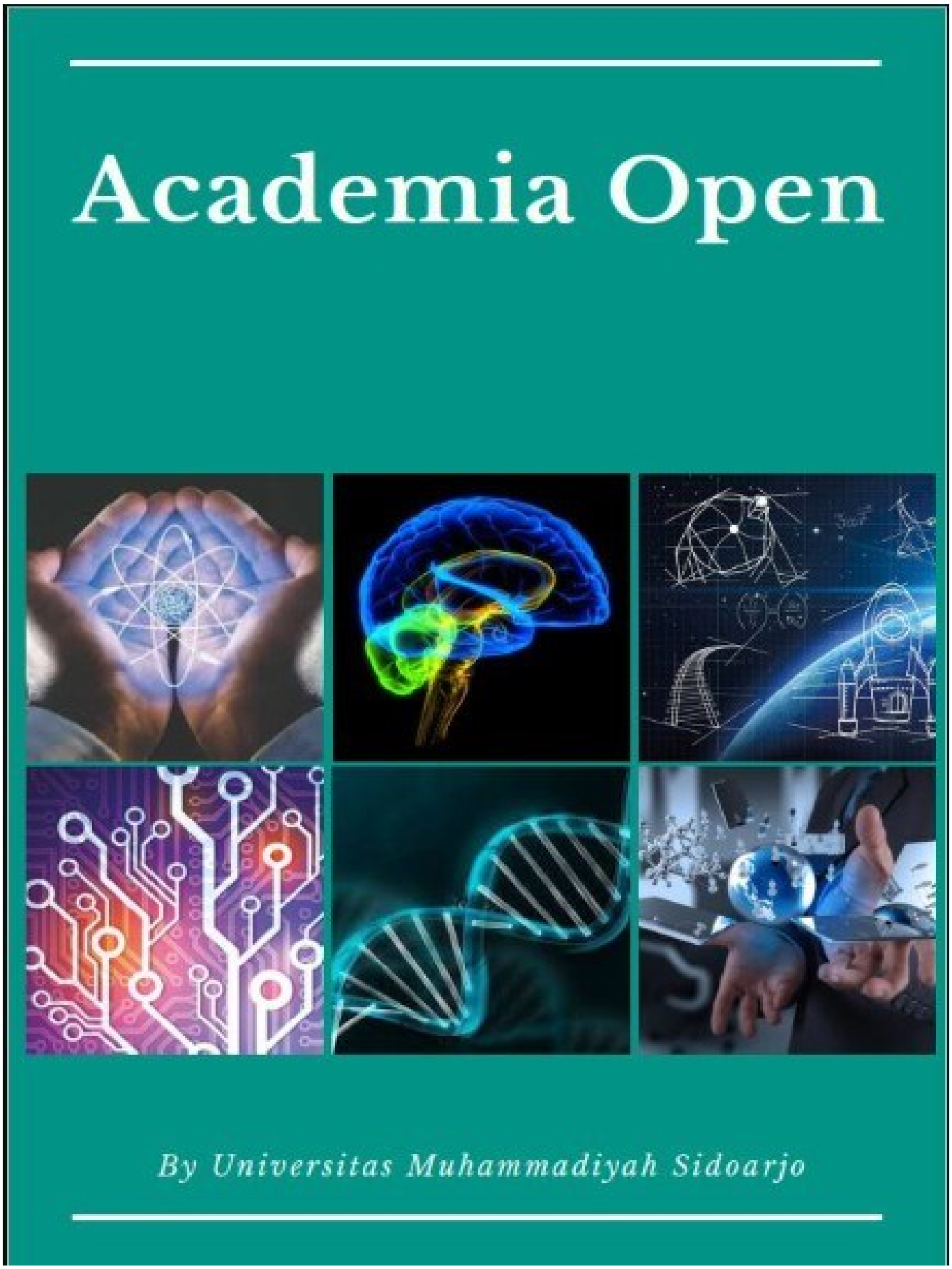
Academia Open

Vol. 11 No. 1 (2026): June
DOI: 10.21070/acopen.11.2026.13065



ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Academia Open

Vol. 11 No. 1 (2026): June
DOI: 10.21070/acopen.11.2026.13065

Table Of Contents

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Academia Open

Vol. 11 No. 1 (2026): June
DOI: 10.21070/acopen.11.2026.13065

Originality Statement

The author[s] declare that this article is their own work and to the best of their knowledge it contains no materials previously published or written by another person, or substantial proportions of material which have been accepted for the published of any other published materials, except where due acknowledgement is made in the article. Any contribution made to the research by others, with whom author[s] have work, is explicitly acknowledged in the article.

Conflict of Interest Statement

The author[s] declare that this article was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Copyright Statement

Academia Open
Vol. 11 No. 1 (2026): June
DOI: 10.21070/acopen.11.2026.13065

EDITORIAL TEAM

Complete list of editorial team (link)

Complete list of indexing services for this journal (link)

How to submit to this journal (link)

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Academia Open

Vol. 11 No. 1 (2026): June
DOI: 10.21070/acopen.11.2026.13065

Article information

Check this article update (crossmark)

Check this article impact (*)

Save this article to Mendeley

(*) Time for indexing process is various, depends on indexing database platform

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Academia Open

Vol. 11 No. 1 (2026): June
DOI: 10.21070/acopen.11.2026.13065

Teacher-Facilitated Plugged Coding for Early Childhood Computational Thinking

Fifi Syara Wahyu, 25011545057@mhs.unesa.ac.id (*)
Prodi Pendidikan Anak Usia Dini, Universitas Negeri Surabaya, Indonesia

Mallevi Agustin Ningrum, malleviningrum@unesa.ac.id
Prodi Pendidikan Anak Usia Dini, Universitas Negeri Surabaya, Indonesia

Yes Matheos Lasarus Malaikosa, matheosmalaikosa@unesa.ac.id
Prodi Pendidikan Anak Usia Dini, Universitas Negeri Surabaya, Indonesia

Andi Kristanto, andikristanto@unesa.ac.id
