



The Implementation of Unplugged Coding Hijaiyah to Improve the Computational Skills of Children Aged 5–6 Years in the Era of KKA

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Abstract

This study aims to analyze the effectiveness of implementing Unplugged Coding Hijaiyah worksheets in improving computational skills among children aged 5–6 years at PAUDQ Nurfadlillah Tuban, particularly within the context of the KKA Era (Coding and Artificial Intelligence). This research employed a Classroom Action Research (PTK) design conducted in three phases: pre-cycle, Cycle I, and Cycle II. Research instruments consisted of structured observations, computational skill assessment sheets, and documentation of children's learning activities. The pre-cycle findings indicated that children's computational skills were still low, as evidenced by difficulties in sequencing, recognizing patterns, and completing tasks based on logic and problem-solving. In Cycle I, after the gradual introduction of the Unplugged Coding Hijaiyah worksheets, improvements were observed in logical and algorithmic thinking through manipulative activities supported by teacher scaffolding. The most significant improvement occurred in Cycle II, when worksheets were applied independently and collaboratively, enabling children to arrange complex Hijaiyah letter patterns, predict solutions, evaluate their steps, and work effectively in groups. In addition to promoting computational skills, the learning process strengthened religious literacy and spiritual values through the integration of Hijaiyah letters into cognitive activities. These findings confirm that the Unplugged Coding Hijaiyah worksheet represents an innovative and effective learning strategy to prepare young learners for the rapid development of digital technology while supporting the formation of Islamic character. This model is recommended as an alternative instructional approach in early childhood education to develop higher-order thinking skills from an early age in a holistic and contextual manner.

Keywords:

Unplugged Coding Hijaiyah; Computational Thinking; Early Childhood

A. INTRODUCTION

The rapid advancement of technology in the 21st century has transformed nearly all sectors of life, including early childhood education. The transition toward the digital and artificial intelligence era requires younger generations to possess fundamental competencies in computational skills from an early age. These skills include logical reasoning, sequencing ability, algorithmic thinking, problem-solving, and pattern recognition, all of which significantly contribute to children's academic readiness and higher-order thinking development in the future. However, despite the global urgency of embedding computational skills in early childhood learning, educational practices in Indonesia particularly in Islamic-based institutions have not fully adopted learning approaches that are able to stimulate these abilities systematically and

sustainably. This condition reflects a clear gap between the competencies required by future generations and the pedagogical approaches implemented in practice.

At the same time, the world of education is currently entering a new reality known as the KKA Era (Coding and Artificial Intelligence), a phase in which computational thinking becomes an inseparable part of children's intellectual development and technological readiness. This era does not merely demand mastery of digital devices, but requires structured, strategic, logical, and reflective thinking as the foundation for navigating future advances in programming and AI. Therefore, early childhood education can no longer focus solely on developing literacy and numeracy; it must also address the development of abilities related to problem-solving, decision-making, and independent planning.

Unplugged coding emerges as a pedagogical innovation that introduces computational thinking through games, physical activities, and concrete manipulatives without digital devices. This model not only serves as an alternative to minimize excessive screen exposure but has also been proven to increase cognitive engagement because children participate actively mentally and emotionally while solving problems. Recent studies show that unplugged coding effectively develops children's ability to construct algorithms, recognize patterns, detect errors, and plan strategies independently (Karimah, 2025; Mutoharoh et al., 2023; Rahmawati & Agustin, 2024; Rahmawati & Kurniati, 2024). Nevertheless, contemporary literature still demonstrates a scarcity of research on integrating unplugged coding within religion-based learning, particularly Hijaiyah literacy, indicating a significant academic gap that requires further exploration.

In the context of Islamic-based early childhood education, the integration of computational learning and religious literacy presents a strategic opportunity to balance technological proficiency and spiritual character. One innovation that represents this integration is *Unplugged Coding Hijaiyah*, which combines algorithmic thinking and sequencing activities with the learning of Hijaiyah letters through educational games. Through this approach, children do not only learn the shapes and sounds of the letters but also process them as symbols that can be logically sequenced, mapped, and categorized. Algorithmic learning of Hijaiyah letters does not merely improve the recognition of Islamic symbols but also strengthens children's emotional engagement and spiritual identity through learning experiences that are aligned with the religious culture of the institution.

