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Introducing Early Coding: A Simple Robotics Workshop for Early Childhood Teacher to Enhance Children's Creativity

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Abstract

The need to strengthen digital literacy in early childhood education requires teachers to have an adequate understanding of practical coding learning. However, limited competencies and facilities remain an obstacle in many schools. This workshop program aims to improve the knowledge and skills of teachers at Melati Purwakarta Kindergarten through an introduction to simple robotics based on Scribble Bot. The research used a qualitative descriptive method through the stages of material delivery, mentoring, and direct practice. Data was collected through observation, interviews, and documentation, then analyzed using thematic analysis through the processes of coding, categorization, and theme extraction. The findings show that: (1) all participants were able to assemble the Scribble Bot independently, indicating an improvement in technical skills; (2) pedagogical understanding of the role of coding in children's cognitive, motor, and social development increased significantly; and (3) a commitment to sustainable implementation emerged in the form of plans to integrate simple robotics into monthly learning. This program has implications for increasing teachers' readiness to adopt more innovative coding learning and emphasizes the need for facility support and further training so that the integration of robotics in early childhood education can be sustainable.

Keywords: *Robotics, Coding, Computational Thinking, Early Childhood Education, Teacher Training*

Abstrak

Kebutuhan penguatan literasi digital pada PAUD menuntut guru memiliki pemahaman memadai mengenai pembelajaran coding yang aplikatif. Namun, keterbatasan kompetensi dan fasilitas masih menjadi kendala di banyak sekolah. Program workshop ini bertujuan meningkatkan pengetahuan dan keterampilan guru TK Melati Purwakarta melalui pengenalan robotik sederhana berbasis Scribble Bot. Penelitian menggunakan metode deskriptif kualitatif melalui tahapan penyampaian materi, pendampingan, dan praktik langsung. Data dikumpulkan melalui observasi, wawancara, dan dokumentasi, kemudian dianalisis menggunakan analisis tematik melalui proses pengodean, kategorisasi, dan penarikan tema. Temuan menunjukkan bahwa: (1) seluruh peserta mampu merakit Scribble Bot secara mandiri, menandai peningkatan keterampilan teknis; (2) pemahaman pedagogis terkait peran coding dalam perkembangan kognitif, motorik, dan sosial anak meningkat signifikan; dan (3) muncul komitmen penerapan berkelanjutan berupa rencana integrasi robotik sederhana dalam pembelajaran bulanan. Program ini berimplikasi pada meningkatnya kesiapan guru dalam mengadopsi pembelajaran coding yang lebih inovatif dan menegaskan perlunya dukungan fasilitas serta pelatihan lanjutan agar integrasi robotik di PAUD dapat berkelanjutan.

Kata Kunci: Robotik, Coding, *Computational Thinking*, AUD, Pelatihan Guru

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INTRODUCTION

In today's rapidly developing digital age, coding and programming skills have become highly sought-after skills and knowledge (Bisma et al., 2023; Murro Nuril Chasanah & Hasibuan, 2024; Priyanti & Warmansyah, 2021). Children growing up in today's digital age need to be equipped with coding skills from an early age in order to be competitive in the future (Maitra, 2024). Teaching coding to children not only helps them develop their creativity, but also teaches them cooperation and communication, improves their problem-solving skills, and enables them to think critically and logically (Salamah et al., 2025).

Coding in general is the process of writing code in a specific programming language so that the code can be understood by a device or computer to be executed (Sopiah et al., 2023; Warmansyah et al., 2024). However, in the context of early childhood education, coding is not only about formal code writing but also about introducing ways to improve critical and logical thinking skills, enhance creativity, cooperation, and communication through fun learning activities through play (Mutoharoh et al., 2023). In the preoperational stage according to Piaget children aged 2-7 years old have begun to use symbols, think critically, and learn through symbolic play (Mu'min, 2013). Therefore, children's play activities through coding learning can provide them with an understanding through a sequence of commands in accordance with the preoperational stage. In addition, children will learn about problem solving by facing challenges, trying, and adjusting.

Coding is very important to be introduced to young children and implemented in learning activities at school. However, currently there are still many schools that have not implemented and prioritized coding learning for young children. This is due to several factors, such as teachers' lack of knowledge about coding learning, limited facilities and resources, and the gap between schools in accessing technology in learning activities. In our partner schools, basic coding lessons are often conducted without devices, using student worksheets in magazine form, rather than concrete practice using technological devices such as laptops or computers.

