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Enhancing Early Childhood Problem-Solving Skills through Unplugged Coding at TK Khadijah 107 Banyuwangi

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Abstract:
Problem-solving skills are a fundamental component of early childhood cognitive development, as they support children's ability to think logically, explore solutions, and adapt to various challenges. This study aimed to examine the effectiveness of an unplugged coding approach in enhancing the problem-solving skills of children aged 5–6 years at TK Khadijah 107 Banyuwangi. The study employed Classroom Action Research (CAR) based on the Kemmis and McTaggart model, conducted in three stages: pre-cycle, Cycle I, and Cycle II, each consisting of planning, action, observation, and reflection. The participants comprised 11 children. The results indicated a significant improvement in children's problem-solving skills, increasing from 45.45% in the pre-cycle to 61.36% in Cycle I, and reaching 84.09% in Cycle II, thereby exceeding the predetermined success indicator of 80%. Throughout the learning process, children demonstrated increased enthusiasm, independence, and critical thinking when solving problems through engaging and challenging unplugged coding activities. These findings indicate that the unplugged coding approach is effective in developing early childhood problem-solving skills and can be applied as an innovative strategy to support 21st-century skills in early childhood education.

Keywords:
Problem-solving; Unplugged coding; Early childhood.

Abstrak:
Keterampilan *problem-solving* merupakan aspek penting dalam perkembangan kognitif anak usia dini karena mendukung kemampuan anak untuk berpikir logis, mengeksplorasi solusi, dan beradaptasi terhadap berbagai tantangan. Penelitian ini bertujuan untuk mengkaji efektivitas pendekatan unplugged coding dalam meningkatkan keterampilan *problem-solving* anak usia 5–6 tahun di TK Khadijah 107 Banyuwangi. Metode penelitian yang digunakan adalah Penelitian Tindakan Kelas (PTK) dengan model Kemmis dan McTaggart, yang dilaksanakan dalam tiga tahap, yaitu pra-siklus, siklus I, dan siklus II. Setiap siklus meliputi tahap perencanaan, pelaksanaan tindakan, observasi, dan refleksi, dengan subjek penelitian sebanyak 11 anak. Hasil penelitian menunjukkan adanya peningkatan yang signifikan dalam keterampilan *problem-solving* anak, yaitu dari 45,45% pada tahap pra-siklus menjadi 61,36% pada siklus I, dan meningkat hingga 84,09% pada siklus II, sehingga melampaui indikator keberhasilan yang ditetapkan sebesar 80%. Selama proses pembelajaran, anak menunjukkan peningkatan antusiasme, kemandirian, dan kemampuan berpikir kritis dalam menyelesaikan masalah melalui aktivitas *unplugged coding* yang menantang dan menyenangkan. Dengan demikian, pendekatan *unplugged coding* terbukti efektif dalam mengembangkan keterampilan *problem-solving* anak usia dini dan dapat dijadikan sebagai strategi pembelajaran inovatif dalam pendidikan anak usia dini berbasis keterampilan abad ke-21.

Kata Kunci:
Problem-solving; *Unplugged coding;* Anak usia dini.

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INTRODUCTION

Early childhood development represents a crucial phase that determines the foundation of children's holistic growth. According to the National Association for the Education of Young Children (NAEYC), early childhood spans the age range of 0–8 years, while in the Indonesian context, early childhood refers to children aged 0–6 years (Suryana, 2016). This period is commonly referred to as the *golden age*, during which brain development and various aspects of growth—such as cognitive, language, socio-emotional, and motor development—progress rapidly. Early Childhood Education (ECE) serves as a strategic platform for establishing children's character and competencies, including cognitive development and thinking skills that are essential for subsequent educational stages (Fauzia, 2022; Ministry of Education and Culture Regulation No. 146 of 2014).

One critical aspect of early childhood cognitive development is problem-solving ability. Problem-solving refers to the capacity to identify problems, analyze situations, design solutions, and evaluate outcomes (Charlesworth & Lind, 2012; Papalia et al., 2011). Children naturally possess a high level of curiosity and frequently encounter everyday challenges that require solutions. However, learning practices in many ECE institutions in Indonesia still tend to emphasize rote memorization and repetitive mechanical activities, such as copying text or tracing letters and numbers (Siraj-Blatchford, 2009; Oktaviani & Nugraheni, 2021). Such approaches have not yet optimally stimulated higher-order thinking skills, including critical thinking and problem-solving.