Prodi Pendidikan Anak Usia Dini, Universitas Negeri Surabaya, Indonesia

Nurul Istiq'faroh, nurulistiqfaroh@unesa.ac.id
Prodi Pendidikan Anak Usia Dini, Universitas Negeri Surabaya, Indonesia

Mohammad Syahidul Haq, mohammadhaq@unesa.ac.id
Prodi Pendidikan Anak Usia Dini, Universitas Negeri Surabaya, Indonesia

Ruqoyyah Fitri, ruqoyyahfitri@unesa.ac.id
Prodi Pendidikan Anak Usia Dini, Universitas Negeri Surabaya, Indonesia

(*) Corresponding author

Abstract

General Background Early childhood education is increasingly required to respond to digital transformation by integrating technology-based learning experiences that support foundational cognitive skills. **Specific Background** One emerging approach is plugged coding, which introduces basic programming concepts through digital devices in play-based classroom activities for children aged 5–6 years. **Knowledge Gap** Despite growing attention to coding in early childhood, limited empirical evidence explains how teacher roles, readiness, and pedagogical strategies shape the development of computational thinking within real classroom contexts, particularly under practical digital constraints. **Aims** This study aims to examine the implementation of plugged coding learning in early childhood education and to analyze the role of teachers in supporting children's computational thinking development. **Results** Using a descriptive qualitative case study at a public kindergarten, findings show that children demonstrated indicators of computational thinking, including sequencing, pattern recognition, and initialdebugging, while teachers employed scaffolding strategies such as prompting questions, visual demonstrations, and guided reflection. However, variations in teacher readiness and challenges related to device availability, technical issues, and screen-time management were evident. **Novelty** This study provides an in-depth qualitative account of teacher-mediated plugged coding practices aligned with a play-based curriculum in an authentic early childhood setting. **Implications** The findings underscore the importance of continuous teacher training, adequate digital infrastructure, and pedagogically appropriate learning media to support sustainable integration of plugged coding in early childhood education.