Therefore, this workshop on simple robotics was conducted with the school's background in mind and aimed to introduce the concepts of coding and programming to school teachers through concrete practice with robot building. In a community service study conducted in the city of Bekasi in April 2025, involving 33 teachers and early childhood education schools in a workshop that emphasized the integration of coding into the early childhood education curriculum to develop children's computational thinking through developmentally appropriate play activities using lecture, demonstration, and unplugged/plugged coding practices such as maze games, the results showed an average increase in understanding of 33.7% (Lamatokan et al., 2025). Therefore, this workshop is expected to provide teachers with knowledge and

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experience in coding and the practice of making simple robots that can be practiced and implemented with children in classroom learning.

Thus, the authors hope that this article can provide an overview of the urgency of coding education for early childhood and the importance of implementing robotics-themed activities in the classroom. The author also hopes that through the workshops conducted, teachers will not only be able to build robots and obtain results, but also be better prepared to implement coding education activities in an effort to improve the quality of education within schools or nationally.

Although prior studies have examined coding, STEAM activities, and the use of educational robots to foster children's problem-solving and creativity (Sopiah et al., 2023; Munirah & Triyanto, 2023; Williams et al., 2024), limited research specifically explores teacher-focused workshops that integrate simple robotics as an accessible entry point for early childhood coding education. Existing literature primarily focuses on children's outcomes rather than teacher readiness, leaving a gap in understanding how educators can be empowered to implement coding confidently in classroom settings. The present study addresses this gap by designing a robotics-based coding workshop tailored for early childhood teachers, emphasizing hands-on, low-threshold, high-ceiling activities aligned with developmentally appropriate practice. The novelty of this study lies in its unique combination of simple robotics, early coding pedagogy, and teacher capacity building within the context of early childhood education—an approach that remains underrepresented in Indonesian and international literature.

Furthermore, research on early coding often centers on digital tools or structured block-based programming (Bers, 2020; Resnick & Rusk, 2020), while studies on unplugged coding and hybrid robotics approaches remain limited. This creates a need for educational models that integrate computational thinking with physical manipulation activities, especially given robust evidence showing that concrete materials significantly enhance symbolic and creative development in early learners (Sara Price et al., 2015; Amri et al., 2021). By introducing a simple robotics workshop, this study contributes a practical, scalable model that aligns coding education with early childhood developmental stages, thus offering an innovative pedagogical alternative.

The purpose of this study is to introduce early childhood teachers to foundational coding concepts through a hands-on simple robotics workshop and to examine its potential contribution to enhancing children's creativity and computational thinking. Given the increasing demands for digital literacy in early childhood education, this study underscores the critical importance of equipping teachers with the competence, confidence, and pedagogical strategies necessary to meaningfully integrate coding into classroom practices. The findings are expected to support schools and policymakers in promoting early coding initiatives and improving the overall quality of digital-age learning environments.

METHODS

DOI: 10.31958/jies.v5i2.15898

Research Design and Participants

This study uses a qualitative descriptive method with the aim of providing a comprehensive overview of the process of implementing coding and simple robotics learning reinforcement activities for early childhood. This method was used because researchers can analyze directly and naturally without manipulation, and can show the real experiences of respondents during the activities. The qualitative approach was chosen by the researcher because it focuses on processes and experiences, in-depth exploration, and context, as the practice was carried out based on the school's background and the participants' abilities. The qualitative approach was also chosen to help describe how teachers, as participants, were able to adapt to the material and the practice of making simple robots, including the obstacles and strategies they encountered.

The implementation of activities covers three main stages, namely material delivery, mentoring, and practice. In the material delivery stage, participants receive explanations about the basic concepts of coding, types of coding, and an introduction to educational robotics devices that can be applied in the learning process. The mentoring stage is carried out to provide direct guidance, ensure participants' understanding of the material, help overcome technical obstacles, and adjust the use of robotics media to the learning needs at school. The final stage is practice, where participants build simple robots as a form of application of the material they have learned.

The research was conducted at Melati Purwakarta Kindergarten, located at Gang Melati III, Nagri Kaler, Purwakarta District, Purwakarta Regency, West Java, on November 17, 2025. The school has implemented basic coding in children's learning activities through worksheets in the form of magazines tailored to learning topics, but it has not been equipped with concrete robotic activities and coding practices, nor has it improved teachers' competence in integrating technology with learning. The research participants included three teachers and one principal who were fully involved in the entire series of activities.

