CODING GAMES AS A MEDIUM TO STIMULATE COMPUTATIONAL THINKING IN CHILDREN AGED 5-6

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ABSTRACT

This study examines the use of coding games as a learning medium to stimulate computational thinking skills in children aged 5–6 years at RA Hj. Sri Musiyarti. The research employed a qualitative descriptive method involving 15 children aged 5–6 years and 2 teacher**s** as research subjects. Data were collected through classroom observations, semi-structured interviews, and documentation, with data validity ensured through source and technique triangulation. Data analysis was conducted using an interactive analysis model consisting of data reduction, data display, and conclusion drawing. The results indicate that coding games effectively stimulate core components of computational thinking, including sequencing steps, recognizing patterns, predicting the consequences of instructions, and performing simple debugging. In addition, coding game activities enhance children's social skills, particularly cooperation, communication, and emotional regulation during problem-solving processes. The study concludes that coding games are an effective medium for introducing the foundations of computational thinking in early childhood and are suitable for integration into the Early Childhood Education curriculum to support children's readiness for 21st-century learning demands.

INTRODUCTION

Early childhood education in the digital era requires an approach that can prepare children for the increasingly rapid development of technology. One skill considered crucial for facing the 21st century is computational thinking (Khaironi, 2017). This ability is not only relevant for aspiring programmers but also serves as a crucial foundation for solving problems systematically, creatively, and logically in various life contexts. Therefore, implementing activities that encourage computational thinking in early childhood learning is an urgent need.

Computational thinking in children aged 5–6 years is not defined as the ability to write computer code, but rather a set of thinking skills that include decomposition, pattern recognition, simple algorithms, and logical

thinking. These abilities can be stimulated through games and activities appropriate to the child's developmental stage. A game-based approach is relevant because the world of early childhood is a world of play, so learning is more effective when presented in a fun and meaningful way. One form of activity considered appropriate for stimulating computational thinking is coding games.

Coding games for early childhood typically come in the form of unplugged games, concrete manipulatives, step-by-step flowcharts, or board-based games that enable children to understand sequence, cause and effect, and problem-solving (Dianradika Prasti et al., 2022). Thus, coding games bridge children's natural play world with the logical concepts necessary for computational thinking. Research by Munawar shows that coding games can improve children's ability to understand instructions, organize sequences of actions, and develop critical thinking and problem-solving skills. Children learn how steps must be executed sequentially to achieve a goal, as well as how to correct errors when the outcome does not go as planned. These skills are essential aspects that form the foundation of computational thinking (Munawar & H, 2023).

Most early childhood education units still emphasize reading, writing, and arithmetic skills, using an instructional and individualized approach. This approach leaves little room for the thinking processes, social interactions, and experiential learning that are the primary characteristics of early childhood education. Consequently, children's potential to develop logical thinking and problem-solving skills through play activities is not optimally utilized. This situation indicates a gap between the demands of 21st-century learning and conventional early childhood education practices.

Meanwhile, research by Dayurni and Rahmadhani (2025) focused on the development of a coding gameboard specifically designed for early childhood education as a practical and effective unplugged coding tool. Interviews with teachers and parents participating in the study showed that using the MIKO gameboard helped children understand the sequence of instructions and color patterns more clearly than conventional learning methods. During the interviews, the teachers explained that initially, the children appeared confused and made more random moves, but after several practice sessions, the children began to recognize patterns and arrange the steps more systematically. The teachers stated that children's active participation in this game developed curiosity, so they not only followed the rules but also began to ask questions and explain the reasons behind their choices. Some teachers also emphasized that this activity demonstrated the development of problem-solving skills because children had to evaluate each step and decide on the next step with a more mature strategy. Other teachers noted that this game helped children recognize errors or simple debugging when the game results did not meet expectations, which then encouraged children to reflect and improve. Furthermore, interviews showed that children's social skills, such as sharing ideas and agreeing on strategies with classmates, improved as the activities progressed. Overall, teachers considered the MIKO gameboard to be an inclusive and effective medium for stimulating computational thinking skills in children aged 5–6 years through simple and enjoyable play activities (Dayurni & Rahmadani, 2025).