Along with technological advancement and the demands of the Industrial Revolution 4.0 and Society 5.0, 21st-century skills—such as critical thinking, creativity, collaboration, and communication—have become core competencies that should be fostered from an early age (Trilling & Fadel, 2009; Saavedra & Opfer, 2012). One approach gaining increasing attention in contemporary education is the development of computational thinking, defined as a form of algorithmic thinking that enables individuals to organize systematic steps to solve problems. In early childhood education contexts, computational thinking can be introduced through unplugged coding, an instructional approach that teaches fundamental programming concepts without digital devices, instead utilizing concrete activities such as games, simulations, and physical movement

(Bell et al., 2009; Brennan & Resnick, 2012; Wing, 2006). Innovative learning media that actively engage learners have been shown to enhance cognitive involvement and meaningful learning processes. Interactive instructional designs encourage learners to explore, make decisions, and participate actively in problem-solving situations (Kiptiyah et al., 2025).

The unplugged coding approach is considered particularly suitable for early childhood learners who are in the preoperational stage, as described in Piaget's constructivist theory. At this stage, children learn primarily through concrete experiences, sensorimotor activities, and symbolic play (Piaget, 1970). Through unplugged activities such as sequencing stories, direction-based games, tic-tac-toe, puzzles, and treasure hunts, children can develop key components of computational thinking—including decomposition, pattern recognition, abstraction, and algorithmic thinking—which support their problem-solving skills (Mutoharoh et al., 2023; Rahmawati et al., 2024). Moreover, this strategy offers a practical solution for ECE institutions facing limited technological infrastructure, as it does not require computers or digital tools.

Despite its potential, research on unplugged coding at the early childhood education level in Indonesia remains limited. Most existing studies have focused on elementary and secondary education levels, with an emphasis on logical reasoning or basic programming skills (Putri & Agustin, 2021; Azzahra et al., 2022). In fact, developing problem-solving skills through computational approaches from an early age can provide children with essential foundations for systematic thinking, self-confidence, and flexibility in responding to life challenges. Therefore, more contextually grounded research is needed to explore the effectiveness of unplugged coding approaches in enhancing early childhood problem-solving skills within ECE settings.

Based on preliminary observations at TK Khadijah 107 Banyuwangi, classroom learning activities were still predominantly characterized by drill and repetition methods. Learning tended to be teacher-centered and provided limited opportunities for children to explore, analyze, and make decisions independently. Activities such as tracing letters or numbers may support fine motor development, but they are insufficient to stimulate higher-order thinking skills. This condition formed the basis for implementing a more innovative and challenging instructional strategy—namely, unplugged coding—to ensure that cognitive learning extends beyond memorization and encourages children to become active problem solvers.

Accordingly, this study aims to examine the effectiveness of the unplugged coding approach in improving the problem-solving skills of children aged 5–6 years at TK Khadijah 107 Banyuwangi. This research is expected to contribute both theoretically and practically. Theoretically, it enriches the body of literature on the application of computational thinking in early childhood education within the Indonesian ECE context. Practically, the findings may serve as an alternative instructional strategy for ECE teachers in fostering children's critical thinking and problem-solving skills through learning experiences that are enjoyable, meaningful, and developmentally appropriate.

METHOD

This study employed a mixed-methods approach using a Classroom Action Research (CAR) design based on the Kemmis and McTaggart model, which consists of four stages: planning, action, observation, and reflection, implemented across two cycles (Kemmis & McTaggart, 1988). The research was conducted at TK Khadijah 107 Banyuwangi, involving 11 children aged 5–6 years as research participants.

The data collected comprised both quantitative and qualitative data. Quantitative data were obtained from assessments of children's problem-solving skills, measured using a four-level star rating system (Star 1–4), which was subsequently converted into numerical scores and analyzed using descriptive statistics. Qualitative data were collected through interviews with the school principal and classroom teachers, as well as documentation in the form of photographs and video recordings of learning activities.

