore, the variety of computational thinking measurement instruments limits the consistency of the results.

Therefore, future Research needs to expand the scope of education to include secondary schools, for example, to determine the effectiveness of unplugged coding across different ages and cognitive abilities. Furthermore, developing more innovative and contextual learning models and teacher training is crucial, as success in the field depends heavily on the preparedness of the teaching staff. Long-term Research is also needed to ensure the impact of this method is sustainable, especially in environments with limited access to technology.

Further Research should also involve regions with varying socioeconomic backgrounds to gain a more comprehensive picture and identify contextual factors influencing learning success. Focusing on factors that support and hinder learning implementation, such as teacher training, learning resources, and parental involvement, will help design more effective and sustainable strategies. Therefore, further Research is expected to significantly contribute to improving the quality of coding learning at various levels of education.

G. Conclusion

Based on a systematic review of 19 Research articles published in 2020–2025, it can

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be concluded that learning unplugged coding has proven effective in improving Computational Thinking (CT) abilities in elementary school students. Method unplugged coding facilitates the development of logical thinking skills, problem-solving, creativity, and analytical abilities from an early age, even in environments with limited access to technology. The Research results show that this approach can be implemented flexibly and enjoyably, and is relevant to the characteristics and development of students. However, challenges remain in implementation, such as the need for teacher training and material adjustments. These findings are expected to form the basis for developing more effective learning strategies and serve as a reference for further Research to improve the quality of technology-based education at the elementary level.

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