JURNAL PENDIDIKAN USIA DINI
2025, VOL. 19, NO. 2, 207 -218
e-ISSN (Online Media): 2503-0566
P-ISSN (Print Media): 1693-1602
http://journal.unj.ac.id/unj/index.php/jpud

Building Creativity Through Coding Activities of ScratchJr in Early Childhood

Widya Dwi Hardiyanti[1]✉, Prayitno[2], Joko Pamungkas[3]

[1,2,3]Early Childhood Education, Universitas Negeri Yogyakarta, Indonesia

ABSTRACT
Creativity is a crucial aspect of early childhood development, but it is often hindered due to the limited number of engaging and effective learning media. This study aims to describe the process of coding activities through ScratchJr to stimulate creativity in early childhood. This study uses a qualitative approach involving 20 children aged 5-6 years in Aisyiyah XI Kindergarten, Surakarta. Data was collected through documentation, observation, and interviews. Data analysis uses the qualitative descriptive model of Miles and Huberman, which includes data reduction, data presentation, and conclusion or verification. The results of this study explain that coding activities through ScratchJr, which uses digital technology media, can develop children's creativity through a simple coding process that is creative and fun. Children can freely express themselves with their creativity to create digital projects through ScratchJr. Therefore, this ScratchJr media is recommended for early childhood learning to stimulate the expression of creativity and imagination in children. Coding activities are important to consider in early childhood education, allowing children to have a more optimal learning experience.

Artikel HISTORY
Submission : 27 June 2025
Received : 22 July 2025
Accepted : 11 October 2025

KEYWORDS
Coding Activities. Creativity, Early Childhood, ScratchJr

DOI. 10.21009/jpud.v19i2.55194

CONTACT Corresponding: Widya Dwi Hardiyanti, Early Childhood Education, Universitas Negeri Yogyakarta, Indonesia
Email: widyadwi.2024@student.uny.ac.id

1. Introduction

Early childhood education is education intended for children aged zero to eight years (Delacruz, 2020; del Olmo-Muñoz et al., 2020). The phase in early childhood is often referred to as the golden age phase. In this phase, the child's ability to absorb information is very high, and the child's brain development develops rapidly. The child's ability is 50% determined in the first four years, 30% before the age of eight, and only 20% after that (Kong & Wang, 2020; Shin & Gweon, 2020). The brain of children between the ages of zero to eight years will develop by approximately 80% (Kucirkova et al., 2020). If this early childhood is not stimulated, then the child's development becomes less optimal. Children are expected to be given positive stimuli that help children grow according to the progress of the times and be able to face the challenges of the times.

The 21st century, as it stands, is an era of very rapid technological development. Technology is developing and spreading to various sectors of life to help humans solve various problems. Technology is used from various ages until children unknowingly grow up to be digital natives. Digital native is a term for children who are born and raised in the digital era (Hammershøj, 2021; Yildiz & Guler Yildiz, 2021). The present era includes the development of industries in the 4.0 and 5.0 eras, which are increasingly digitized (Anwar et al., 2024). Among the pros and cons of using digital technology devices that accompany children's growth and development, it is undeniable that early childhood education institutions also take advantage of the convenience of information and communication technology in this era as learning materials (Olszewski & Crompton, 2020). Early childhood education should also anticipate the digital era because children are the next generation.

Whether children are aware of it or not, children use digital technology media as a daily consumption activity. Therefore, it is necessary for digital education as a provision for children to face the world. Several studies have sought to make children not only consume digital media, but also need to provide positive activities, so that programs focused on STEAM (Science, Technology, Engineering, Art, and Mathematics) emerged (Angeli & Valanides, 2020; Rapti & Sapounidis, 2024) And activities that develop the 4Cs (Creative thinking, Critical thinking, Communication, and Collaboration) skills (Hammershøj, 2021). Researchers, educators, and practitioners agree on the importance of developing 4C skills to prepare children for the challenges of the 21st century (Bakala et al., 2021). These abilities can be taught and learned effectively by integrating digital technology media that is integrated into the learning curriculum in schools.