Instruments and Data Collection Procedures

The research instruments used in this study included observation sheets, interviews, and documentation in the form of photos and videos, starting from the material preparation stage, through the practice stage, to the final result in the form of a simple robot. The researchers recorded the activities starting from the material session, through the mentoring stage, to the creation of a simple robot. Data collection began with an analysis of the partners' needs regarding coding learning, which was still limited, so that the researchers were able to come up with innovative activities for a simple robot coding workshop.

Data Analysis Techniques and Ethical Considerations

DOI: 10.31958/jies.v5i2.15898

Data analysis was conducted using a thematic approach through data collection, grouping, and identification of partner school needs. This was done to determine the needs of teachers and partner schools in order to deepen their experience and knowledge of coding education for early childhood. A thematic approach can be used to increase researcher credibility and validity. Trustworthiness strategies such as triangulation, member checking, and reflexivity can be applied in this context. Triangulation can be done by using several data sources, such as observation to verify the research results on the effectiveness of workshops. Member checks are carried out by asking teachers to verify the research results and provide feedback. Reflexivity is carried out by identifying researchers and their influence on research results. Using these trustworthiness strategies increases the credibility and validity of research results on the impact of robotics and coding learning on early childhood development(Dewi, 2025).

RESULTS AND DISCUSSIN

Results

A workshop entitled "The Urgency of Coding Education for Early Childhood" with practical sessions on making simple robots was successfully held according to plan. The workshop, which was attended by teachers and principals from Melati Purwakarta Kindergarten, produced a simple robot called Scribble Bot, which is capable of moving and writing independently. Scribble Bot is one of the educational robotic devices developed by Wonder Workshop, combining physical elements such as a movable and drawable robot with a companion digital application. This robot allows children to make scribbles on the robot's body, after which the robot responds through movement or sound while introducing basic programming concepts through a simple interface. Scribble Bot is designed to encourage scribbling as a form of creative expression that also plays a role in developing fine motor skills.

Table 1. Workshop Activities

Activities	Outcome	Evidene
Coding lessons	Teachers are able to understand the basic material regarding coding and coding learning.	Summary of material
Robot building assistance	Teachers understand how to make simple robots and the urgency of practicing making logic robots for children.	Participant observation of teachers during the mentoring stage
Robot building practice	Teachers are able to practice how to make robots.	Results of the Scribble Bot robot created by teachers

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The workshop was held against the backdrop of coding lessons at Melati Kindergarten in Purwakarta. Melati Kindergarten often conducts basic coding lessons in the classroom using worksheets in the form of magazines containing various cognitive and language activities. In order to create a learning environment that keeps pace with the times, Melati Kindergarten wants to improve the quality of learning by using more complex coding in its lessons. However, Melati Kindergarten lacks experience in implementing robotics coding learning activities due to a lack of teacher competence and experience, facilities, and resources. To overcome these issues, this workshop was held to provide teachers with new knowledge and experience in more complex coding learning through the practice of making simple robots.

Figure 1. The coding learning material stage

Figure 2. Mentoring stage

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Figure 3. Robot manufacturing workshop

In terms of implementation, this workshop provided teachers with important knowledge and experience. First, explanatory material on coding in general and in the context of early childhood, as well as examples of coding lessons that teachers can conduct in the classroom. Second, material on coding that impacts aspects of early childhood development. Third, learning methods that can be implemented in applying coding learning activities to early childhood. Fourth, the practice of making a simple Scribble Bot robot, which was carried out directly and independently by teachers so that they could gain firsthand experience and knowledge about making Scribble Bots. The practical activities were the main outcome of the program because they produced a tangible product in the form of a Scribble Bot prototype while also improving the technical skills of the participants.

The results of simple robotics practice in the form of Scribble Bot have become one of the activities that support learning in the classroom by realizing the STEAM approach through the integration of 5 elements, (1) Science, where children can explore the concepts of physics through vibration and balance, (2) Technology in the use of DC motors and batteries, (3) Engineering, where children are able to assemble and design with prototype planning, (4) Art, which can be seen in the abstract images produced by the robot's movements, and (5) Mathematics, measuring patterns and geometric shapes(Williams et al., 2024). This simple robotics activity allows children to build knowledge through active play while developing creativity, problem-solving, and skills.

