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Unplugged Coding as an Innovative Approach to Creative Learning in Kindergarten: A Case Study at TK Kristen 1 Satya Wacana Salatiga

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ABSTRACT
This study examines the implementation of unplugged coding as an innovative approach to creative learning in early childhood education at TK Kristen 1 Satya Wacana Salatiga. A mixed-methods case study design was employed to explore children's learning processes and describe changes in their performance during unplugged coding activities. The study focused on three concepts: reading and understanding rules, basic programming algorithms, and layered combinations. Data were collected through observations during pre-test and post-test activities, with the pre-test conducted without instructional guidance and the post-test following teacher explanations and demonstrations. The findings showed that, during the pre-test, only two children could follow color-coded directional instructions, while eight children could correctly interpret instructions for assembling a flower plant. In the layered combination activity, three children could interpret visual patterns and complete the assigned tasks. Post-test observations indicated improved performance across the three concepts following teacher guidance. These findings suggest that unplugged coding activities, supported by appropriate scaffolding, may help children develop foundational computational thinking skills, including sequencing, pattern recognition, and logical reasoning. However, further quantitative analysis is needed to determine the extent of improvement. This study highlights the potential of unplugged coding as a playful learning approach in kindergarten.

Keywords: Unplugged Coding, Innovative Creative Learning, Early Childhood Education.

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1. INTRODUCTION

In the era of globalization and rapid technological advancement, early childhood education is required to continuously innovate in order to optimize the potential for creativity and critical thinking skills from a young age. Learning can no longer rely solely on traditional methods; interactive and contextual approaches are key to creating a fun and effective learning environment (Muhammad Hafeez, 2021). One such innovation is unplugged coding, which is a method of introducing basic programming concepts through physical activities and games without the use of electronic devices (Akiba, 2022). This concept is rooted in the constructivist theory which emphasizes the importance of learning through direct experience and active exploration (Zhang et al., 2025). Previous studies have highlighted the potential of unplugged coding to support the development of computational thinking in early childhood education. In a systematic literature review, evidence that both plugged and unplugged approaches can support young children's computational thinking, with concrete learning experiences offering particular advantages in early childhood contexts (Bati, 2022). Unplugged coding activities based on everyday experiences enabled children aged 5–6 years to follow instructions, seek solutions to problems, explain their activities, and collaborate with peers (Fitriyah et al., 2026). These findings suggest that unplugged coding can provide opportunities for children to develop foundational computational thinking skills through concrete, play-based experiences without relying on digital devices.

The issue that arises is that although unplugged coding has been adopted in various educational institutions to develop children's logic and creativity, its implementation in early childhood education in Indonesia is still relatively limited (Siagian & Adriany, 2020). At TK Kristen 1 Satya Wacana Salatiga, although there have been innovative efforts through the use of unplugged coding, there are still shortcomings in evaluating the effectiveness of this method. The main questions to be answered include: How is the implementation process of unplugged coding in the environment of TK Kristen 1 Satya Wacana Salatiga? To what extent does this method enhance children's creativity, logic, and problem-solving skills? And what are the perceptions of teachers and parents regarding the implementation of this innovative method? Concerns about the suitability of the learning method with the characteristics of young children and resource limitations also present a unique challenge (Vidal-Hall et al., 2020).

Although previous studies have explored the potential of unplugged coding for developing computational thinking in early childhood, further investigation is needed to document how specific coding concepts are translated into concrete classroom activities and how children respond to these activities before and after teacher guidance. In particular, the present study focuses on three learning concepts: reading and understanding rules, basic programming algorithms, and layered combinations. By examining these activities in the context of TK Kristen 1 Satya Wacana Salatiga, this study seeks to provide a context-specific account of the implementation process and children's observed performance. Rather than assuming that the approach is universally effective, the study documents children's responses to the activities and explores the potential contribution of teacher guidance to their understanding of basic coding concepts.