Early childhood is the best time for children to learn. Early childhood education is the foundation of lifelong learning. Academic foundations, such as numbers and the alphabet, that develop cognition are important, but the development of creativity is also important (Behnamnia, Kamsin, & Ismail, 2020). One of the experiences that helps

develop creativity is through learning coding. Learning to code allows children to express their creativity and develop digital literacy. Early childhood coding learning is all about exploration. The goal is to encourage children to express themselves while developing creativity (Behnamnia, Kamsin, Ismail, et al., 2020). Early childhood coding is a series of cognitive processes that start from a simple stage to a higher level to solve problems by finding effective and efficient solutions or systematic such as how computer systems work (Bakala et al., 2021). Although the term coding is still considered new in the early childhood education environment, children are already coding in daily activities, such as learning to make food dishes by following a series of steps in food recipes. Learning coding in early childhood education is a concept of education through digital means. This concept is that children are not educated to be programmers, but as a means to stimulate aspects of child development, which include physical, motor, cognitive, language, and social-emotional. This is in line with (Peraturan Menteri Pendidikan, Kebudayaan, Riset, Teknologi Republik Indonesia Nomor 12 Tahun 2024 Tentang Kurikulum Pendidikan Anak Usia Dini, Pendidikan Dasar, Pendidikan Menengah, 2024). The developmental aspects in early childhood include religious and moral values, Pancasila values, cognitive, physical, motor, language, and social-emotional. One of the learning implementations that is in accordance with the development of industries in an era that is increasingly digitized is through coding.

Learning to code has a positive impact on early childhood's ability to recognize sequences correctly and learn to solve problems (Yang et al., 2022). Easy-to-use coding learning allows children to develop simple algorithms as children begin to play with coding sequences (Terroba et al., 2022). The selection of technology tools and interactive media must be adjusted to the child's developmental age, individual readiness, and interests, and appropriate in the context of the family and community culture, to determine how effectively technology can be used as a coding learning medium (Singhal, 2022). The purpose of early childhood coding learning is to stimulate computational thinking skills, which refer to the ability to solve problems systematically by applying basic concepts of computer science. In addition, learning to code can also stimulate creativity. Coding invites children to get to know technological developments directly. This will help children to be able to adapt to the times. The benefit of coding for the future is being able to provide better career and job security. Because the need for workers in the field of coding continues to grow. The most effective learning in early childhood is when the child can produce meaningful work (Kyza et al., 2022). ScartchJr is one of the media for children in making artwork in the form of digital animations. ScratchJr is a graphic programming tool for kindergarten through second-grade elementary students. Scratchjr is a visual programming language application designed for children aged 5-7 years in the form of simple coding activities to create digital animation projects. ScratchJr can create a visual programming environment that allows children to create animations independently using programming blocks, called the coding process (Clarke-Midura et al., 2023). The results of the study stated that children who were given coding learning were able to solve problems more creatively, and higher levels of cognitive skills, such as analysis and evaluation, were more developed compared to children who were not given coding learning (Gerosa et al., 2022). Learning to code is an important skill today, because through coding learning children are able to develop creativity to help achieve the next stage of development optimally.

By presenting coding, schools will be able to keep up with the times. This will show the school's commitment to providing the latest and up-to-date curriculum. However, the application of coding in early childhood education in Surakarta City is still not optimal, causing problems. One of the problems is that children's creativity is still low. This problem is because teachers in early childhood education have limited abilities in applying coding, especially by utilizing digital technology media. The use of appropriate media greatly affects the learning process. The selection of technological tools and interactive media must be adjusted to the child's developmental age, readiness, and individual interests, which will determine how effectively technology is used as a learning medium. Therefore, early childhood learning requires alternative media that are by the stage of development and able to attract children's attention so that a pleasant atmosphere is created in learning.

The urgency of this research is the importance of building early childhood creativity through coding activities, because it will have an impact on children's abilities in the future. If children are not introduced to learning using digital technology media from an early age, it will have an impact on adapting difficulties to compete in the world of work that demands children with a strong understanding and digital technology skills. The solution that will be developed from this problem is coding activities through ScratchJr. This study uses ScratchJr to explore the practice of coding activities in early childhood, especially in children aged 5-6 years. The purpose of this study is to describe coding activities through ScratchJr that are effective in stimulating early childhood creativity. The results of this study are expected to provide an overview for teachers on how to create interesting and fun coding learning to stimulate creativity in early childhood.