Data collection techniques included participatory observation, semi-structured interviews, and documentation. Observation was used to examine the development of children's problem-solving skills during learning activities employing the unplugged coding approach, defined as a strategy for introducing computational thinking concepts without the use of digital devices, as proposed by Bell, Alexander, Freeman, and Grimley (2009).

Data analysis was conducted using descriptive quantitative methods to calculate the percentage of children's skill achievement scores and qualitative analysis to interpret learning dynamics based on interview and documentation data. The percentage of achievement was calculated using the following formula:

$$\text{Percentage} = \left(\frac{f}{n}\right) \times 100\%$$

where *f* represents the number of scores in a particular category and *n* denotes the total possible score.

The success indicator of the intervention was set at 80% of participants demonstrating a significant improvement in problem-solving skills from the pre-cycle to the final cycle. To ensure data trustworthiness, this study employed source and method triangulation (Miles, Huberman, & Saldaña, 2014).

RESULTS AND DISCUSSION

Enhancing Early Childhood Problem-Solving Skills through Unplugged Coding at TK Khadijah 107 Banyuwangi: Pre-Cycle Phase

Problem-solving skills constitute a key indicator of early childhood cognitive development. This ability reflects the extent to which children can confront, understand, and resolve problems independently through a series of cognitive processes, such as identifying problems, exploring possible solutions, and making decisions. Based on the results of the initial observation (*pre-cycle*), the problem-solving skills of children aged 5–6 years at TK Khadijah 107 Banyuwangi were found to be at a relatively low level.

During the pre-cycle phase, children tended to imitate the actions of teachers or peers rather than demonstrating initiative or exploratory efforts to solve problems independently. These findings indicate an urgent need for the implementation of instructional approaches that actively stimulate children's cognitive engagement. One such approach is unplugged coding, which emphasizes active participation, exploration, and logical thinking through concrete, play-based activities.

Score Level	Number of Children (Pre-Cycle)	Achievement Rate (Pre-Cycle)	Number of Children (Cycle I)	Achievement Rate (Cycle I)	Number of Children (Cycle II)	Achievement Rate (Cycle II)
Star 1	5	45.45%	2	18.18%	0	0%
Star 2	4	36.36%	4	36.36%	1	9.09%
Star 3	1	9.09%	3	27.27%	4	36.36%
Star 4	1	9.09%	2	18.18%	6	54.55%
Total	11	100%	11	100%	11	100%

Table 1. Distribution of Early Childhood Problem-Solving Skill Levels Across Pre-Cycle, Cycle I, and Cycle II

Based on the pre-cycle observation results, out of a total of 11 children, five children (45.45%) were classified in the Star 1 category, indicating very low problem-solving skills. Meanwhile, four children (36.36%) were categorized as Star 2, reflecting problem-solving attempts that still required assistance from others. Only one child (9.09%) reached the Star 3 category, and another one child (9.09%) achieved Star 4,

demonstrating independent and consistent problem-solving abilities. When viewed in terms of achievement criteria—children categorized as Star 3 and Star 4—only 2 out of 11 children (18.18%) met the minimum indicator of problem-solving skills. Overall, the total success rate reached only 45.45%, which remains far below the predetermined success criterion of 80%.

In addition to quantitative data, qualitative data were obtained through interviews with the principal of TK Khadijah 107 Banyuwangi. The principal stated, *"So far, children have rarely been trained to solve problems independently. Most learning activities are instructional rather than exploratory."* This statement was reinforced by a classroom teacher, who noted, *"When given challenging tasks, children usually wait for instructions. They rarely attempt to solve problems on their own."* These findings indicate children's dependency on direct instruction and highlight the limited implementation of teaching methods that foster independent and critical thinking.

Observation and interview data collectively reveal that children's problem-solving skills had not yet developed optimally. Most children remained at levels requiring direct guidance, even when dealing with basic tasks such as identifying simple problems. This condition reinforces the notion that early childhood learners require instructional approaches that go beyond directive teaching and instead encourage active thinking, exploration, and experimentation in contextual learning environments. The low level of achievement observed during the pre-cycle phase underscores the need to implement an innovative learning model based on exploration and simulation, such as unplugged coding, which is designed without digital devices yet effectively stimulates algorithmic thinking and problem-solving processes.

