

The Urgency of Learning Coding for Elementary School Students in Indonesia

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ABSTRACT

The rapid development of digital technology demands early coding education in elementary schools. Coding enhances students' logical thinking, creativity and problem-solving skills, preparing them for future challenges. This research explores the urgency of coding education in Indonesia through a qualitative literature review. Findings show that coding promotes computational thinking and 21st century skills. However, its implementation faces challenges, such as lack of teacher training, limited infrastructure and gaps in the curriculum. The government and education stakeholders should integrate coding into the primary school curriculum, provide training for teachers and develop supporting infrastructure. Addressing these challenges will ensure coding education benefits Indonesian students, equipping them for the digital age.

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1. INTRODUCTION

Education must be able to prepare learners to deal with technological developments in an increasingly rapid world that increasingly demands logical thinking and problem-solving skills. Progressivism thinking in education emphasizes that learning should be relevant to real life and equip learners with skills that can be applied in various situations (Faizi et al, 2022). Coding, as part of digital literacy, allows children to not only be users of technology but also active creators. This is in line with John Dewey's ideas that emphasize the importance of hands-on experience in learning, where learners develop critical and creative thinking skills through exploration and practice [5].

Coding learning for primary school learners can be examined through constructivism theory which emphasizes that knowledge is constructed by individuals based on their experiences and interactions with the environment. Jean Piaget suggested that children learn actively by constructing their own understanding through exploration and experimentation, while Lev Vygotsky added that social interaction and support from more knowledgeable people, such as teachers or peers, play an important role in cognitive development [4]. In this context, coding learning becomes a means for learners to develop computational thinking, problem-solving, and creativity skills through hands-on experience and guidance that is appropriate to their zone of proximal development.

Therefore, constructivism theory supports coding learning variables as a factor that contributes to the cognitive development of elementary school learners [7]. In addition, the urgency of coding learning in Indonesia can be attributed to the statement of the vice president of the Republic of Indonesia, Gibran Rakabuming Raka

who highlighted the role of technology in improving the effectiveness of learning using coding. He stated that technology integration in education can accelerate the learning process, increase learner engagement and develop 21st century skills, including digital literacy, critical thinking and collaboration [11]. In this study, learner skill variables are the main focus in assessing the impact of coding learning in elementary schools.

With coding learning, learners not only gain technical skills, but also develop a more systematic and adaptive mindset to technological change. This shows that digital learning theory is relevant in explaining how coding learning can provide significant benefits for learners in the digital era. Although many countries have adopted coding learning as part of the primary school curriculum, in Indonesia the implementation of this learning still faces various challenges. While previous studies have focused on the benefits of coding in improving computational thinking and problem-solving skills, there are limited studies that specifically highlight the urgency of implementing coding for primary school learners in Indonesia.

In addition, most of the existing studies discuss the application of coding at the secondary education level, while studies that examine the readiness of elementary schools, teachers, and implementation challenges at the initial level of education are still minimal [5]. On the other hand, the rapid development of technology requires students to have digital skills from an early age in order to be able to compete in the industrial revolution 4.0 era. However, there are still gaps in the implementation of coding learning in elementary schools, both in terms of policy, infrastructure, and educator competence[9].

Previous research has not comprehensively examined the factors that become obstacles in the integration of coding into the primary school curriculum in Indonesia as well as strategies that can be done to overcome these challenges[12]. Therefore, more in-depth research is needed to understand the urgency of learning coding for primary school students in Indonesia as well as factors that support or hinder its implementation. Based on the description above, the researcher wants to conduct research on The Urgency of Learning Coding For Elementary School Students In Indonesia with the aim of describing how learning coding is implemented, challenges and opportunities in Indonesian elementary schools.

2. METHODS

This research uses a type of qualitative research with a literature review approach to sources that are relevant to this research. Creswell in Meliyanti, [10] Research using a literature review approach has stages including: (1) collecting data relevant to the research study (2) researchers present the data that has been collected (3) data reduction and inventory (4) conclude based on the results of valid and reliable data verification. The data obtained from the literature review from the sources analyzed referred to using the process theory of Miles & Huberman (in Cresswell, 2014).