2. Method

This study uses a qualitative descriptive approach by collecting and analyzing data through direct observation. The data analysis in this study uses the Miles and Huberman qualitative analysis stages, which include data collection, data reduction, data display, and data verification. These stages are interactive processes that take place simultaneously with data collection in the field. Miles and Huberman revealed that in this analysis process, researchers continuously carry out these stages, namely data collection, data reduction, data display, and data verification, to ensure accurate, valid, reliable, and meaningful research results (Miles et al., 2020).

The data collection techniques in this study included direct observation of the coding activities of ScratchJr at Kindergarten Aisyiyah XI Surakarta with 20 research subjects and in-depth interviews with two teachers who teach group B children to identify the obstacles faced in implementing coding activities through ScratchJr. The study used unstructured interviews, which are free interviews where the researcher does not follow the guidelines of planned and systematic interviews. In addition, a documentation study was carried out to obtain relevant evidence of written information to complete the research data. Data collection is also complemented by literature studies to find valid references and used as a reference to compile research. The process of data collection and analysis in qualitative research is interrelated. The researcher made direct observations on the implementation of coding activities through ScratchJr at Kindergarten Aisyiyah XI Surakarta during the activity. To strengthen the findings, the researcher supplemented the data with relevant documents. The data analysis technique can be seen in Figure 1.

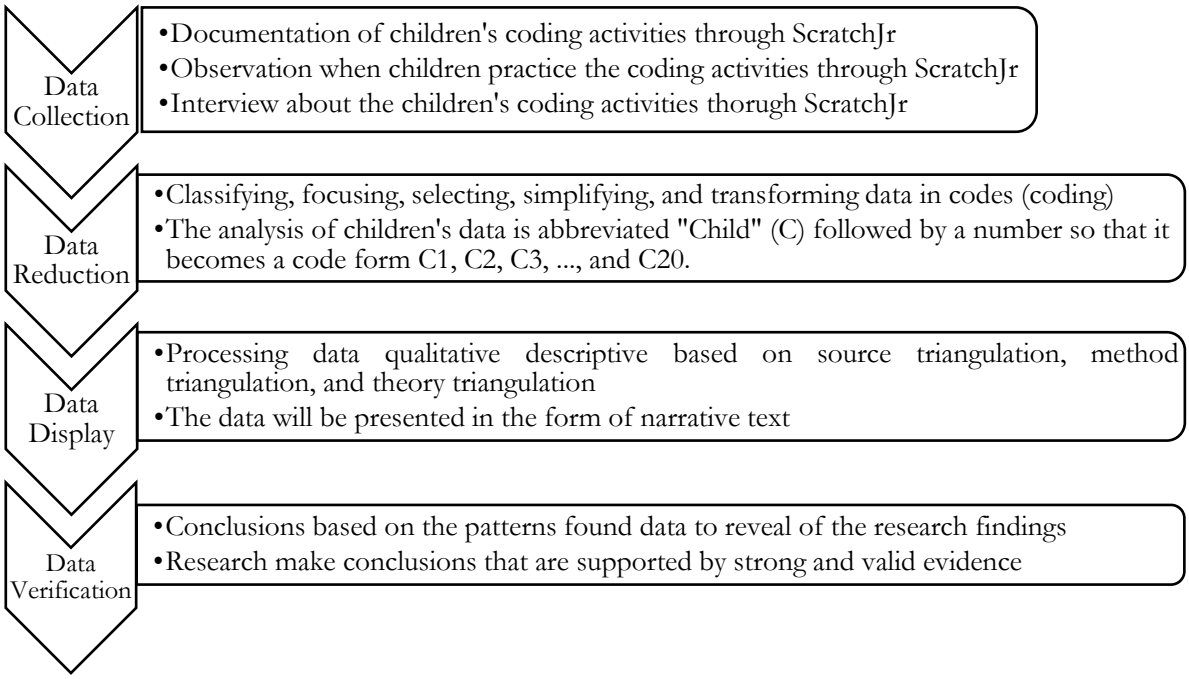

Figure 1. Data Analysis Technique

Participants were selected using the purposive sampling method to identify information-rich cases for in-depth analysis in the research. 20 samples of children will generate data for the study. The data of this research were collected from 20 children aged 5-6 years at Aisyiyah XI Kindergarten, Surakarta. All children have the same knowledge background and ability to use technological media. Sample selection criteria in Table 1.