Unplugged coding is an instructional approach that introduces fundamental computational and computational thinking concepts to children through physical activities, games, and concrete manipulatives without the use of electronic devices (Bell et al., 2009). This approach is highly suitable for early childhood learners because it is concrete, enjoyable, and supportive of cognitive as well as social development. According to Papert (1980), children learn most effectively when they are directly involved in activities that facilitate real problem-solving experiences. In this context, unplugged coding functions as an exploratory medium that enables children to actively and collaboratively engage in problem-solving processes. This perspective aligns with Vygotsky's constructivist theory, which emphasizes the importance of social interaction and mediating tools in the development of children's cognitive abilities (Vygotsky, 1978).

Based on these initial findings, it can be concluded that one-way, instruction-centered learning is insufficient to support the development of problem-solving skills in early childhood. The low achievement observed in the pre-cycle phase indicates that children require more challenging yet developmentally appropriate learning approaches. The unplugged coding approach is considered relevant because it harmonizes the need for exploration, critical thinking, and problem-solving within concrete and enjoyable learning experiences. Therefore, the implementation of this approach is expected to increase the proportion of children achieving higher levels of problem-solving skills in subsequent research cycles.

Enhancing Early Childhood Problem-Solving Skills through Unplugged Coding at TK Khadijah 107 Banyuwangi: Cycle I

Following the implementation of Cycle I using the unplugged coding approach, early childhood problem-solving skills at TK Khadijah 107 Banyuwangi began to show a fairly significant improvement compared to the pre-cycle stage. Children appeared more actively engaged in learning activities, demonstrated greater interest in attempting to complete tasks, and began to develop initiative and confidence in responding to the challenges presented. Although some children still experienced difficulties in understanding instructions, the learning process gradually shifted from imitation-based behavior toward exploration and independent thinking.

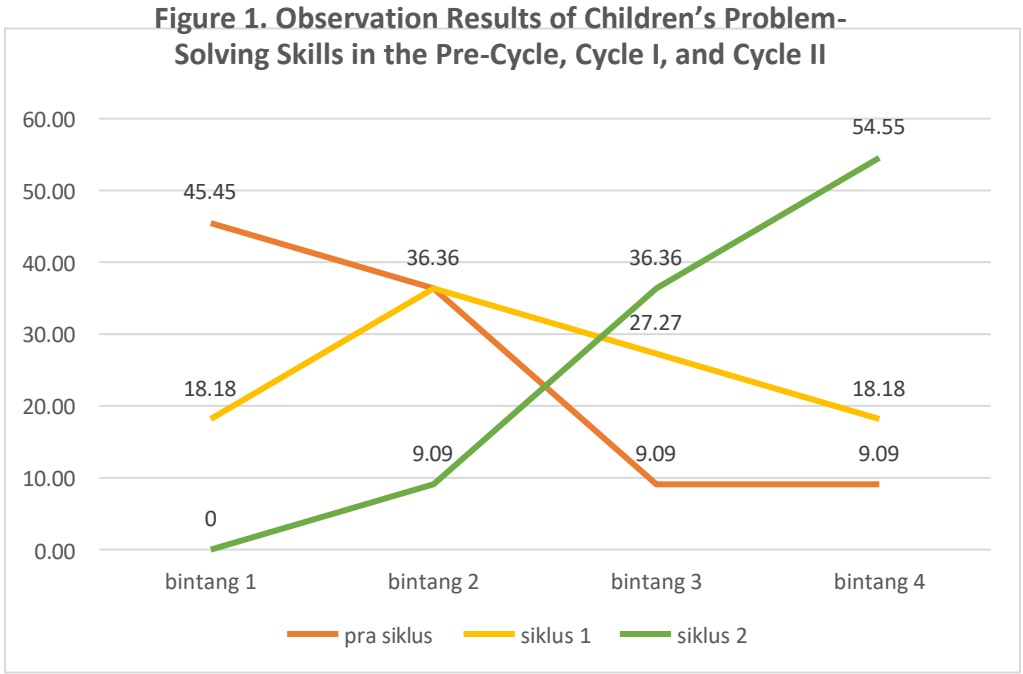

Figure 1. Observation Results of Children's Problem-Solving Skills in the Pre-Cycle, Cycle I, and Cycle II

Based on observation results and children's performance assessments at the end of Cycle I, changes were evident in the distribution of problem-solving skill achievement levels. Of the 11 children involved in the study, the distribution was as follows: Star 1 included 2 children (18.18%), Star 2 included 4 children (36.36%), Star 3 included 3 children (27.27%), and Star 4 included 2 children (18.18%). Accordingly, the total percentage of children who reached the Star 3 and Star 4 categories (the established success criteria) increased to 61.36%. This result represents an improvement of 15.91% compared to the pre-cycle achievement level of 45.45%.