In their discussion of this research, Dayurni and Rahmadhani (2025) reported that the MIKO gameboard media proved feasible, practical, and effective in improving early childhood computational thinking skills, particularly in debugging and problem-solving. Interviewed teachers reported that children demonstrated improvements in these skills after several play sessions, making the game more than just an entertainment activity but also a structured learning experience. Gameboard-based unplugged coding activities enabled children to understand logical concepts, enabling them to connect symbols with concrete actions. Teachers also noted that the use of this media helped children overcome initial confusion in following instructions in a more enjoyable and interactive manner. These findings are consistent with the argument that unplugged coding supports the development of computational thinking skills without relying on digital devices, making it more applicable in early childhood education contexts that lack comprehensive technological facilities. These results reinforce the relevance of game-based media as an effective learning strategy for stimulating logical and systematic thinking in early childhood.

In Indonesia, the integration of computational thinking skills in early childhood is still relatively new and uneven. Some early childhood education institutions still focus on conventional learning that emphasizes basic cognitive aspects such as reading, writing, and arithmetic (Prasetyo et al., 2023). However, computational thinking skills Computational learning can trigger much more comprehensive cognitive development, including the ability to plan, analyze, and make decisions. RA Hj. Sri Musiyarti, an early childhood education institution striving to keep up with the times, has begun adopting technology-based learning and innovation. However, stimulating computational thinking through coding games has not been fully utilized systematically. Initial observations indicate that children have a strong interest in rule-based and step-based games, but have not been explicitly directed to develop computational thinking skills.

This situation demonstrates an opportunity for teachers to develop learning activities specifically designed to stimulate computational thinking skills through coding games. With the right approach, coding games can not only be engaging but also provide meaningful learning experiences for 5–6-year-olds at RA Hj. Sri Musiyarti. The use of coding games also aligns with the Independent Curriculum, which emphasizes experiential learning, exploration, and the development of 21st-century skills. Through play activities containing algorithmic elements, children can develop an initial understanding of logic and systematic thinking structures without direct contact with digital devices (Padang, 2019).

Although several studies have explored the effectiveness of coding games in improving early childhood computational thinking skills, most of these studies focus on cognitive aspects or media development, and have not examined how coding games operate within the social context of early childhood education (PAUD) classrooms. Furthermore, empirical studies that place coding games as a socio-educational learning practice within the context of PAUD institutions in Indonesia are still relatively limited. Based on these conditions, this study seeks to examine the use of coding games as a socio-educational learning medium to stimulate the computational thinking skills of 5–6-year-old children at RA Hj. Sri Musiyarti. This research is expected to provide an empirical contribution to the development of early childhood education (PAUD) learning practices that are more contextual, collaborative, and relevant to the demands of children's social and cognitive development in the 21st century.

Research on coding games for early childhood also confirms that these activities can improve concentration, predictive skills, coordination, and reflection. Children learn that thinking processes are not always linear and that failure at one step is an opportunity to refine strategies. The importance of this process makes coding games a relevant learning medium for early childhood at RA Hj. Sri Musiyarti.

This study aims to describe the application of coding games as a learning medium at RA Hj. Sri Musiyarti, analyze how these activities stimulate the computational thinking skills of children aged 5–6 years, identify developing computational aspects such as decomposition, pattern recognition, simple algorithms, and problem solving, assess the effectiveness of coding games in improving logical and systematic thinking skills, and formulate recommendations for developing relevant learning strategies for early childhood education.

Based on this description, research is needed to examine how coding games can be used as a medium to stimulate computational thinking skills in children aged 5–6 years at RA Hj. Sri Musiyarti. This research is expected to provide an empirical overview of the effectiveness of coding games in the context of early childhood education and contribute to the development of innovative learning strategies that are appropriate to children's developmental needs.