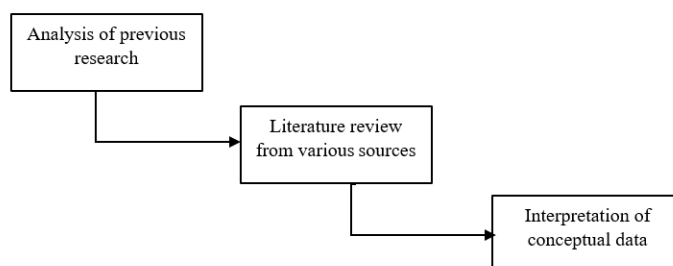


Fig. 1. Data processing and analysis

3. RESULTS AND DISCUSSIONS

Based on the research sources that have been collected and reviewed related to The Urgency of Learning Coding For Elementary School Students In Indonesia, the researcher compiled several relevant studies and can be reviewed in supporting this research. the results can be seen in the table below:

Table 1. Research relevant to the Urgency of Coding Learning for Elementary School Students in Indonesia

No	Title	Authors	Publication Year	Result
1	Analyzing Computational Thinking Studies	J. Red, K. Green	2021	This article analyzes various studies on computational thinking taught through Scratch programming, focusing on elementary school students.

No	Title	Authors	Publication Year	Result
2	in Scratch Programming Experiences of Pre-Service Elementary Teachers	S. Grey, T. White	2023	This article explores the programming experiences of prospective elementary school teachers, providing insight into how they are prepared to teach coding to students
3	Coding and Computational Thinking Across the Curriculum: A Review of Educational Outcomes	Kathy A. Mills, Jen Cope, Laura Scholes, Luke Rowe.	2024	This study highlights that learning to code is not just about technical programming, but also about computational thinking that can be applied in areas such as math, media literacy and game design. Coding has evolved into an essential skill for the future, with growing demand in various industries, not just in technology. However, the implementation of coding in education is still often limited and separate from the main curriculum. Therefore, this research emphasizes the need for a systematic approach in integrating coding into cross-disciplinary learning to enhance learners' critical thinking, problem-solving, and innovation skills.
4	Coding as Another Language: An International Comparative Study of Learning Computer Science and Computational Thinking in Kindergarten.	Marina Bers, Tess Levinson, Zhan Xia Yang, et al	2023	This research examines the Coding as Another Language (CAL) approach, which is designed to integrate the learning of computer science and computational thinking into early childhood education, particularly in kindergarten. The study was conducted in various countries, including the United States, Argentina and Israel, with the aim of exploring how the CAL curriculum can be applied in various cultural and linguistic contexts.
5	Coding for Kids: Introduction to Programming for Elementary School Children as the New Digital Literacy in Industry 4.0	Zeeshan, K., Hämäläinen, T., & Neittaanmäki, P.	2024	This research is a community service activity to introduce programming for teachers and students at Madrasah Ibtidaiyah (MI) Nasyrul Ulum 1 Grobogan. The results of the survey for teachers and students after the training said that no one had ever learned programming. Eight out of nine teachers felt that coding should be taught to children and were interested in teaching it. Overall, the coding training activities for teachers and students of MIS Nasyrul Ulum 1 were considered good, fun, memorable, and useful.

3.1 Importance of coding learning in Indonesian primary schools

Learning coding in elementary schools is becoming increasingly important in Indonesia along with the rapid development of digital technology. Coding is not just a technical skill, but also a tool to develop logical, systematic thinking, creativity, and problem-solving abilities in students from an early age[1]. Teaching coding at the elementary school level aims to introduce the world of programming to students in a fun and interactive way. Technology-based education makes educators feel the need to direct students to be literate and wise in using technology through a program that can encourage students to understand how technology works[13].

There are several reasons why it is important to teach coding in elementary school. First, coding can boost creativity and problem-solving skills. Learners will learn to solve complex challenges through a coding approach, preparing them to create digital products. Secondly, coding enhances 21st century skills that are much needed in this digital era.

Teaching coding from an early age helps children understand how technology works, create applications, and solve problems creatively and innovatively. Rendy Wijaya, a founder of a tech education startup in Indonesia, stated that coding skills will become the “new language” of the future workforce. Children with coding skills will not only be more competitive in the workforce, but also better prepared to face complex problems in everyday life with more logical and structured thinking [6].

3.2 How can coding learning in Indonesian primary schools be implemented?

Learning coding in elementary schools in Indonesia can be implemented through practical and theoretical approaches integrated into the curriculum. Schools can include coding as part of Information and Communication Technology (ICT) subjects or as a standalone subject (Isnaini & et al., 2021). In the practical approach, students can learn through platforms specifically designed for children such as Scratch, Tynker, or Code.org, which allow them to learn the basics of programming and then create simple projects such as animations, games, or interactive stories.