This study aims to examine the implementation of unplugged coding as a creative learning approach at TK Kristen 1 Satya Wacana Salatiga. Specifically, it seeks to: (1) describe the implementation of unplugged coding activities involving reading and understanding rules, basic programming algorithms, and layered combinations; and (2) document changes in children's observed performance between the pre-test and post-test activities, particularly in following instructions, sequencing steps, and interpreting visual patterns. Through these objectives, the study aims to provide a context-specific understanding of how unplugged coding activities and teacher guidance can support the introduction of foundational computational thinking concepts in kindergarten learning.

This study contributes to early childhood education research by providing a detailed account of how unplugged coding can be implemented through concrete, play-based activities in a kindergarten setting. Its findings may help early childhood educators design learning experiences that introduce basic computational thinking concepts through directional instructions, sequential tasks, and visual patterns without requiring digital devices. The study may also provide practical insights into the role of teacher guidance in helping children understand and engage with these activities. Although the findings are context-specific, they may inform further research and classroom practice concerning the integration of unplugged coding into developmentally appropriate early childhood learning.

Through a thorough analysis of the implementation and impact of unplugged coding, the case study at TK Kristen 1 Satya Wacana Salatiga is expected to encourage a rethinking of traditional learning approaches and inspire the development of creative learning models that align with the dynamics of technological advancement and the character needs of today's children.

2. METHOD

This study employed a qualitative case study design supported by descriptive quantitative analysis to examine the implementation of unplugged coding activities at TK Kristen 1 Satya Wacana Salatiga. The qualitative component focused on describing children's interactions, responses, and learning processes during the activities, while the descriptive quantitative component summarized the number of children who successfully completed each activity during the pre-test and post-test phases. The study examined three foundational coding concepts: reading and understanding rules, basic programming algorithms, and layered combinations. This approach enabled the researchers to describe the implementation process and compare children's observed performance before and after teacher guidance.

The study was conducted at TK Kristen 1 Satya Wacana Salatiga and involved six kindergarten children aged 5–6 years. The research focused on children's participation and performance during unplugged coding activities designed to introduce foundational programming concepts through physical activities and visual instructions. The classroom learning activities served as the primary context for observing children's responses, understanding of instructions, sequencing abilities, and interpretation of visual patterns.

The research procedures consisted of preparation, pre-test activities, teacher-guided learning activities, and post-test observations. During the preparation stage, the researcher designed unplugged coding games and prepared simple learning materials, including colored cards, directional arrows, picture cards, and visual pattern worksheets.

During the pre-test phase, the six children were invited to participate in the activities without receiving prior explanations about how to complete the tasks. The researcher observed their ability to interpret visual instructions, follow directional commands, arrange steps in sequence, and recognize patterns.

Following the pre-test, the educator provided explanations and demonstrations of the rules and procedures for each activity. The children then participated in the guided learning activities. During the post-test phase, their performance was observed again to document the number of children who successfully completed each activity after receiving instructional guidance. The three coding concepts were incorporated into a combined game called Treasure Hunt Adventure.

Data were collected through classroom observations recorded on observation sheets during the pre-test and post-test activities. The observations focused on children's ability to follow directional instructions, understand task rules, arrange sequential steps, and interpret visual patterns. The quantitative data were summarized by counting the number of children who successfully completed each activity in both phases. The results were then compared descriptively to identify changes in children's observed performance following teacher guidance. Qualitative observation notes were

analyzed by selecting relevant information, organizing the observations according to the three coding concepts, and presenting the findings narratively. The quantitative summaries and qualitative descriptions were interpreted together to provide an overview of children's learning processes and responses to unplugged coding activities.

3. RESULTS AND DISCUSSION

Results

Research was conducted on Monday, June 16, 202 at TK Kristen 1 Satya Wacana. The educator introduced unplugged coding learning to 6 kindergarten students, focusing on 3 main concepts: the Concept of Reading and Understanding The Rule, the Concept of Basic Programming Algorithms, and the Concept of Layered Combination. The research was carried out in 2 stages: Pre-Test and Post-Test. In the Pre-Test, the educator presented various games they would play without explaining how to play them. The students were asked to observe these games and then attempt to play according to their understanding. In other words, they were to translate the instructions through the images in the games. The educator would then observe the playing methods presented by each student and record the results as observations. Meanwhile, the Post-Test involved the students receiving information about how to play the various games.