Unfortunately, the implementation of this model within Qur'an-based early childhood education institutions in Indonesia remains very limited. Most Hijaiyah learning still focuses on memorization (drill and repetition), lecturing, and passive worksheets. As a result, children's critical thinking, creativity, independence, and problem-solving abilities do not develop optimally. When children are only asked to repeat without analyzing, the literacy process becomes shallow and lacks meaningful engagement.

These conditions are consistent with previous studies. Dwistia, (2022) found that the drill method in Hijaiyah learning increases short-term memory but does not build conceptual understanding or reflective abilities. Putri & Suriani, (2024) also demonstrated that one-way instruction leads children to become passive, dependent on the teacher, and lacking confidence in completing tasks independently. In another study, Susanto & Usman, (2024) showed that algorithmic sequencing through game-based learning significantly enhances problem-solving skills, pattern prediction, and concentration. In relation to computational thinking in early childhood education, Lestari et al., (2024) concluded that unplugged coding consistently improves children's abilities to arrange step-by-step instructions, detect logical errors (debugging), and design strategies to complete tasks. Meanwhile, Muttaqin, (2024) highlighted that screen-free computational activities are more effective than device-based digital activities because they provide stronger multisensory experiences, improve social interaction, and foster independent learning.

However, within Islamic education institutions, studies that integrate Hijaiyah learning with computational thinking remain scarce. Only a few studies have addressed this integrative aspect. Arahma, (2025), for example, developed a "Hijaiyah Maze" medium based on step-by-step sequencing and reported improvements in letter recognition and algorithmic thinking.

Nevertheless, their study did not explore the development of problem-solving skills in depth. Another study by Nasution, (2020) revealed that Hijaiyah learning through logic-based games improved children's spiritual motivation but did not explicitly integrate computational concepts. Therefore, there is still no comprehensive study on the implementation of *Unplugged Coding Hijaiyah* as a model that simultaneously develops computational abilities and religious literacy. This research gap indicates the urgent need for a pedagogical approach that not only teaches Hijaiyah literacy but also optimizes algorithmic thinking, systematic logic, and problem-solving skills while remaining rooted in Islamic values.

Preliminary observations at PAUDQ Nurfadlillah Tuban further reinforce this urgency. Computational abilities of children aged 5–6 years remain low; children have difficulty following sequential instructions, predicting patterns, understanding cause-and-effect relationships, and completing tasks that require step-by-step strategies. In problem-solving activities, most children are still highly dependent on teacher assistance and are unable to evaluate or revise strategies independently. This indicates that their logical, systematic, and reflective thinking skills have not yet developed optimally. In addition, Hijaiyah learning is still dominated by memorization and worksheets, causing children to become passive and insufficiently stimulated to think critically or explore learning experiences. The gap between 21st-century competency demands and traditional Hijaiyah instructional methods reflects an instructional problem that requires an innovative, contextual, and value-based learning solution.

Within this framework, *Unplugged Coding Hijaiyah* becomes highly relevant as a learning alternative that is adaptive to technological development while maintaining Islamic educational identity. This model offers playful, exploratory, participatory, and screen-free learning experiences while stimulating children's ability to structure steps, identify patterns, evaluate outcomes, revise strategies, and think reflectively. Children do not merely memorize letters; they engage in higher-order mental processes that require analysis, prediction, and decision-making. This approach also promotes social collaboration, peer communication, independence, and spiritual internalization through meaningful learning activities that foster enjoyment without abandoning the religious context. Furthermore, this model has the potential to support the development of long-term thinking skills relevant to future technological advancements while preserving children's spiritual identity.

Therefore, this study specifically aims to address the research gap regarding the integration of computational thinking and Hijaiyah literacy within Islamic-based early childhood education. The novelty of this study lies in the application of *Unplugged Coding Hijaiyah* as a learning model that simultaneously optimizes computational skills and Islamic literacy among children aged 5–6 years through a screen-free, active, exploratory, and contextual pedagogical approach. This innovation is clearly reflected in the research title “The Implementation of Unplugged Coding Hijaiyah to Improve Computational Skills of Children Aged 5–6 Years in the Era of KKA (Coding and Artificial Intelligence).”