On the theoretical side, schools can teach basic concepts about programming logic, algorithms, and computational thinking so that students not only become coding tools but also understand how the technology behind it works. The implementation of coding in primary schools requires support from various parties, including training for teachers so that they have the necessary skills to teach coding. The government is also planning to expand the program to the primary school level, with efforts such as teacher training, provision of adequate facilities and infrastructure, and development of a relevant curriculum.

The success of this program is highly dependent on the development of learning materials that are appropriate for the elementary school age level. Coding materials should start from the introduction of programming logic concepts through educational games or simple applications such as scratch. Material development should involve educational practitioners and technology experts to keep the learning content relevant and applicable and focus on exploratory practices rather than just theory.

3.3 Effective strategies, models and methods used for learning coding in Indonesia

Strategies, models and methods in learning coding need to be well determined to get good learning outcomes. There are various strategies that can be used in learning coding in Indonesia, some strategies that can be done are the use of problem-based projects, collaboration between students, and the application of technology in learning [3]. The same thing is also described by [11] which shows the results that community-based or collaborative learning models also increase social support for students in learning coding. these strategies are then combined with models that are effective in meeting the needs of students in learning coding.

The learning model that can be used in the coding programming teaching approach is to use a graphical interface where learners can drag and drop “blocks” Previous research conducted by [7] explained that learning coding can be done using the block method for beginners in primary and secondary school students can attract and increase student motivation in learning coding instructions to build programs. The most famous example of block-based programming is Scratch, which is designed to make it easier for beginners to understand basic programming concepts without having to deal with complex syntax.

This approach aims to make programming more accessible and fun, especially for children and beginners. In addition, the model that can be used is the e-learning model. which includes interactive learning modules, discussion forums, and project-based assignments [8]. It is designed to provide a more engaging and supportive learning experience. The method used can be a method of playing while learning because with the stimulus of learning games it becomes fun and interactive students have learning motivation. In line with the research of [2] which shows evidence that integrating games can significantly increase student engagement and motivation. methods of providing education with the form of games such as Quiz, Kahoot, word wall can also be integrated so that student learning motivation is maintained [14].

3.4 Challenges of learning coding in Indonesian elementary schools

In learning activities, teachers and learning facilities are generally the main needs needed by students in learning. Teachers are learning resources, facilitators, mentors and evaluators in the student learning process (Arfandi, A., & Samsudin, M. A., 2021), so teachers cannot be separated in teaching and learning activities. In the coding learning process activities, teachers need to master the competencies to teach coding to their students. According to S. Gray, T. White (2023) that every teacher who teaches coding needs programming attitudes and skills, such as scratch to facilitate understanding of basic coding concepts.

This makes it clear that in learning coding in Indonesia the role of teachers is needed in learning coding with basic programming skills and platforms that support and facilitate understanding of basic coding concepts for students in elementary schools. The challenge in Indonesian elementary schools is that not all schools have teachers who understand technology and programming. Technology integration needs to be emphasized to teachers in elementary schools if coding learning is to be taken seriously by the government in learning in Indonesian elementary schools. The solution that can be implemented is to provide training for teachers related to programming and supporting factors for coding learning.

For prospective teachers, coding learning also needs to be given. This can be synergized through general courses and those provided in teacher professional programs. The practice of learning coding in elementary schools certainly requires facilities that support coding learning. Necessary facilities such as internet access, learning media and technology laboratories need to be held to support quality coding learning (Nurstalis et al., 2021). The challenge comes because not all elementary schools in Indonesia have facilities that support coding learning. The government needs special attention and support in providing facilities that support coding learning, both learning curriculum, internet access, technology laboratories, so that there is no imbalance in learning in elementary schools.

4. CONCLUSIONS

Planning coding in elementary schools in Indonesia is very important along with the rapid development of digital technology. Coding not only serves as a technical skill, but also as a tool to develop students' logical thinking, systematic, creativity, and problem-solving abilities. By introducing the world of programming in an interactive and fun way, students can be prepared to face challenges in the digital era. The integration of coding into the curriculum, both as part of Information and Communication Technology (ICT) subjects and as standalone subjects, allows students to learn through platforms specifically designed for children, such as Scratch and Tynker.

Challenges in implementing coding learning in elementary schools still exist, mainly related to the limited number of teachers who understand technology and programming. In addition, adequate facilities, such as internet access and technology labs, are also needed to support quality learning. Solutions to overcome these challenges include training for teachers and providing supportive facilities, as well as support from the government in providing curriculum and technology infrastructure. With these measures, learning to code can be a long-term investment that prepares Indonesia's young generation for the ever-evolving digital world. Future researchers may wish to conduct a more in-depth analysis on coding learning in Indonesia through a more comprehensive approach.

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