1. Concept of Reading and Understanding the Rule

Simply put, this concept is designed to train reading skills and understanding instructions, correctly following directions, and enhancing students' problem-solving abilities. The tools and materials required include: colored cards and arrows (red-up, blue-left, yellow-right, green-down), picture cards of mountains (arranging flowers), and picture cards of rivers (jump 1 time).

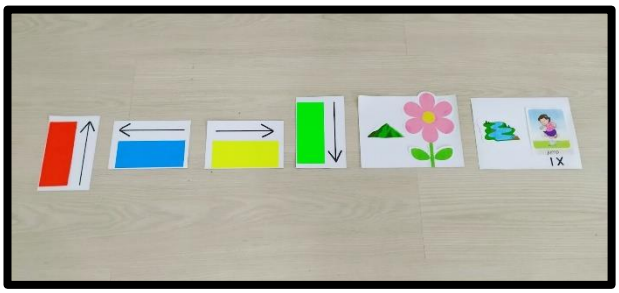


Fig 1. Concept Reading And Understanding

2. Basic Programming Algorithms Concept

In this concept, students are trained to develop logical thinking, enhance skills in arranging sequential instructions, and improve problem-solving abilities.



Fig 2. Algoritmits Concept

3. Layered Combination Concept

The various games in this concept are designed to train children to understand the concepts of structure and sequence, as well as to develop pattern and logic skills.

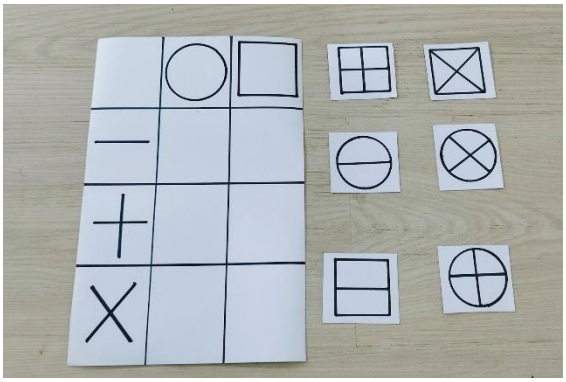


Fig 3. Combination Concept

The three parts of the play variety were then designed into a complete play variety titled '**TREASURE HUNT ADVENTURE**.'

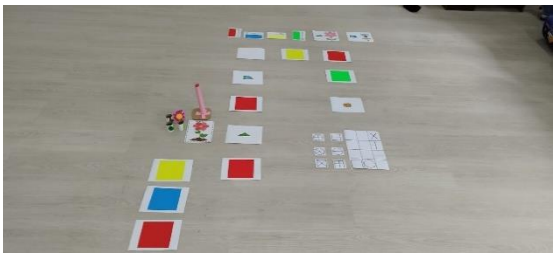


Fig 4. Concept Treasure Hunt Adventure

PRE-TEST

In the pre-test phase, the researcher observes the unplugged coding play activities designed to test three main aspects: the ability to read and understand rules, the introduction of basic programming algorithms, and the application of layered combination concepts. During this Pre-Test phase, students are given the opportunity to read the instructions and understand how to play based on their own comprehension without any information on how to play from the educator.

When the children see the various play activities prepared by the educator, all the children are enthusiastic and curious to play. In the aspect of reading and understanding the rules, students are invited to walk following the direction of the arrows indicated by color. Observations show that only 2 students were able to read and follow the instructions indicated by color and the direction of the arrows. They examined the instruction images several times before playing to ensure they followed the visual instructions correctly. Meanwhile, the majority of students could not identify the meaning of the color and arrow instructions.