METHOD

This study used a descriptive qualitative approach aimed at in-depth descriptions of how coding games are used as a medium to stimulate computational thinking in children aged 5–6 years at RA Hj. Sri Musiyarti. This approach was chosen because it captures the process of children's interactions with learning media, their response

patterns to a series of activities, and the teachers' perspectives in a naturalistic way within the learning situation. The research location was in the classroom environment of RA Hj. Sri Musiyarti, where children routinely engage in learning activities designed based on the Independent Curriculum (Tampubolon, 2023).

The study subjects consisted of 15 children in Group B (aged 5–6 years) who were directly involved in coding game activities, as well as two class teachers responsible for planning and implementing the activities. Subject selection was purposive, considering that children in this group already possess sufficient basic skills to follow the sequence of activities and are able to interact in playful learning. Teachers were chosen as key informants in the interviews because of their strategic role in assisting and evaluating the development of children's computational thinking throughout the activities. (Hikmawati, n.d.)

The data collection techniques used in this study included participant observation, semi-structured interviews, and documentation. Observations were conducted to directly capture children's behavior, step-ordering patterns, pattern recognition, and problem-solving strategies that emerged during the coding game. Semi-structured interviews were used to explore teachers' understanding of the effectiveness of the media. coding games, the dynamics of activity implementation, and teacher assessments of changes in children's computational thinking skills. Documentation in the form of activity photos, teacher diaries, and children's work were used as supporting data to enrich the description of the observed phenomena.

In data analysis, the researchers employed the Miles and Huberman interactive analysis model, which includes the stages of data reduction, data presentation, and conclusion drawing. Data reduction was carried out to sort and simplify the raw data obtained from observations, interviews, and documentation to focus on aspects relevant to the research objectives. Data presentation was systematically carried out in the form of descriptive narratives and supporting tables when necessary. The researchers then drew conclusions based on logical relationships between data units emerging from various sources.

To maintain data validity, this study applied triangulation techniques, namely technical triangulation using more than one data collection technique; source triangulation by comparing data from children and teachers; and member checking with teachers to ensure that the researcher's interpretations were in accordance with field conditions. The entire research process was carried out for approximately four weeks following the regular learning schedule at RA Hj. Sri Musiyarti without changing the natural classroom environment, so that the data obtained reflected authentic learning practices. (Annisa, 2023)

The coding game is implemented in a structured, phased manner. The activity begins with the teacher explaining the rules and objectives of the game, followed by a challenge in the form of determining a path or sequence of steps using instruction cards or a grid. Children are asked to logically arrange the steps before executing the object's movement. Throughout the process, children observe the results of the instructions, evaluate their suitability to the objectives, and debug any errors. The teacher acts as a facilitator, providing reinforcement and prompting questions without directly directing the answers.

Qualitative data analysis was conducted through an open coding process, identifying units of meaning from observations, interviews, and documentation related to children's computational thinking skills and social interactions. The initial codes were then grouped through a categorization process into key themes, such as sequence sequencing, pattern recognition, consequence prediction, simple debugging, and socio-emotional aspects. This process allowed for the drawing of relationships between categories to obtain consistent patterns of findings.

The research was conducted in accordance with ethical principles for early childhood education research. Approval was obtained from the school and teachers, as well as the children's parents as guardians. The identities of the research subjects were kept confidential and not included in the research report. All research activities were conducted without disrupting the regular learning process, ensuring that the children participated voluntarily, safely, and comfortably throughout the activities.

RESULT AND DISCUSSION

In the early stages, children appear to explore randomly, without using a directed mindset. They tend to guess moves, moving tokens based on intuition rather than analysis. This is not surprising, given that young children are not yet accustomed to activities that require prediction and planning skills. However, precisely because their starting point is low, the changes that emerge after treatment become very visible (Salamah et al., 2025). Children begin to understand that every instruction has consequences, so token movements cannot be separated from the underlying logic. This shift in how children understand visual instructions is one indicator that coding games can function as a conceptual bridge between play and more analytical mental processes.