B. METHODS

This study employed a Classroom Action Research (PTK) design because it aimed to improve the learning process directly through iterative and reflective actions. According to Kemmis and McTaggart, PTK consists of cycles of planning, action, observation, and reflection to enhance instructional quality (Widayati, 2008). Arikunto also emphasizes that PTK is designed to solve real instructional problems through systematic intervention to produce improvements in both the learning process and learning outcomes (Syaifudin, 2021). PTK was chosen as the appropriate method to evaluate the implementation of Unplugged Coding Hijaiyah progressively until the learning success indicators were achieved.

The study consisted of three major stages: pre-cycle, Cycle I, and Cycle II. The pre-cycle aimed to identify the initial condition of Hijaiyah learning and children's problem-solving skills before the implementation of the intervention. At this stage, observations were conducted on traditional memorization-based learning and baseline assessments were carried out to evaluate children's ability to recognize patterns, sequence letters, determine strategies to complete tasks,

and correct mistakes. The pre-cycle findings indicated that children's problem-solving skills were still low; therefore, an algorithmic-based learning intervention was needed.

Cycle I was implemented in three meetings through the stages of planning, action, observation, and reflection. In the planning stage, the researcher designed Unplugged Coding Hijaiyah instructional tools consisting of patterned letter cards, a grid-based instruction board, and algorithmic activity guidelines. During Cycle I, learning focused on introducing basic algorithmic patterns by asking children to organize letter routes according to simple step-by-step instructions. During the observation stage, the researcher examined children's engagement, ability to follow instructions, and independence in solving educational challenges. The reflection stage revealed increased motivation and emerging pattern recognition; however, some children still required substantial guidance when facing more complex algorithmic instructions. Therefore, improvements were planned for Cycle II.

Cycle II was also carried out in three meetings, with a focus on enhancing independence, strategic problem-solving, and self-correction. The intervention in Cycle II involved tasks with higher complexity, including color-coded instructions, branching patterns, and collaborative missions. Children were encouraged to work more independently and in teams to arrange Hijaiyah letter routes based on more varied algorithmic instructions and to explain the reasoning behind their chosen strategies. Observations during Cycle II showed improvements in children's ability to identify problems, determine logical steps, evaluate strategies, and modify them when necessary. The reflection stage concluded that the targeted problem-solving skills had been achieved, and thus the study was terminated after Cycle II.

This study was conducted with full ethical consideration, including obtaining parental consent, providing child-friendly explanations of activities, protecting the confidentiality of students' identities, and ensuring that all learning activities were non-discriminatory and psychologically safe. Ethical aspects are crucial because the study involved young children as research participants. In addition, the observation instrument was described in detail to ensure the accuracy of measurement. The instrument consisted of an observation sheet of children's problem-solving skills with four indicators: (1) ability to identify problems and task objectives, (2) ability to develop step-by-step strategies, (3) ability to execute steps and correct errors, and (4) independence in completing tasks. Scoring was conducted using a 1–4 rubric (not developed, emerging, developed as expected, highly developed) along with a behavioral description column to document children's real learning behaviors. The instrument also included documentation of learning activities and anecdotal notes to capture children's cognitive behaviors more holistically.

Furthermore, data validation was strengthened through triangulation procedures, including technique triangulation (observation, documentation, and performance assessment), source triangulation (class teacher, researcher, and assistant), and member checking through reflective discussions with the teacher to ensure consistency of observational findings with children's actual development. These procedures ensured that the collected data were accurate and not biased by a single evaluator.

The methodological approach of this study aligns with (Putri et al., 2024), who noted that algorithmic-based learning enhances children's systematic thinking and problem-solving skills. Rabbana et al., (2025) also emphasized that unplugged instructional approaches allow children to understand computational concepts without digital devices while still developing higher-order cognitive skills. Ariani et al., (2025) affirmed that game-based learning strengthens motivation and builds independence in completing tasks. Through the cycle-based CAR model, ethical compliance, and rigorous data validation, this research provides credible and relevant findings regarding the enhancement of early childhood problem-solving skills through Unplugged Coding Hijaiyah.