For the aspect of basic programming algorithms, the pre-test was directed to assess the children's ability to understand and follow a sequence of steps logically. Observations found that most children could follow the sequence in a structured manner, indicating an understanding of basic algorithm concepts. In this play activity, 8 students were able to read the instructions correctly. They could assemble parts of a flower plant into a complete flower plant. However, 2 children struggled to understand the instructions through the presentation of the parts of the flower plant.

In the aspect of *layered combination*, the children were encouraged to understand patterns and logic. 3 students were able to interpret the visual instructions presented. They could read patterns and use logic to complete the worksheets provided.

Overall, the pre-test results indicate that only a small portion of the students were able to translate instructions through images and patterns without direct information or instructions from the educator. The students do not yet have a sufficiently strong foundational understanding of the rules and sequence of unplugged coding activities. They also need to develop their ability to integrate the steps. These findings provide an initial picture of the potential and areas that need to be strengthened in the implementation of unplugged coding learning in the classroom, as well as serve as a reference for designing more interactive teaching strategies that support the development of computational skills in early childhood.



Fig 5. Reading and Understanding The Rule



Fig 6. Basic Programming Algorithms



Fig 7. Layered Combination

POST-TEST

In the Pre-Test Phase, students did not receive information on how to play from the educator; however, in the Post-Test Phase, students received an explanation of the instructions for playing the game. The educator explained detailed instructions for each type of play in each unplugged coding concept. In the post-test stage, observations showed a significant increase in students' understanding and skills in the game "TREASURES HUNT ADVENTURE."

In terms of reading and understanding the rules, the children appeared more fluent and confident in reading and comprehending the instructions provided. They not only followed the commands mechanically but were also able to explain the meaning behind each rule in their own words. Some children even began to engage in small discussions about the logic behind the sequence of commands, indicating a deeper development of conceptual understanding.

In terms of basic programming algorithms, the results of the post-test observation indicate that the children are now better able to identify and organize instructional steps logically. They can accurately determine the correct sequence in assembling a complete flower arrangement. This improvement is evident when the children successfully complete tasks involving more than two steps with minimal assistance, indicating that basic algorithm concepts such as sequencing and repetition have begun to take root in their thinking.

On the aspect of layered combinations, the children demonstrate better abilities in understanding and completing the various play activities provided. Educators do not need to offer assistance for them to complete tasks in their play activities



Fig 8. Explanation & Instruction



Fig 9. Reading and Understanding The Rule



Fig 10. Basic Programming Algorithms

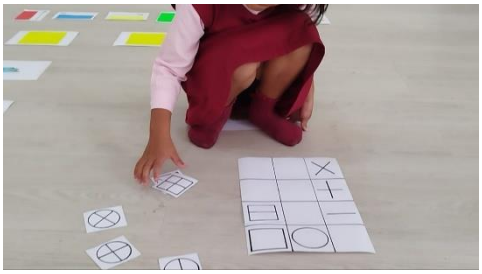


Fig 11. Layered Combination

Overall, the results of the post-test observations reflect a positive advancement in three main aspects of unplugged coding. This development indicates that through interactive and game-based learning methods, students of TK Kristen 1 Satya Wacana not only mastered the rules and instructional sequences but also began to internalize programming concepts comprehensively. These findings support the effectiveness of the unplugged coding approach as a means to develop computational skills from an early age.

In terms of layered combination, the children demonstrated improved abilities in understanding and completing the various games provided. Educators did not need to assist them in completing tasks related to their games.

DISCUSSION

The findings of this study illustrate how unplugged coding activities can introduce foundational computational thinking concepts to kindergarten children through concrete, play-based experiences. The three activities (reading and understanding rules, basic programming algorithms, and layered combinations) required children to interpret instructions, follow sequences, and

recognize visual patterns. These activities are relevant to early computational thinking because they encourage children to organize information and follow logical steps without requiring digital devices (Bati, 2022), in a systematic literature review, reported that unplugged approaches can support computational thinking development in early childhood, particularly through concrete learning experiences. Similarly, with the result of research that unplugged coding activities based on everyday experiences provided opportunities for children to follow instructions, seek solutions, explain their activities, and collaborate with peers (Fitriyah et al., 2026). Furthermore, a systematic review by (Paraskevopoulou-Kollia et al., 2025) identified unplugged and technology-based coding activities as prominent approaches to fostering CT among preschool and primary school children, while highlighting variations in assessment methods. The present study adds a context-specific account of how these foundational concepts can be introduced through structured games in a kindergarten classroom.