Table 1. Sample Selection Criteria

Subjects	Criteria	Number of Subjects
Children	Group B (Age 5-6 years old)	20
Teachers	Teaching in Group B	2
Total of Subjects		22

Due to the ethical research process, to ensure the confidentiality of the participants' privacy, the analysis of children's data was abbreviated as "Child" (C) followed by a number so that it became a form of code, C1, C2, C3, ..., C20. To maintain the code of ethics of children's subjects, the documentation used as supporting data for writing this research article does not show the child's face directly. Data from observations, documentation, and interviews were analyzed using descriptive analysis techniques. This process involves encoding the data, identifying themes, and drawing conclusions based on the patterns found in the data. After completing the data collection process, all observation results and documentation of children's ScratchJr works are thoroughly analyzed to reveal the results of the research. Data verification is carried out by describing findings based on arguments and reviews of promoters

and colleagues to find consensus among informants to ensure accurate, valid, reliable, and meaningful results. The data analysis procedure was applied by applying in-depth descriptive analysis and found two themes, namely: 1) Implementation of coding activities through ScratchJr; and 2) Building creativity through ScratchJr.

3. Result

Implementation of coding activities through ScratchJr

Early childhood is greatly influenced by what they see, hear, and feel. The process of observing is an important part of early childhood development because children's curiosity about their environment develops rapidly. Coding activities through ScratchJr, children learn simple coding to create digital project works in the form of an animation. Children learn various types of features in ScarcthJr such as understanding the functions of various programming blocks, choosing a background, choosing a character, deleting characters, and moving characters. Children are taught to use ScratchJr by following the teacher's instructions at the same time to create animated digital project works. Coding activities through ScratchJr are based on the principles of early childhood education, such as learning while playing, a conducive environment, and the STEAM (Science, Technology, Engineering, Art, and Mathematics) approach, where learning uses digital technology media with a focus on the overall aspects of child development. The stages (syntax) of implementing coding activities through ScratchJr can be seen in Table 2.

Table 2. Stages or Syntaxs of Implementation Coding Activities Through ScratchJr

No	Stages / Syntaxs	Teacher Activities	Children's Activities
1.	Open the ScratchJr app	The teacher introduces and shows the ScratchJr application	The child observes and listens to the teacher's explanation
		The teacher introduces different forms of features in ScratchJr and their functions	The child observes and listens to the teacher's explanation
2.	Create a new project	The teacher facilitates and invites the child to create a new ScratchJr project	Children observe and listen to how to create new ScratchJr projects
		The teacher gives an example of using programming blocks to create animations	The child observes and listens to how to use the programming blocks
3.	Add a background (story theme)	The teacher gives an example of how to add a background (story theme)	Children observe and listen to how to add backgrounds
		Teacher guides in adding background (story theme)	Children add background (story theme) freely according to their creativity
4.	Add characters	The teacher gave an example of how to add characters according to the theme	Children observe and listen to how to add characters according to the theme story
		The teacher guides in adding characters according to the chosen background (story theme)	Children are free to choose characters according to the chosen background (story theme) and their creativity
5.	Make the character move	The teacher gives an example of how to make the character move by dragging and arranging programming blocks	The child observes and listens to how to make the character move by arranging programming blocks
		The teacher guides in making the characters move by dragging and arranging programming blocks	Children are creative in choosing various programming blocks that are arranged into coding to make the characters move
6.	Save animation project works using children's names	The teacher gave an example of how to save the finished animation project work with the child's name	Children observe and listen to explanations on how to save the finished animation project
		The teacher guides the child to save the animation by typing the child's name	Children save the work of animation projects by typing their names
7.	Tell the results animation project (display or presentation)	The teacher invites children to tell the results of their animation projects	Children share the results of their digital animation projects
		The teacher invites children to appreciate the work of a friend's animation project	Children appreciate the work of a friend's digital animation project