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Academia Open

Vol. 11 No. 1 (2026): June
DOI: 10.21070/acopen.11.2026.13065

Highlights:

- Children demonstrated sequencing, pattern recognition, and basic error correction during technology-supported activities.
- Pedagogical scaffolding and play-based design were central to guiding learning processes.
- Limited devices and teacher digital readiness shaped classroom implementation strategies.

Keywords: Computational Thinking, Early Childhood Education, Plugged Coding, Teacher Role, Digital Learning

Published date: 2026-01-19

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Vol. 11 No. 1 (2026): June
DOI: 10.21070/acopen.11.2026.13065

Introduction

The increasingly connected digital era is bringing significant changes to educational programs for young children.[1] The rapid advancement of technology is reshaping the way children understand and interact with information. Early childhood education can no longer be separated from the impact of digital technology, which has become an essential element in everyday life.[2] This transformation encompasses not only learning tools and media, but also teaching methods and the role of teachers in supporting children's learning processes. One of the learning materials that is becoming increasingly popular in early childhood education institutions is coding, which is introduced through play and exploration activities.[3] Its implementation can be carried out with two main approaches, namely unplugged coding (without digital devices) and plugged coding (with digital devices) such as computers, tablets, or interactive robots.[4] Plugged coding learning allows children to interact directly with technology so they can see the results of the commands or instructions they give in a tangible form. Through activities like this, children learn to understand cause-and-effect relationships, make predictions, and enhance creativity as well as higher-level thinking.[5] The ability to think computationally is not only crucial for computer science, but also forms the foundation for enhancing children's critical thinking, problem-solving, and creativity in various areas of life. Computational thinking is a fundamental skill on par with the ability to read, write, and do arithmetic.[6]

The role of the teacher is very crucial in the implementation of plugged coding learning. Early Childhood Education (PAUD) teachers not only function as information providers but also as guides, supporters, and designers of meaningful learning experiences for children.[7] Educators are expected to have good pedagogical and technological skills in order to be able to select the appropriate methods, media, and activities according to the characteristics of early childhood. However, in practice, the implementation of plugged coding learning in early childhood education still faces various challenges. Some teachers still have limitations in understanding coding concepts, and the lack of training and limited time for learning become the main obstacles.[8] Furthermore, some early childhood education teachers still face difficulties in operating digital applications and adapting technology to learning objectives. This situation causes the potential of plugged coding to not be optimally utilized in developing children's computational thinking skills.[9]

Connected coding education in Indonesia has shown significant progress between 2023 and 2025, as part of the digital education system transformation initiated by the Ministry of Education, Culture, Research, and Technology. This initiative aims to enhance children's 21st-century skills, particularly in logical, structured, and computational thinking, in accordance with the Ministry of Education and Culture curriculum. The development of connected coding education in Indonesia is related to national policy. Starting in 2024, the Ministry of Education and Culture will develop a curriculum that integrates coding and artificial intelligence across educational levels from early childhood education to high school, with the implementation of internet-based methods, both connected and offline. The connected coding approach emphasizes the use of digital devices such as tablets, laptops, and robots in education to introduce the basics of programming logic. The success of coding programs for preschool children is greatly influenced by the support and imagination of teachers in guiding learning that is based on exploration and play.[10]

The problem formulation in this study is how the role of the teacher in implementing plugged coding learning in early childhood, how the teacher's teaching approach encourages computational thinking in children, and what factors become digital obstacles in the implementation of plugged coding in early childhood education. This study differs from previous research, which showed that by applying computational thinking, children will be trained and accustomed to finding solutions and forming solution patterns. It is very possible for early childhood to be creative as well as productive when learning coding with the Scratch application. Therefore, the researcher is interested in conducting research entitled The Role of Teachers in Developing Early Childhood Computational Thinking Through Plugged Coding at TK Negeri Pembina Biau Subdistrict, with the aim of analyzing plugged coding learning on the development of computational thinking in early childhood and the role of teachers in the implementation of learning.