As the activity progresses, coding games develop more reflective learning patterns. Children begin to demonstrate the ability to systematically sequence steps. This is evident when they arrange instruction cards, no longer based on spontaneous choices, but based on grid calculations and path evaluation. This phenomenon supports the concept that children can internalize the principles of computational thinking even without digital devices. When children are able to predict the correct steps, assess the most efficient path, and correct errors, it suggests that coding games provide hands-on experience with logical structures, patterns, and simple algorithmic concepts. These findings also align with Piaget's theory of cognitive development, in which children begin to enter the late preoperational phase, enabling them to connect visual symbols with concrete actions.

Another noteworthy change is the children's improved debugging skills. Initially, they appeared confused about determining the error point when a token failed to reach its destination. However, after some practice, they began to be able to isolate the problematic step and correct it without teacher instruction. This debugging activity is at the heart of computational thinking, as it requires children to evaluate the process, not just the outcome. This change demonstrates that coding games not only improve the accuracy of actions but also enhance procedural awareness. Children not only follow instructions but also understand the structural relationships between them. In context, this finding strengthens the argument that concrete media can provide a solid foundation for early childhood computational literacy.

In terms of classroom dynamics, coding games create a much more collaborative learning atmosphere than conventional methods typically used by teachers. Children are seen discussing with each other, correcting each other's instructions, and agreeing on shared strategies. This social process adds significant value because computational thinking skills are not developed in isolation but are also influenced by children's ability to communicate, express ideas, and accept feedback (Yusra et al., 2024). Coding activities indirectly train metacognitive skills, as children need to explain the reasons behind their choices. Thus, the benefits of coding games extend beyond the cognitive domain to include language, social, and emotional competencies. These findings further strengthen the relevance of coding games in supporting holistic learning in early childhood education (PAUD).

Teachers responded positively to the use of this media. They recognized that coding games reduced teacher dominance and provided space for children to become more independent. Teachers also found it helpful because the media simplified the concepts of direction, position, and sequence, making them easier to integrate into thematic learning. This teacher response is important because the implementation of new media in PAUD is often hampered by the perception that these activities are too difficult for young children (Prasetyo et al., 2023). In this study, this perception changed significantly. Teachers acknowledged that coding games are flexible, not burdensome, and can be adapted to the child's developmental level. These teacher reflections support the validity of the findings that coding games are indeed flexible for implementation in schools.

Additional findings indicate an increase in children's emotional resilience. Children who are typically frustrated by failure begin to understand that mistakes are part of the process. This is achieved by coding games presenting failure in a safe, non-threatening way, and often eliciting laughter. When a token goes wrong, children don't feel embarrassed or depressed, but rather wonder how to fix it. This change in attitude is crucial for long-term learning, as the ability to manage failure is a key foundation for problem-solving. Therefore, coding games not only

develop computational thinking but also build mental toughness, which is relevant for children's overall development. From a literature perspective, these research findings are consistent with numerous studies showing that manipulative media can enhance systematic thinking skills in early childhood. Previous research has shown that grid-based activities, visual symbols, and logical sequences help instill structured thinking.

Interviews with class teachers at RA Hj. Sri Musiyarti revealed that the use of coding games in learning is considered highly effective in stimulating computational thinking in children aged 5–6 years. The first teacher revealed that in the early stages of learning, many children were not yet accustomed to structured thinking and tended to choose steps randomly. However, after several coding sessions, the teacher noted a marked change, as the children began to be able to arrange steps more systematically and not simply follow intuition. According to the teacher, the children's understanding of the relationship between instructions and their consequences is evidence that the coding game successfully stimulated logical thinking skills gradually. This is consistent with the goal of learning computational thinking, which emphasizes simple algorithmic understanding in the context of play.

The teacher's further responses indicated that the coding game not only activates cognitive aspects but also provides a space for children to collaborate and discuss. In the interviews, the teacher stated that children often exchange ideas about the most effective game strategies, for example, determining the most efficient sequence of steps to ensure tokens move according to plan. The teacher believes that such interactions help children strengthen social skills, including communication and cooperation in small groups. Teachers also observed that children who initially struggled to follow along with their peers gradually learned to take turns and listen to others' ideas. Group activities in coding games provided a natural outlet for children to practice interpersonal skills while solving logical challenges.