The initial coding activities began with an introduction to ScratchJr, and the teacher gave an explanation regarding the various features in ScratchJr and their functions. Then the teacher gave an example of how to create a digital project in the form of an animation through ScratchJr using the demonstration method directly in front of the children. After that, the children were asked to try the practice of making digital projects in the form of animations one by one. During coding activities, the teacher gives directions and repeats instructions if the child makes a mistake. The activity ended with a joint evaluation or reflection session, where children were invited to tell their friends about the results of digital projects in the form of animations that were successfully made. The teacher gave appreciation

and input related to the work of the digital project in the form of animations that were successfully made by the children. The appreciation from this teacher provides motivational support to children to increase their enthusiasm and confidence when making digital project works in the form of animation through ScratchJr. Teachers hope that with the appreciation of their work, children will be more motivated to be more active in participating in coding activities through ScratchJr and be able to create digital projects in the form of animations that are more interactive and interesting. Documentation of implementation coding activities through ScratchJr can be seen in Figure 2.


The child is opening ScratchJr


The child is starting a new project


The child adds background (theme)


The child adds characters according to the story theme


The child is constructing program blocks to move characters


The child is saving an animation project by typing his name

Figure 2. Implementation of Coding Activities Through ScratchJr

Based on the observations, most children randomly choose ScratchJr's programming blocks to explore first. Children choose the theme of the story according to their liking, choose the background or stage background, and choose a character and provide coding using programming blocks to the selected character so that the character can move according to their wishes. Most of the coding processes that children do to create an animation project are associated with real life. Once the children have completed the first coding process, they can organize the programming blocks based on the goal of the story theme project to be created. During the second coding process onwards, the children had the goal of a story theme in creating digital project animations through ScratchJr.

Based on observations, most children use their time until the last minute, while some spend their time productively exploring the features of ScratchJr. Early childhood experiences of 5 to 6-year-olds who sit in kindergarten using ScratchJr programming in general are enthusiastic and excited when creating ScratchJr projects. Children face challenges, feel failure, and do repeated trials until they become the work of a digital project in the form of animations that contain interesting storylines. Most of the children are very interested in the ScratchJr programming application. The children are enthusiastic about the coding process in choosing various kinds of programming blocks as the basis for creating digital project works in the form of animations using the features of the programming blocks in ScratchJr. Children compile programming blocks and complete the coding process to create digital project works in the form of animations with meaningful, interactive, and interesting storylines.

Coding activities through ScratchJr are activities to create animations by arranging a sequence of graphic programming blocks. ScratchJr is an integral part of early childhood education, learning about coding or programming with guided instructions. Guided instruction will be effective when children have no prior knowledge in the area of learning, and will be beneficial to the child before tackling open-ended tasks. When children try to learn the coding process of creating a ScratchJr project for the first time, they need guidance from an adult or teacher regarding the functions of various ScratchJr features and how to use these features in order to produce digital project works in the form of interactive and interesting animations. Coding activities through ScratchJr at Aisyiyah XI Kindergarten are guided instructions from teachers to make it easier for children to make digital project works in the form of animations through ScratchJr. After the child can follow the instructions from the beginning to the end, the next child is free to make works of art in the form of digital animations according to their imagination and creativity.

Observation of coding activities through ScratchJr at Kindergarten XI Surakarta is carried out naturally, namely when children do simple coding activities to make digital project works in the form of animation, as usual, or naturally, without any engineering. This ensures that the results of the observations reflect the child's true potential, interests, and talents. The researchers found that high enthusiasm, courage, and confidence in children were positively correlated with the ability to create digital project work in the form of animation. The observation results showed that all children (20 children) had achieved a very good level of development in doing coding activities through ScratchJr, shown by the children being able to follow instructions from the teacher so that they could successfully create digital project works in the form of interactive and interesting animations. This indicates that coding activities through ScratchJr are appropriate to the stages of early childhood development.