Method

This study uses a descriptive qualitative method aimed at providing a detailed explanation of the implementation of integrated coding learning applied in Early Childhood Education (PAUD) institutions and also assessing the role of teachers in enhancing computational thinking skills in young children. The goal of descriptive qualitative research is to systematically, realistically, and accurately reflect or describe the facts and interactions between the phenomena being studied. The qualitative research method is a research method used to examine objects in their natural conditions, where the researcher acts as the key instrument, data collection techniques are conducted through triangulation (combination), data analysis is inductive, and qualitative research results emphasize meaning rather than generalization.[11]

Results and Discussion

In general, the implementation of plugged coding at TK Negeri Pembina in Biau District shows that children are able to actively engage in activities such as arranging movement steps and correcting sequence errors, although intensive guidance from the teacher is still needed at the beginning of the sessions. The teacher makes a series of improvements from cycle to cycle, including simplifying the instruction display, limiting the number of steps in one session, and dividing the children into small groups so that interaction and scaffolding are more focused. The observations found the following results:

ISSN 2714-7444 (online), https://acopen.umsida.ac.id, published by Universitas Muhammadiyah Sidoarjo

Academia Open
Vol. 11 No. 1 (2026): June
DOI: 10.21070/acopen.11.2026.13065

Table 1. Observation of Plugged Coding Learning

No	Plugged Coding Learning	Computational Aspect	Observation description
1	Child Arranging Letters Using an Interactive Flat Panel (IFP)	Pattern recognition	The child arranges the letters on the screen in order, demonstrating an understanding that each letter has a specific position in the sequence that should not be swapped.
2	The child connects pictures and letters	Decomposition	Children solve problems by matching pictures with the initial letters as a small step, observing the pictures, saying the name of the object, and then finding the corresponding initial letter on the screen, before finally drawing a line/clicking the correct pair.
3	The child is counting numbers using pictures of apples	Algorithm	The child follows a consistent sequence of steps when counting, starting from the first apple image on the screen and pointing to each apple image one by one while saying the numbers in order, so that each apple image is counted only once.

Figure 1. Plugged coding learning

Based on the observations that have been made, integrated coding learning using an Interactive Flat Panel (IFP) shows that children are very enthusiastic. They follow certain steps displayed on the screen, such as selecting blocks, arranging them in the correct order, and pressing the start button, so the elements of algorithms or sequencing begin to appear in their actions. In this case, the teacher uses the IFP to display coding challenges that are visually rich, such as games that match pictures with letters or numbers, as well as character movement paths, while guiding the children to solve the given problems. Through prompting questions and direct demonstrations on the screen, the teacher helps students recognize patterns (such as directional patterns or object sequences), choose the correct steps, and reflect on mistakes to correct them later.

Interviews with several teachers were conducted on November 7, 2025, at TK Negeri Pembina in the Biau District. Based on the results of observations, interviews, and document analysis, there are three main thematic findings: the level of teacher readiness in implementing plugged coding, digital challenges in early childhood education institutions, and teachers' instructional approaches to encourage computational thinking in children. Each theme is interrelated and contributes to the emergence of indicators of children's computational thinking, such as skills in arranging sequences of instructions, recognizing patterns, and performing simple debugging. The findings indicate that teachers have a strong motivation, but there is still variation in their conceptual understanding of computational thinking and their experience with connected coding practice. This aligns with other research findings that suggest many early childhood education teachers do not yet feel confident in their computational thinking skills and technology integration, even though they recognize that these abilities are important for children. Some educators emphasized the importance of guidance and training:

> *Teacher 1: "At first, I thought programming was only for elementary school children and above, but it turns out that even kindergarten children can be trained to arrange steps using a simple application."*