In the subsequent interview, the teacher emphasized that the simple debugging phenomenon that occurs during coding activities is a crucial aspect demonstrating the effectiveness of this medium. The teacher explained that when children encounter results that do not match expectations, they do not immediately give up, but tend to evaluate each step they have taken. This process, according to the teacher, shows that children are beginning to understand that mistakes are part of the learning process and must be analyzed to find better solutions. This demonstrates the development of problem-solving skills that are not merely mechanical but also reflective. The teacher believes that this ability is an early sign of critical and systematic computational thinking.

Several teachers also observed that using coding games encouraged children to be more focused and patient in following a series of sequential activities. In interviews, teachers mentioned that children's focus and attention increased as they engaged in challenging yet enjoyable games. Children who typically bored quickly with conventional activities showed a strong interest in coding games because the game elements were interactive and provided immediate feedback on decisions made. Teachers noted that this type of interaction not only helped children understand logical structures but also expanded their attention span, which is an important foundation for further learning.

Overall, the interviews showed that teachers at RA Hj. Sri Musiyarti consistently viewed coding games as an effective learning medium for stimulating computational thinking in early childhood. Teachers agreed that this medium not only facilitated the gradual development of logical and algorithmic thinking skills but also enriched children's social and emotional skills. Teachers emphasized that the hands-on experience of constructing steps, evaluating errors, and discussing with peers was an effective combination that distinguished coding games from passive learning activities. Thus, this interview strengthens the research findings that coding games deserve to be integrated more systematically into the PAUD curriculum as a contextual and meaningful 21st-century learning strategy for children aged 5–6 years.

The research findings at RA Hj. Sri Musiyarti add empirical evidence to support this claim, particularly in the context of Indonesian education, which still lacks integration of computational literacy at the early childhood

education level. Thus, this study not only demonstrates the effectiveness of the media but also reinforces the urgency of integrating coding games into a more modern and digitally relevant early childhood curriculum.

Figure 1.1 shows a Coding Game Activity at RA Hj. Sri Musriyati.

The implementation of the coding game begins with the use of the Merdeka curriculum with the theme of Electronic Communication Devices, in the preparation center. Upon entering the classroom, children are prepared for prayer, then the teacher sets up the coding game and explains the rules. The core activity involves giving children a worksheet containing numbers for each color. The children then match the colors without numbers to add them together by referring to the color codes provided by the teacher. For example, on the worksheet, there are red and yellow; red represents the number one and yellow represents the number two, so the children can add one plus two, using the numbers derived from the red and yellow color codes. With the availability of coding games, children's thinking abilities improve, as indicated by children being able to understand addition correctly.

Overall, these results and discussion indicate that coding games significantly contribute to fostering the development of computational thinking in children aged 5–6 years. The learning process becomes more structured, collaborative, and meaningful. The cognitive, social, and emotional changes that emerge demonstrate that this medium is not only understood but also internalized by children through their direct experiences. This research provides a strong foundation for developing simple coding-based learning models in early childhood education (PAUD), both as core activities and as enrichment activities. In other words, coding games are not just a trend, but rather an effective and relevant pedagogical medium for 21st-century learning needs.

This research also shows that changes in children's mindsets occur not only due to physical activity but also due to the internalization of rules that emerge during coding play. Children begin to recognize that each instruction follows certain rules, thus learning to distinguish between "reasonable" steps and those that are unlikely to lead tokens to their goals. This understanding is one of the hallmarks of the emergence of logical thinking skills at an early age. When children begin to apply rules consistently, without prompting, it indicates the beginning of the process of forming mental schemas. In the context of early childhood education, this kind of thing shows that children are able to build concepts through direct experience, not through abstract explanations from teachers.

Furthermore, this study also shows that coding games help develop children's visual-spatial abilities. They not only follow instructions but also learn to mentally map distances, directions, and routes. When children move a token one square forward, they are actually translating concepts of direction and space into concrete actions. This ability is crucial for basic mathematical literacy, as it relates to measurement, direction, patterns, and visual

representation. Children who previously had difficulty seeing the relationship between starting and ending positions began to form mental images before planning their steps. This demonstrates significant progress in their ability to connect visualization and planning.