Figure 4. Results of the scribble bot practice

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Figure 5. Scribble bot created by teachers

During the workshop, several questions were raised regarding the application of robotics learning activities in daily classroom learning activities. The questions were answered by stating that simple robotics practices for early childhood can be implemented once a month to once every two months, depending on the needs of the school and the children. The implementation of simple robotics practices that can be applied to early childhood education is not only in the form of Scribble Bot, but can also be other types of robots that are adapted to the topics of students' weekly and monthly activities.

The implementation of this workshop was supported by certain factors. One of the factors supporting the implementation of the workshop was the background of schools that had implemented basic coding in their learning activities. Therefore, the author took the opportunity to provide facilities in the form of knowledge and direct experience regarding coding and simple robotics practices that could be used as a reference for sustainability activities in the classroom and school progress. However, there are long-term challenges in implementing this workshop, namely accessibility, because interactive technologies such as robots have the potential to widen the digital divide if they are not accompanied by teacher support. In early childhood education, adult supervision is essential to ensure that Scribble Bot is used safely and effectively, and to prevent frustration that may arise from an interface that children find complex. Therefore, it is necessary to provide ongoing training to teachers conducting the workshop so that they can observe each process that occurs in children during activities using Scribble Bot. In addition, there are challenges in terms of accessibility to some of the tools and materials that will be used, such as dynamo motors, which are rarely found. Therefore, alternative measures need to be taken regarding the tools and materials to be used. For example, the materials used can be tools or materials that are more easily found by the general public.

The success of this workshop can be seen from the tangible results. First, all participants were able to complete the Scribble Bot independently, which indicates that the material and guidance were easy to understand. Second, the teachers gained a better understanding of the connection between coding, robotics, and child development, as

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evidenced by their active participation in discussions and their ability to explain the role of robots in the context of early childhood education. Third, the positive feedback from participants during the verbal evaluation showed that the workshop provided a new perspective on the development of coding learning that is in line with the demands of the current era. Furthermore, through discussions with teachers, a follow-up plan emerged in the form of implementing simple robotics activities once or twice a month based on school needs. Teachers also stated that robotics activities are not limited to Scribble Bot but can also be adapted to daily or monthly themes and the characteristics of children.

Overall, this workshop received very positive feedback from teachers and principals. They found the material easy to understand and relevant to the school's needs, especially since coding had previously been taught using worksheets only. The event opened their eyes to the importance of coding using robotics and how such activities can improve educational standards at Melati Purwakarta Kindergarten.

The factor that hindered the implementation of this workshop was the limited opportunity to practice making other types of robots. During the activity, participants could only make one type of robot due to limited time, tools, and materials. The lack of practice opportunities meant that workshop participants were unable to explore other shapes and models that could have broadened their learning experience. As a result, participants' understanding of the basic application of robotics in early childhood education was limited, and the exploration process, which should have been more extensive, was not carried out properly and was less than optimal.

Limited practice opportunities also hindered the exploration and reflection process of workshop participants. Participants still wanted to try again and make other robot models to ensure their understanding of the steps involved in making, assembling, using various components, and applying basic coding principles. The limited number of devices also means that participants have to wait their turn in large groups, so that practice time becomes even shorter and passes quickly. This obstacle has an impact on the suboptimal nature of this workshop activity, which is to provide a more comprehensive understanding of the application of coding and simple robotics in the learning process of early childhood.

Discussion

Playing is an activity during childhood. According to contemporary play theory, playing is not only designed for pleasure, but also for learning purposes. Playing with coding is one of the activities that children enjoy because it can optimally develop their early problem-solving skills. In robotics activities, teachers act as facilitators who guide children in the learning process, provide resources and materials, and encourage creativity and experimentation. Teachers also help children overcome difficulties and facilitate discussion and collaboration. Learning that uses a curriculum focused on children's activities and is combined with play activities is an attractive, useful, and

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easy-to-learn program solution for children. With these play activities, children will feel happy so that their brains can develop to their full potential. The orientation of coding learning in early childhood is not to produce technological products but to develop structured and logical thinking in identifying and solving problems.

Robotics can support indicators of children's fine motor and social-emotional development. In terms of fine motor skills, robotics improves hand-eye coordination through the use of simple robotic tools and enhances problem-solving skills through robot building. In terms of social-emotional skills, robotics improves collaboration and teamwork skills in robot building, develops the ability to share and take turns using tools, and boosts self-confidence through the achievement of building robots.