> *Teacher 2: "We still need real examples of lesson plans or teaching modules that explain unplugged coding activities, so that we don't make mistakes in setting objectives and assessments."*

> *Teacher 3: "After trying a few times, I started to feel more confident, but I'm still worried about time management and classroom tools."*

Obstacles in the digital world that arise include the limited number of devices, technical issues, and teachers' concerns about young children being exposed to screens for too long. This situation aligns with research showing that infrastructure, technological readiness, and institutional policies are important factors for the success of the digitalization process in early childhood education institutions. Some teachers stated:

> *Teacher 1: "In class, only a few tablets can be used, so we have to take turns and keep the other children engaged*

Vol. 11 No. 1 (2026): June
DOI: 10.21070/acopen.11.2026.13065

with supporting activities."

Teacher 2: "Sometimes the network or apps suddenly error, so we have to quickly switch activities so the children don't have to wait too long."

Teacher 3: "We always remind them that this is not just 'playing on the phone,' but there are rules and clear times to keep it safe for the children."

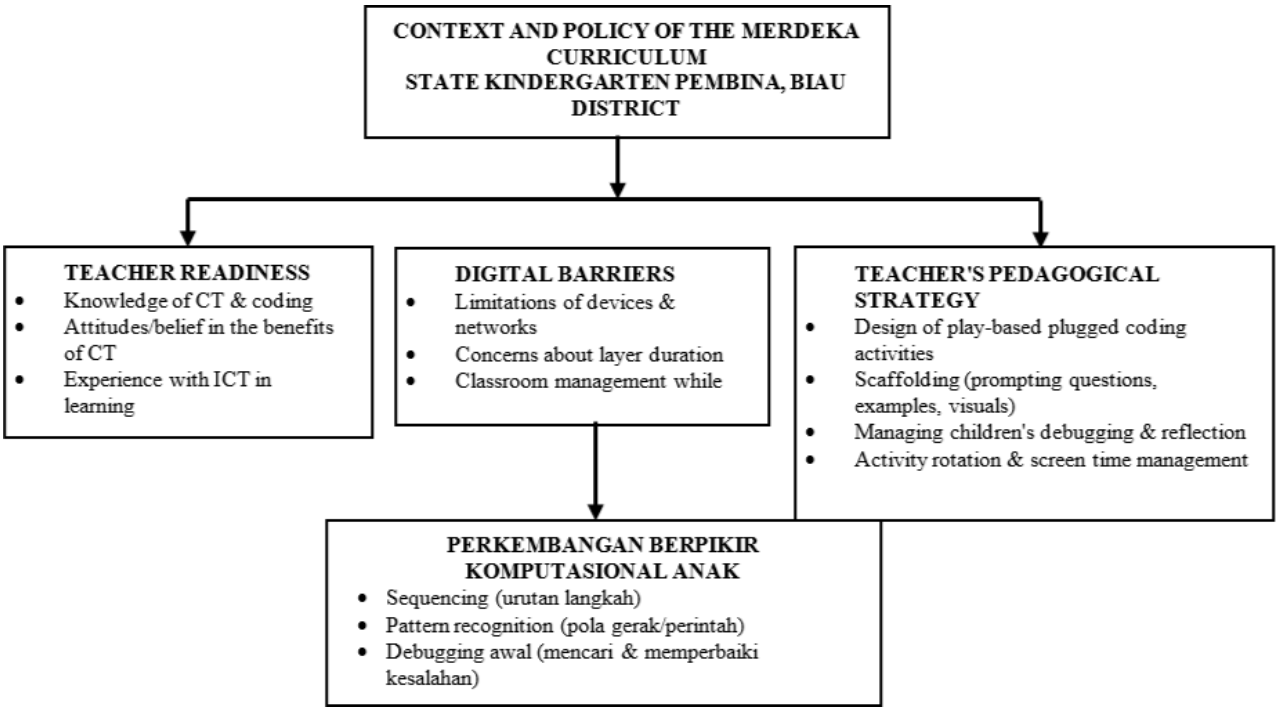
Teacher's pedagogical strategy The teacher uses various teaching methods that serve as supports for computational thinking: the use of real-life examples, thought-provoking questions, visual aids, and simple error correction exercises. These methods align with the early childhood CT education framework, which emphasizes organizing activities, play-based approaches, and the teacher's role in helping children understand CT concepts, CT practices, and CT perspectives (such as perseverance and reflection). Some teacher quotes reflecting these strategies include:

Teacher 1: "I often ask the question, 'What is the first step that should be taken?' or 'What would happen if the order were reversed?' so that the children can reflect on the sequence."

Teacher 2: "If a child makes a mistake, I don't immediately correct them, but instead invite them to re-evaluate: 'Where do you think the mistake is?' so that they can learn to correct it themselves."

Diagram of findings relationships This diagram can be visualized as a flow model: Context & Policy → (Teacher Readiness + Digital Barriers) → Teacher's Pedagogical Strategies → Children's CT Development,

Table 2. The Impact of Plugged Coding Learning



1. Implementation of Plugged Coding Learning

Coding education for early childhood is a process specifically designed to introduce basic programming concepts and develop logical and computational thinking skills. Educators who have a good understanding of the essence and benefits of coding education will find it easier to design an effective and enjoyable learning proc ess.[12] Planning is carried out collaboratively by educators through regular forums, such as annual meetings, using a meaningful playful learning approach. In this approach, coding education is positioned as an educational play tool, where children can explore concepts of logic and sequence of commands through fun and contextual activities.[13] The curriculum used is flexible and adaptive, allowing teachers to design activities that are responsive to the dynamics of child development. This curriculum combines play-based learning, a scientific approach, and the strengthening of children's social skills. Educators integrate elements of the scientific approach into plugged coding games, with the hope of fostering curiosity, building meaningful understanding, and cultivating religious values as well as appreciation for the creations of God Almighty, as emphasized, that a science-based play approach can help children form meaningful knowledge.[14]

Programming learning is an effort made consciously and systematically to achieve competence in attitudes, skills, and knowledge closely related to programming practice from a young age, aiming to strengthen basic literacy and shape the character of Pancasila students. Programming activities involve a set of codes consisting of numbers, letters, or symbols used to represent information by following the writing rules established in a specific programming language.[15]

Vol. 11 No. 1 (2026): June
DOI: 10.21070/acopen.11.2026.13065

Programming is not just a programming language, but also a method to develop various skills. Based on all the findings, it can be concluded that the implementation of plugged coding in early childhood education:

a. Can effectively improve the computational thinking skills of young children if designed in a playful and cooperative manner.

b. Highly dependent on the teacher's preparation, both in terms of digital literacy and play methods.

c. Requires support from institutions and authorities to be sustainably integrated into the early childhood education curriculum.

2. The Role of Teachers in Facilitating Children's Computational Thinking

As a teacher or often referred to as an educator, teachers are required to convey their knowledge to students. Advising and directing students to better behavior than before. A teacher is someone who provides facilities for the process of transferring knowledge from learning sources to students. As professional educators, teachers have the main task of educating, teaching, guiding, directing, training, assessing and evaluating students. It can be concluded that teachers are individuals who have professional skills to educate, teach, guide, assess and evaluate students in the process of transferring knowledge from learning resources available to students.