Building creativity through ScratchJr

Based on the results of observations and interviews with teachers, information was obtained that coding activities through ScratchJr have a positive impact on building early childhood creativity. Coding activities through ScratchJr play an important role in building children's creativity by providing a different learning atmosphere. Based on data from interviews with teachers, coding activities through ScratchJr are still rarely taught for early childhood education or kindergarten. Therefore, the child's growth period, which is often referred to as the golden age, needs to be used as optimally as possible by providing useful activities to help children's growth and development according to the child's age and developmental stages. Teachers implement coding activities through ScratchJr as a means for self-expression as well as building children's creativity from an early age.

Table 3. Connections between Creativity Indicators and Implementation of Coding Activities Through ScratchJr

Aspects	Indicators	Implementation of Coding Activities Through ScratchJr
Fluency	Children can pour out many ideas smoothly	Children are able to generate tons of ideas smoothly through a wide variety of blocks and programming features within ScratchJr to create meaningful, interactive, and engaging animation projects.
Flexibility	Children can produce various types of ideas from various perspectives	Children are able to generate a variety of ideas, answers, or questions, and can see a problem from different perspectives through ScratchJr. For example, if a child wants to make several characters move, they can create a variety of programming blocks that characters can move.
Originality	Children can come up with original ideas from their unique experiences	Children can come up with new ideas or different ideas to produce story animation projects independently through ScratchJr (Children's ideas are different from other children in general).
Elaboration	Children can develop detailed ideas	Children are able to develop ideas by adding or detailing the details of an object in ScratchJr. When a child puts together a variety of programming blocks in a logical order and adds sequence details to the selected characters becomes an interesting interactive animation.

Coding activities through ScratchJr show that early childhood can create creations of digital project works in the form of animations. ScratchJr is entirely block-based with images or symbols, not coding blocks in the form of text. Even if children can't read yet, they can use ScratchJr because it's entirely graphic (non-text). Coding activities through ScratchJr encourage new ways of thinking as children create digital animations with ScratchJr, and children learn how to explore and express themselves by trying out complex programming blocks. During the study, most of the children explored the various blocks of ScratchJr programming to produce digital project work in the form of interesting animations. The integration of technology has become an important part of education, and educational technology has been combined with coding activities that can be taught from early childhood education. In addition to being able to introduce the advancement of technological development, this can help develop children's creativity.

Coding activities through ScratchJr encourage children's curiosity. Curiosity is one aspect of the early childhood learning process. Children's curiosity becomes complex because it can involve affective, cognitive, expressive, physiological, and motivational processes. Therefore, early childhood is very important for having curiosity when learning to code. Children's curiosity during coding activities through ScratchJr is evidenced by children questioning many things during the coding process to make digital animation artworks. Questions that children often ask include: "What is the name of this game?"; "What is the function of this block?"; "How to move the character?"; "How do I change the background of the theme?"; "Can I add another character?"; "How do I delete a character?". Some children actively ask a lot of questions, there are some children complete the coding process by asking a few questions, and there are even children who never ask questions at all. Children's curiosity is one part of the design process. The design process in ScratchJr starts with children asking questions that can trigger ideas and ends with creating product works that can be shared with others. In addition, there are several processes in the coding process that are repetitive, including: asking, imagining, planning, producing, testing, improving or improving, and sharing with others. This method is open because there are many possible answers to a particular problem. Therefore, asking questions during the coding process plays an important role when creating digital project works in the form

of animation through ScratchJr because it shows the ability of the child's design process. Some of these coding processes can build imagination and creativity in early childhood.

Children can put together various programming blocks that are shaped like jigsaw puzzles to make the characters move. When children code with programming blocks in ScratchJr, they learn to think in sequence, explore cause and effect, develop design and problem-solving skills, which can help develop creativity. Children take systematic steps during the coding process through ScratchJr, including: choosing a background according to the theme of the story, choosing a programming block that suits the character so that they can move, then the child completes the coding process according to the purpose of a logical storyline, and forming an interesting animation. ScratchJr provides tools to create interesting story animations by composing a sequence of graphic programming blocks. Therefore, children are free to express themselves using various graphic programming blocks shaped like jigsaw puzzles to create animations according to their creativity.