Qualitative data obtained from interviews with the classroom teacher further supported these quantitative findings. The teacher reported that after children were introduced to unplugged coding activities—such as constructing directional paths using arrows to reach a specific goal—children appeared more enthusiastic and engaged. The teacher stated:

> *"When children participated in directional games, they became more focused and were less likely to give up. Even children who were usually passive began to confidently suggest directions to their peers."*

This statement indicates that, in addition to cognitive development, there were observable improvements in social interaction and self-confidence, which are essential components supporting the problem-solving process.

Both quantitative data and teacher interviews demonstrate that the unplugged coding approach began to have a positive impact on children's problem-solving skills. The shift in scores from Star 1 toward Star 3 and Star 4 reflects progress in children's initiative, exploratory behavior, and ability to complete problem-solving tasks. Although the improvement had not yet been evenly distributed among all children, the emerging pattern of progress suggests that this method is effective in encouraging logical thinking and the systematic development of problem-solving strategies.

These findings are consistent with Bers' (2020) assertion that unplugged coding enables young children to develop key components of computational thinking, such as sequencing, pattern recognition, and strategic planning. This approach is particularly suitable for early childhood learners because it is grounded in play, physical movement, and concrete media without the use of computers. Similarly, Papadakis and Kalogiannakis (2019) emphasize that unplugged coding activities promote active engagement, decision-making, and the development of problem-solving skills from an early age.

Interpretively, the results of Cycle I indicate that unplugged coding has begun to function effectively as a strategy for enhancing children's problem-solving skills.

Although the outcomes had not yet reached an optimal level, the progress achieved demonstrates a positive response from children toward this approach. Through games that stimulate logical and exploratory thinking, children became more actively involved in solving problems independently. These findings provide a strong foundation for proceeding to Cycle II, with refinements in instructional delivery, media selection, and differentiation of task difficulty in accordance with children's individual abilities.

Enhancing Early Childhood Problem-Solving Skills through Unplugged Coding at TK Khadijah 107 Banyuwangi: Cycle II

The improvement of early childhood problem-solving skills in Cycle II demonstrated a significant advancement compared to the previous cycle. Following refinements in instructional strategies, the unplugged coding approach was implemented in a more structured manner and aligned with children's developmental needs. Children appeared increasingly active, demonstrated greater initiative in exploring multiple solution possibilities, and began to naturally develop critical thinking skills. A learning environment designed around play-based activities and concrete challenges successfully stimulated children's ability to solve problems.