Coding activities are not only interpreted as using computers, which is called plugged coding, but also include coding learning activities without computers, commonly referred to as unplugged coding (Hasbi et al., 2020). Robotics is one of the unplugged coding activities that can support indicators of children's fine motor and social-emotional development. In terms of fine motor skills, robotics improves hand-eye coordination through the use of simple robotic tools and enhances problem-solving skills through robot building. In terms of social-emotional skills, robotics improves collaboration and teamwork skills in robot building, develops the ability to share and take turns using tools, and boosts self-confidence through the achievement of building robots.

Unplugged coding activities are a constructivist approach that allows children to solve various problems and challenges found in these activities, such as obeying rules, finding various ideas, thinking about concepts related to programming, and solving problems (Wang et al., 2023). The unplugged coding approach provides children with more concrete experiences that can facilitate programming activities that later interact directly with computers.

The unplugged coding approach covers various pattern recognition, algorithms, and forms (Rahmawati & Agustin, 2024). Some unplugged coding activities that can be done in early childhood education include making patterns with beads, recognizing various patterns in different images, recognizing symbols, pictures, photos, and even using simple robotics (Sisca Cletus Lamatokan et al., 2025). To increase access to robotic technology and STEAM education for all children, community programs and partnerships with schools are essential (Priyanti & Warmansyah, 2021; Warmansyah et al., 2023). This will enhance creativity, innovation, and cognitive abilities in children who apply STEAM concepts in a more engaging and interactive way. Bers, (2020) states that simple programming robots help children understand cause-and-effect relationships and problem solving without having to be able to read complexly. For example, children can draw paths and set the robot to follow them, thereby forming an understanding of basic algorithms.

Simple robotics practices directly in the classroom can attract children's interest in science and technology, improve basic understanding, critical thinking skills, and

DOI: 10.31958/jies.v5i2.15898

problem solving (Morris et al., 2016; Williams et al., 2024). Learning activities using simple robotics can also develop children's social and collaborative skills when done in groups, including cooperation, sharing ideas, and mutual respect among friends. Teachers may lack the knowledge and skills to implement coding and robotics learning, as well as have different backgrounds and experiences. The lack of training resources to improve teachers' abilities is also an obstacle, so efforts are needed to improve teachers' abilities through training, mentoring, and adequate resources, especially in terms of introducing the technology that will be applied in learning activities (Hasanah et al., 2024; Safitri et al., 2023; Warmansyah et al., 2022). Munirah & Triyanto, (2023) states that the introduction of simple robotic technology in kindergarten aims to develop creativity and imagination in early childhood. Methods that can be used in learning include demonstrations and experiments where children learn about robots through presentations and hands-on practice. Robotic coding has been proven to improve problem-solving skills in early childhood (Sopiah et al., 2023). Children learn technology as well as critical and creative thinking skills. Coding activities show that STEAM learning can be engaging and interactive, allowing children to learn and apply the concepts they have learned.

Scribble Bot is an interactive educational robot created by Wonder Workshop, specifically designed for children aged 3-6 years old (Amri et al., 2021). This robot combines physical and digital elements, allowing children to draw or "scribble" on the robot's surface using a pen or writing tool, which then responds with movement, sound, or light according to the scribble pattern created (Resnick & Rusk, 2020). Furthermore, Scribble Bot is connected to a digital application that introduces the basics of coding, where children can program robots to react to their scribbles, for example by following the lines drawn or performing simple actions (Bers, 2020). Scribble Bot is an activity that helps improve children's motor skills, from hand-eye coordination to motor control. In addition, this activity also facilitates free experimentation with shapes, colors, and patterns without restrictions, as well as reducing creative anxiety (Jewitt, 2015). In addition to Scribble Bot, there are several simple robots that can be used in classroom learning activities, such as humanoid robots or fixed robots that can be used to enrich children's learning experiences and build multi-school collaborations so that good practices, innovations, and experimental results can be shared and developed continuously.

CONCLUSION

The workshop on the urgency of coding education for early childhood, which included practical sessions on making simple robots, held at Melati Kindergarten in Purwakarta, showed that the importance of coding education is beginning to be implemented in early childhood education. Coding greatly supports early childhood development when done through play, exploration, and concrete activities. The sustainability of coding programs in schools can be achieved by integrating coding into

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the school curriculum, providing adequate facilities, and conducting training and professional development for teachers. Schools can ensure that coding programs remain relevant and effective. Through the practice of simple robotics as one of the applications of coding, it was evident that the training participants understood the material and were confident in applying what they had learned in the classroom environment. Coding learning through simple robotics not only develops children's skills but also supports waste reduction because it can be reused as a learning medium in the long term and sustainably.

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