The findings related to reading and understanding rules highlight the importance of making instructions accessible to young learners. During the pre-test, only two of the six children were able to follow the color-coded directional instructions correctly. This observation suggests that interpreting visual symbols and translating them into appropriate actions may require explicit learning support for some children. In unplugged coding activities, directional arrows function as representations of commands, requiring children to connect a visual symbol with a corresponding movement. Furthermore, unplugged coding activities supported computational thinking and problem-solving skills among preschool children aged 5–6. These findings highlight the value of providing concrete visual cues, clear instructions, and appropriate teacher guidance when introducing coding concepts to young learners (Saygıner & Tüzün, 2025). Unplugged learning activities helped preschool children develop an understanding of computational concepts, including sequences, through structured learning experiences (Moreno-León et al., 2025). These findings support the use of concrete, hands-on tasks, such as arranging flower components, to introduce algorithmic thinking in kindergarten.

Computational thinking and programming activities can support young children's development when learning experiences are appropriate to their developmental stage. In the present study (Bati, 2022), the flower arrangement activity provided a concrete context for introducing sequential instructions without requiring children to use programming software. However, the extent to which children's performance improved after teacher guidance should be interpreted using the verified pre-test and post-test observations.

The layered combinations activity introduced children to visual patterns and the relationships among elements within a task. During the pre-test, three of the six children were able to interpret the visual instructions and complete the worksheets. This finding indicates that children differed in their ability to interpret and apply visual patterns independently. Pattern recognition is an important component of early computational thinking because it helps children identify relationships and use those relationships to complete a task. The findings are consistent with the broader literature on unplugged coding, which identifies pattern-based activities, directional games, and simple algorithms as common strategies for introducing computational thinking in early childhood education (Azizah & Putra, 2026). These activities may provide meaningful opportunities for children to practice logical reasoning through concrete materials and visual representations.

Teacher guidance is an important pedagogical consideration in implementing unplugged coding in kindergarten. In this study, the pre-test activities were conducted without prior explanations, whereas the subsequent learning activities involved explanations and demonstrations from the educator. This sequence provided an opportunity to observe how children responded to the activities under different instructional conditions. Teacher guidance can help children understand the meaning of symbols, identify task requirements, and organize the steps needed to complete an activity.

The findings have practical implications for kindergarten teachers who wish to introduce computational thinking through developmentally appropriate learning experiences. Directional games, sequential tasks, and visual pattern activities can be incorporated into classroom learning using simple materials that do not require electronic devices. Teachers can begin by demonstrating basic instructions and gradually encourage children to interpret symbols and complete tasks independently. However, this study has several limitations. It involved only six children in one kindergarten setting, and the findings were based on classroom observations and descriptive counts of successful performance. In addition, the absence of a control group and the limited quantitative data restrict the conclusions that can be drawn about the effectiveness of the approach. Future studies could involve a larger number of participants, clearer performance criteria, and more systematic comparisons between learning phases to provide stronger evidence regarding the contribution of unplugged coding to early computational thinking development.

4. CONCLUSION

Based on the implementation of the unplugged coding case study at TK Kristen 1 Satya Wacana in Salatiga, it can be concluded that this method is effective in enhancing the foundational coding skills of early childhood children. In the pre-test phase, students showed limitations in reading and independently translating instructions through images and patterns. However, after being given clear guidance, explanations, and instructions in the post-test phase, there was a significant improvement in reading and understanding rules, constructing logical steps (basic algorithms), and applying layered combination patterns. This emphasizes that the role of educators in providing directed instructions is crucial for optimizing children's understanding and creativity in unplugged coding activities.

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