C. RESULT & DISCUSSION

Result

1. Initial Condition of Children's Computational Skills

During the pre-cycle stage, preliminary observations were carried out to map the basic skills of children aged 5–6 before the implementation of the *Unplugged Coding Hijaiyah* worksheets. The results showed that most children were still accustomed to passive memorization and conventional worksheets, which limited their ability to think logically, recognize patterns, and sequence Hijaiyah letters. Learning activities prior to the intervention focused mainly on memorizing the letters without involving children in algorithmic thinking or problem-solving processes. Based on the pre-cycle worksheet assessment, only approximately 36% of the children were able to complete the tasks correctly, such as copying letter sequences, marking simple patterns, or grouping letters based on certain categories. The children also demonstrated high dependence on the teacher and passive learning behaviors. These findings align with Mumun et al., (2025), who emphasizes that children learn most effectively through direct experiences that stimulate active engagement, interaction, and creativity. This initial condition highlights the need for innovative learning methods that integrate computational skills and Islamic literacy from an early age.

2. Introduction of Basic Concepts Through the Unplugged Coding Hijaiyah Worksheets

Cycle I focused on introducing the foundational concepts of computational thinking, particularly sequencing, pattern recognition, and following simple instructions through *Unplugged Coding Hijaiyah* worksheets. In the first session, children completed worksheets that required them to follow letter sequencing commands, identify correct steps, and complete simple patterns. Approximately 50% of the children successfully completed the task, demonstrating initial understanding of order and logic. In the second session, direct scaffolding was provided to support children who faced challenges, resulting in 67% of the children being able to arrange the letter sequences accurately, indicating significant progress in algorithmic thinking. The third session emphasized repeated pattern recognition such as the sequence “Alif–Ba–Alif–Ba” which led to 73% of the children successfully identifying and completing the repeated patterns.

Overall, children's average computational skill level increased to 63% after Cycle I. These findings indicate that the use of interactive and contextual worksheets effectively enhances logical reasoning and analytical abilities while simultaneously strengthening Hijaiyah literacy and spiritual values. This is in line with Yuliana, (2024), who asserts that computational thinking can be developed from an early age through meaningful activities that integrate exploration, analysis, and creativity.

3. Implementation of the Unplugged Coding Hijaiyah Worksheets to Improve Computational Skills of Children Aged 5–6 in the KKA Era

Cycle I focused on introducing the foundational concepts of computational thinking, particularly sequencing, pattern recognition, and following simple instructions through *Unplugged Coding Hijaiyah* worksheets. In the first session, children completed worksheets that required them to follow letter sequencing commands, identify correct steps, and complete simple patterns. Approximately 50% of the children successfully completed the task, demonstrating initial understanding of order and logic. In the second session, direct scaffolding was provided to support children who faced challenges, resulting in 67% of the children being able to arrange the letter sequences accurately, indicating significant progress in algorithmic thinking. The third session emphasized repeated pattern recognition such as the sequence “Alif–Ba–Alif–Ba” which led to 73% of the children successfully identifying and completing the repeated patterns. Overall, children's average computational skill level increased to 63% after Cycle I. These findings indicate that the use of interactive and contextual worksheets effectively

enhances logical reasoning and analytical abilities while simultaneously strengthening Hijaiyah literacy and spiritual values. This is in line with Lamatokan et al., (2025), who asserts that computational thinking can be developed from an early age through meaningful activities that integrate exploration, analysis, and creativity.

Discussion

The results of the study show that the implementation of the *Unplugged Coding Hijaiyah* worksheets significantly improved the computational skills of children aged 5–6 at PAUDQ Nurfadlillah Tuban, particularly in preparing them to face the demands of the KKA Era (Coding and Artificial Intelligence). The developmental analysis was carried out through three main stages pre-cycle, Cycle I, and Cycle II which demonstrated a progressive increase in children's logical thinking, algorithmic reasoning, problem-solving ability, Hijaiyah literacy, and spiritual values.

In the pre-cycle stage, the initial condition revealed that the learning process previously applied tended to be passive and memorization-oriented. Children were only introduced to Hijaiyah letters by imitation and repetition without being involved in activities that encouraged logical thinking or sequential processing. Diagnostic worksheets showed that only 36% of the children were able to complete the tasks correctly, such as copying letter sequences, identifying simple patterns, or grouping specific letters. Children showed strong dependence on teacher guidance and lacked initiative in completing tasks independently. These findings confirm Lamatokan et al., (2025) constructionism theory, which emphasizes that higher-order thinking can only develop when children are actively involved in meaningful and challenging learning activities.