The knowledge that early childhood education teachers have about teaching coding to children can be further developed, so that the teachers' perspective does not just stop at knowledge alone. In addition, they can use coding instruction as one of the activities to enhance six aspects of early childhood development. By understanding knowledge about coding instruction, teachers can be more effective in designing activities that help children develop programming skills. Considering the rapid development of technology, children nowadays cannot be separated from gadgets. They are already very familiar with various technological devices, and if not properly guided, this could negatively affect their behavior. Therefore, in order for children not to be merely passive users of media, they need to be guided in making good use of technology. The hope is that in the future, these children will be able to create something useful to support the resilience of the Republic of Indonesia. For this reason, fundamental coding is very important for school-aged children to know and understand.[16]

3. Teacher Strategies in Facilitating Children's Computational Thinking

Computational thinking is a learning method that encourages the brain to think systematically, orderly, critically, and logically. Computational thinking is a structured approach to recognizing and solving problems. Computational thinking is a logical skill in solving problems that comes from the discipline of computer science.[17] Research conducted by Maharani, Nusantara, As'ari, and Qohar shows that after conducting small and large-scale experiments on six children at PAUD Himmatul Hidayah, the CSK media (Computational Thinking Sheets for Children) is effective in stimulating children's computational thinking, as evidenced by its validity, effectiveness, and practicality. Meanwhile, research by Zahid, Dewi, Asih, Winarti, Putri, and Susilo reveals that both teachers and children do not yet understand mathematical thinking and computational thinking, as well as the media used to introduce these two concepts. In the study, Zahid, Dewi, Asih, Winarti, Putri, and Susilo utilized the Scratch application as a medium to introduce computational thinking. Their findings indicate that the Scratch application can be used to stimulate indicators of computational thinking. Based on the results of the research conducted, it can be concluded that teachers' strategies in facilitating computational thinking can be nurtured through programming learning. The use of computational thinking is still quite new in Indonesia, so this poses a significant challenge for the country's education sector, which aims to produce a superior generation capable of competing and adapting to the developments of the times.

Conclusion

The Role of Teachers in Developing Computational Thinking in Early Childhood through Plugged Coding at TK Negeri Pembina, Biau District, concludes that teachers play a central role in three main stages: planning activities aligned with the Merdeka Curriculum, facilitating through pedagogical scaffolding (prompting questions, visual support, debugging management), and reflection for continuous improvement. This approach successfully fostered indicators of algorithmic thinking skills, pattern recognition, problem-solving abilities, and reflection on errors or debugging in 15 children in group B. Thematic findings show a high level of teacher preparedness despite limitations posed by digital barriers (limited devices, network issues, screen time), which were addressed through strategies such as group rotation and supporting media. Overall, this supports the development of children's computational thinking in accordance with the Pancasila Student Profile's critical-creative reasoning dimension.

References

1. J. Fatmawiyati and R. S. R. E. Permata, "Implementasi Pendidikan Inklusif Di PAUD," Flourishing Journal, vol. 2, no. 8, pp. 567–582, 2023, doi: 10.17977/um070v2i82022p567-582.
2. A. Muanifah, "Mendirikan PAUD (Pendidikan Anak Usia Dini) Yang Berkualitas," Cendekia: Jurnal Pendidikan Dan Pengajaran, vol. 18, no. 1, pp. 1–12, 2024, doi: 10.1007/s10639-023-11787-5.
3. A. Ambariani and D. Suryana, "Hambatan Implementasi PAUD Berbasis Holistik Integratif," Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini, vol. 6, no. 5, pp. 4047–4056, 2022, doi: 10.31004/obsesi.v6i5.1599.
4. S. C. Lamatokan et al., "Peningkatan Kompetensi Guru PAUD Dalam Pembelajaran Coding Untuk Anak Usia Dini Melalui Workshop Di Kota Bekasi," Jurnal Pengabdian Masyarakat Dan Penerapan Ilmu Pengetahuan, vol. 6, no. 1, pp. 45–53, 2025, doi: 10.25299/jpmpip.2025.22309.
5. A. H. Arifin, W. R. Pratiwi, A. Andriyansah, and Z. Sultan, "Peningkatan Kreativitas Guru PAUD Di Kota Tangerang