Coding games also indirectly strengthen children's executive functions, particularly in self-control, attention focus, and sequential memory. Children are required to concentrate on the given challenge, resist the urge to spontaneously move tokens, and remember multiple steps simultaneously (Djatmika, 2023). Activities like this are crucial for the development of executive functions, as children learn to delay impulsive responses, maintain focus, and process sequential instructions. In other words, coding games not only stimulate computational abilities but also increase children's capacity to manage higher cognitive processes.

Furthermore, this study revealed that coding games can accommodate various learning styles in children. Children who prefer movement have the opportunity to explore through token manipulation. Visual learners are supported by instructional symbols and grid patterns. Auditory learners are stimulated by discussions with teachers and peers when planning steps. Thus, this medium naturally adapts to the diverse learning characteristics of children without requiring major modifications. This strongly argues that coding games are an inclusive and developmentally friendly medium for early childhood development, especially in heterogeneous classroom environments.

On the other hand, this study also shows that the teacher's role remains crucial in guiding the learning process. Although coding games are self-directed and allow children to explore independently, teachers still play a role as facilitators, maintaining a structured flow of thought. Teachers assist children when they are confused, provide prompting questions, and guide reflection when children encounter errors (Meliala & Ahman, 2024). This role is crucial to ensure that children not only play but also gain conceptual understanding from the activity. These findings confirm that innovative media can never completely replace teachers' pedagogical sensitivity, but only enhance it.

Another additional finding is that coding games can reduce learning anxiety in some children. Some children, who are typically reluctant to engage in academic activities, appear more confident when participating in coding games. This occurs because coding games don't have the evaluative feel of worksheets or simple tests. Children feel like they're playing, not being tested. When learning anxiety is reduced, children's cognitive capacities actually function more optimally. In the context of early childhood education, this emotional state is crucial, as a positive mood lays the foundation for meaningful learning.

From a curriculum development perspective, this research demonstrates that coding games can be an alternative to small project-based learning. Children plan, try, evaluate, and improve. This cyclical process aligns with the experimentation and inquiry-based learning approach recommended in the Independent Curriculum. In other words, coding games can be incorporated as core activities in various themes, not just supplementary activities. This research demonstrates that even simple activities using inexpensive media can still produce profound learning experiences if designed with the right pedagogical approach.

More broadly, this research also demonstrates that young children actually possess a higher adaptability than adults often assume. Many teachers assume coding concepts are too abstract and too "technological." However, the results of this study show the opposite: when the media and activities are simplified into coding games, children are able to grasp the core concepts. This means that the limitations often attached to children's abilities actually stem more from adult perceptions, not from the children themselves. This finding has important implications for innovation in early childhood education: many advanced concepts can be introduced earlier when presented through play.

CONCLUSION

This study shows that coding games can serve as an effective socio-educational learning medium in stimulating the computational thinking skills of children aged 5–6 years. Through structured play activities, children are able to develop the ability to sequence steps, recognize patterns, predict the consequences of instructions, and perform simple debugging. In addition to cognitive aspects, coding games also contribute to strengthening children's social and emotional skills, particularly in cooperation, communication, and emotional management during the problem-solving process. These findings confirm that the development of computational thinking in early childhood can be carried out contextually without reliance on digital devices.

Theoretically, this research reinforces the view that computational thinking in early childhood is not limited to technological skills but is part of the cognitive and social development process that can be developed through play. The results of this study expand the socio-educational learning framework by positioning coding games as an integrative tool for children's logical thinking, social interaction, and emotional regulation within the context of early childhood education.

Practically, the findings of this study provide an alternative for early childhood education (PAUD) teachers in designing learning that encourages the development of computational thinking skills in a natural and enjoyable way. Coding games can be integrated into thematic learning activities without requiring complex digital tools, making them easy to implement in various PAUD units. Furthermore, this approach encourages the role of teachers as facilitators, supporting children's thinking processes through interaction, discussion, and reflection during play activities.

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