Cycle I focused on introducing basic concepts of computational thinking through worksheets that required children to follow instructions, arrange sequences, and identify repeated patterns. Children's abilities increased gradually in each meeting. In the first meeting, 50% of the children successfully understood the sequencing patterns presented in the worksheet. In the second meeting, with the use of scaffolding strategies, the completion rate increased to 67%, demonstrating a positive response to guided learning. In the third meeting, repetitive pattern exercises such as "Alif-Ba-Alif-Ba" resulted in 73% of the children completing the tasks accurately. This improvement indicates that structured and repetitive practice combined with manipulatives-based worksheets is effective in building children's logical and algorithmic thinking foundations while strengthening Hijaiyah literacy and spiritual habituation. These findings support Kempirmase & Firman, (2025), who asserts that computational thinking can begin to be developed during early childhood through meaningful activities.

Cycle II aimed to extend computational challenges by providing worksheets that promoted advanced thinking strategies, problem-solving, and collaborative work. In the first meeting of this cycle, 80% of the children successfully arranged more complex sequences without significant errors. The second meeting required children to identify extended patterns and determine their own completion strategies, raising the success rate to 87%. In the third meeting, worksheets were completed collaboratively with assigned roles (leader, executor, and observer), enabling children not only to solve algorithmic tasks but also to develop communication, cooperation, and self-reflection. By the end of Cycle II, 93% of the children had achieved mastery of computational skills. To illustrate children's developmental progress throughout the study, the percentage increases are presented in the following table:

Table 1. Percentage Improvement of Children's Computational Skills through the Unplugged Coding Hijaiyah Worksheet

Learning Cycle	Average Percentage of Achievement	Development Category
Initial (Pre-Action)	36%	Low
Cycle I – Meeting 1	50%	Beginning to Develop
Cycle I – Meeting 2	63%	Developing
Cycle II – Meeting 1	80%	Developing Very Well
Cycle II – Meeting 2	87%	Developing Very Well
Final (Post-Action)	93%	Highly Developed / Optimal

The improvement shown at each stage demonstrates that the *Unplugged Coding Hijaiyah* worksheets are an effective approach for developing computational skills from early childhood. Beyond logical thinking, algorithmic reasoning, and problem-solving, this learning model simultaneously strengthens Hijaiyah literacy, collaboration skills, and the internalization of spiritual values. The learning process remains gadget-free yet aligns with future competencies, addressing the demands of 21st-century education that emphasize creativity, communication, critical thinking, and collaboration. In conclusion, this study proves that the integration of the *Unplugged Coding Hijaiyah* worksheets can create a learning experience that is simultaneously cognitive, technological, social, and religious. Therefore, it is a relevant and applicable strategy for early childhood education in the KKA Era.

D. CONCLUSION

Based on the results of the study conducted through three phases pre-cycle, Cycle I, and Cycle II it can be concluded that the implementation of the Unplugged Coding Hijaiyah worksheet proved effective in enhancing the computational skills of children aged 5–6 years at PAUDQ Nurfadlillah Tuban in the era of KKA (Coding and Artificial Intelligence). The worksheet-based learning model, systematically structured in a gradual and contextual design, successfully shifted children's learning style from passive memorization to active learning that requires logical reasoning, algorithmic thinking, pattern recognition, sequencing, and problem-solving. The improvement in children's abilities was evident from the pre-cycle through the end of Cycle II, marked by consistent progress driven by manipulative activities, step-by-step guidance, and collaborative learning.

In addition to cognitive development, the worksheet also contributed to strengthening children's religious literacy through the integration of Hijaiyah letters and spiritual values, resulting in holistic and meaningful learning. Therefore, Unplugged Coding Hijaiyah not only equips children with academic readiness and future technological competencies but also fosters adaptive thinking, creativity, communication, and collaboration core components of 21st-century skills. This learning model is highly recommended as an innovative strategy in early childhood education to address the challenges of the digital era without abandoning Islamic values as a foundational aspect of character building.

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