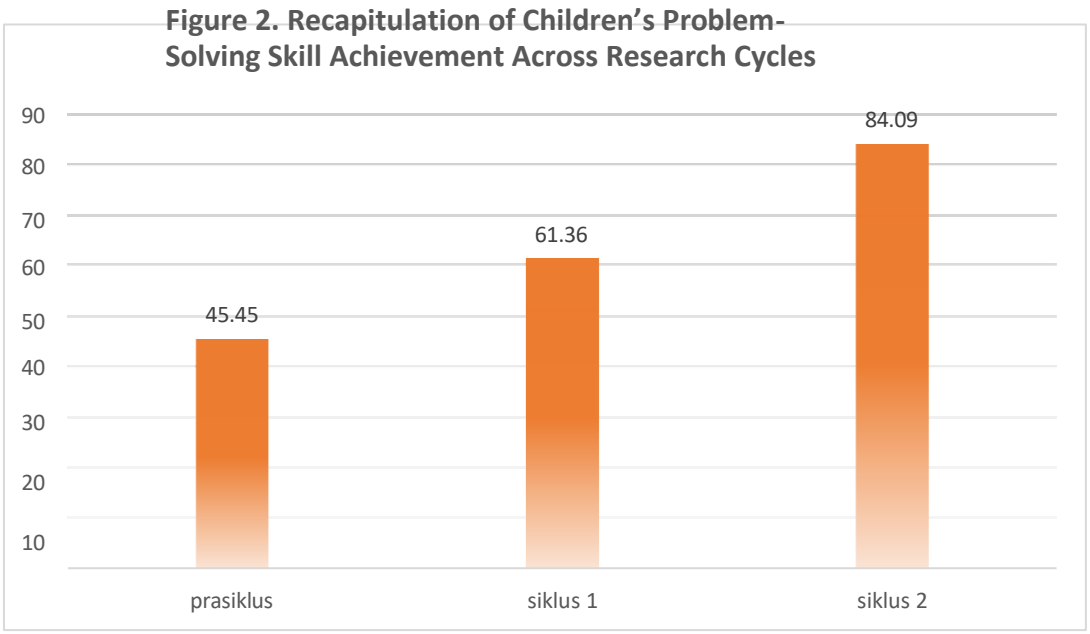

Figure 2. Recapitulation of Children's Problem-Solving Skill Achievement Across Research Cycles

The observation results indicate a substantial increase in the number of children who achieved the success criteria. Based on the assessment outcomes, six children (54.55%) reached the Star 4 category, four children (36.36%) were classified as Star 3,

one child (9.09%) remained in Star 2, and no children were categorized as Star 1. Overall, the success rate reached 84.09%, reflecting a significant improvement compared to Cycle I, which achieved only 61.36%.

Interviews with the classroom teacher further strengthened these findings. The teacher stated, *"Children are now more independent and do not panic when they encounter difficulties. They prefer to try solving problems on their own before asking for help. Activities such as creating directional paths or arranging instruction codes using arrow cards really help them think logically and systematically."* This statement suggests that the media and strategies employed in the unplugged coding approach effectively facilitated a constructive learning process aligned with early childhood learning styles.

The improvement observed in Cycle II demonstrates progress across three main problem-solving indicators: the ability to identify problems, to formulate solution steps, and to evaluate the outcomes of actions. Children no longer relied solely on teacher guidance but began to develop their own strategies. For example, when arranging character pathways in the *"Robot Walking Home"* game, children showed the ability to recall patterns and anticipate potential errors based on prior experiences.

Theoretically, these outcomes are consistent with Papert's (1980) constructionism, which emphasizes that children learn most effectively when they actively construct knowledge through concrete activities. Within the context of unplugged coding, children function as solution designers, reflecting the application of constructivist principles in early childhood education. In addition, these findings support Bers' (2018) assertion that coding activities without digital devices can foster computational thinking and problem-solving skills in young children through physical, narrative, and collaborative activities. This finding aligns with previous research indicating that learning environments which emphasize reasoning, exploration, and active engagement contribute significantly to the development of students' critical and problem-solving abilities (Alatas et al., 2025).

With an overall achievement of 84.09%, this study concludes that the unplugged coding approach implemented in Cycle II reached an effective level. This success indicates that interventions using concrete, play-based media significantly support children's development of problem-oriented thinking. When children are provided with opportunities to explore and reflect on their actions, they not only learn to solve technical problems but also develop self-confidence and independence in thinking. Consequently, this approach holds strong potential for broader implementation within PAUD curricula grounded in computational thinking that are engaging, meaningful, and developmentally appropriate.

CONCLUSION

This study demonstrates that the unplugged coding approach is effective in enhancing early childhood problem-solving skills at TK Khadijah 107 Banyuwangi. During the pre-cycle phase, the level of children's achievement reached only 45.45%. Following the implementation of Cycle I, the success rate increased to 61.36%, and further improved to 84.09% in Cycle II.

Children began to demonstrate logical thinking, initiative, and the ability to solve challenges independently and creatively. Learning activities that were concrete, enjoyable, and challenging through unplugged coding were proven to effectively stimulate children's thinking processes and problem-solving abilities from an early age.

Therefore, the unplugged coding approach can be considered an effective alternative instructional strategy for developing critical thinking and problem-solving skills in early childhood education.

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