Dalam Membuat Media Pembelajaran Berbasis Canva," Journal of Humanities Education, vol. 4, no. 1, pp. 55–63, 2024, doi: 10.31004/jh.v4i1.571.
6. N. Nurdin and L. Anhusadar, "Efektivitas Pembelajaran Online Pendidik PAUD Di Tengah Pandemi COVID-19," Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini, vol. 5, no. 1, pp. 686–697, 2020, doi: 10.31004/obsesi.v5i1.699.
7. I. B. Hastuti, T. Asmawulan, and Q. F. Fitriyah, "Asesmen PAUD Berdasar Konsep Merdeka Belajar Merdeka Bermain Di PAUD Inklusi Saymara," Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini, vol. 6, no. 6, pp. 6151–6161, 2022, doi: 10.31004/obsesi.v6i6.2508.
8. M. M. Jannah and H. Rasyid, "Kurikulum Merdeka: Persepsi Guru Pendidikan Anak Usia Dini," Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini, vol. 7, no. 1, pp. 77–86, 2023, doi: 10.31004/obsesi.v7i1.3800.
9. M. Fauziddin, G. D. Lestari, N. Mariana, Hendratno, and W. Sukartiningsih, "Analysis On Value Of 12 Verses Gurindam By Raja Ali Haji In The Context Of Learning Islam In Early Childhood (PAUD)," International Journal of Membrane Science and Technology, vol. 10, no. 2, pp. 1268–1276, 2023, doi: 10.15379/ijmst.v10i2.1268.
10. S. Nurjannah and H. Hermanto, "Curriculum Modification To Accommodate Inclusive Education Supporting Holistic Integrative Early Childhood Education," Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini, vol. 7, no. 4, pp. 4898–4909, 2023, doi: 10.31004/obsesi.v7i4.4898.
11. P. D. Sugiyono, Metode Penelitian Pendidikan: Pendekatan Kuantitatif, Kualitatif, Dan R&D. Bandung, Indonesia: Alfabeta, 2014.
12. T. Yilmaz and S. Izmirli, "Unplugged And Plugged Coding Activities And Computational Thinking Skills Of Secondary School Students," Journal of Educational Technology and Online Learning, vol. 6, no. 3, pp. 521–536, 2023, doi: 10.31681/jetol.1375335.
13. B. T. Kamalabadi and M. Precharattana, "Elementary School Students' Perception Of Integrating Unplugged And Plugged Coding Activities With Self-Questioning Strategies For Solid Waste Management (SDG11)," in Proceedings of the IEEE International STEM Education Conference, 2025, pp. 1–6, doi: 10.1109/iSTEM-Ed65612.2025.11129389.
14. F. Pelizzari, M. Marangi, P. C. Rivoltella, G. Peretti, D. Massaro, and D. Villani, "Coding And Childhood Between Play And Learning: Research On The Learning Of 4-Year-Olds," Research in Education and Media, vol. 15, no. 1, pp. 1–14, 2023, doi: 10.2478/rem-2023-0003.
15. M. Uğraş, H. Güneş, H. Uğraş, S. Papadakis, and M. Kalogiannakis, "Coding Activities In Early Childhood: A Systematic Review," International Journal of Technology Enhanced Learning, vol. 17, no. 1, pp. 1–20, 2025, doi: 10.1504/IJTEL.2025.143512.
16. C. Montuori, G. Pozzan, C. Padova, L. Ronconi, T. Vardanega, and B. Arfé, "Combined Unplugged And Educational Robotics Training To Promote Computational Thinking And Cognitive Abilities In Preschoolers," Education Sciences, vol. 13, no. 9, p. 858, 2023, doi: 10.3390/educsci13090858.
17. H. Gao, W. Yang, and Y. Jiang, "Computational Thinking In Early Childhood Is Underpinned By Sequencing Ability And Self-Regulation: A Cross-Sectional Study," Education and Information Technologies, vol. 28, no. 9, pp. 11787–11805, 2023, doi: 10.1007/s10639-023-11787-5.