4. Discussion

The 21st century, as it stands, is an era of very rapid technological development. Technology is developing and spreading to various sectors of life to help humans solve various problems. The role of technology in the world of education is very important. By utilizing technology, teachers become more creative in developing lesson plans, teaching, conducting learning activities, and conducting learning evaluations. Likewise, in the world of early childhood education. Early childhood will certainly be very enthusiastic and happy if the teacher has competence in the field of technology. Technology-based learning taught by teachers will become more varied and creative. The challenges faced by educators are not only limited to developing learning methods that are able to stimulate children's creativity, but also lead to a deep understanding of the role of learning media, especially technology-based ones. Early childhood is characterized by high creativity is characterized by great curiosity, strong imagination, and the ability to produce works. The lack of digital-based innovation in early childhood learning at Aisyiyah XI Kindergarten in Surakarta has also caused a low level of children's creativity. The low level of early childhood creativity associated with the lack of digital-based innovation in learning is supported by several studies. Research highlights that the lack of use of electronic-based learning media has an impact on children's creativity (Rahmawati & Tirtayani, 2021). The results of the study show the significant contribution of technology-based learning media in stimulating children's creativity through visual elements, interactivity, and personal involvement. The implication of this research is the importance of developing a curriculum that integrates the use of digital technology, as well as the role of teachers in supporting the use of digital technology-based learning media. The results of the study show that the wise use of digital technology-based learning media can be a strong foundation for the development of early childhood creativity (Asmara et al., 2023). Other research shows that teachers' low understanding of using digital media, lack of supporting facilities, and lack of support from educational institutions are factors causing the lack of use of digital media for early childhood learning (Lukman, 2023). This has an impact on the lack of stimulation of children's creativity, which should be improved through innovative learning media and in accordance with the characteristics of children's development. Other research shows that the low development of children's creativity in digital works is caused by the lack of understanding of teachers in using computers or laptops. As a result, teachers have not been able to provide creative and fun learning media for early childhood education (Karmila, 2024). Improving the quality of teachers, providing adequate facilities, and supporting educational institutions are needed to encourage optimal use of digital media and help develop early childhood creativity.

In addition, children also become more familiar with technology, which is important to prepare children to face the challenges of the times in the digital era. Therefore, it is necessary for digital education as a provision for children to face the world. One of the efforts to realize digital education is to introduce coding activities through ScratchJr, which provides opportunities for children to explore and create (Unahalekhaka & Bers, 2021). Coding activities through ScratchJr at Kindergarten Aisyiyah XI Surakarta is one of the implementations of coding education learning that is in accordance with the development of the 21st-century era or the digital native generation. Technology is used from various ages until children unknowingly grow up to be digital natives. Digital native is a term for children who are born and raised in the digital era (Yildiz & Guler Yildiz, 2021). Early childhood children who sit in kindergarten today are included in the digital native generation because they use technology as a daily consumption activity. This is by several research results that seek to make children not only use technology, but also need to provide positive activities, so that programs focused on STEAM (Science, Technology, Engineering, Art, and Mathematics) emerged (Yalçın & Erden, 2021). The STEAM integration of this coding activity combines Science (how the program works), Technology (devices and applications), Engineering (compiling logic blocks), Art (editing characters and settings), and Mathematics (sequence of steps). Children are encouraged to learn holistically about its application in real-life situations. This will help learners in terms of becoming great problem solvers.

One of the positive activities that utilizes digital technology media in early childhood education learning is through coding. Coding in early childhood education is the use of digital technology, such as computers, tablets, or smartphones, to create works in the form of digital products. Coding is important to be introduced from an early age because it can help children develop creativity, problem-solving skills, and understanding of digital literacy

through the use of technology for children. One of the implementations of coding in early childhood education is coding activities through ScratchJr. This is by the results of the study, which shows that the experience of preschoolers aged 5 to 6 years using ScratchJr programming is generally enthusiastic and enthusiastic when making ScratchJr projects. Children face challenges, feel failures, and do repeated trials until they become the work of an animation project that contains an interesting storyline (Yang et al., 2022). ScratchJr is a visual introductory programming application to create digital animation projects through coding activities for children aged 5-7 years (Clarke-Midura et al., 2023). The results show that children aged 5-6 years have limited ability to understand coding, so simple features in the form of images or symbols are needed that will be easier for children to understand, such as ScratchJr (Misirli & Komis, 2023). Children can change the look of the character, design the background, add sounds, and then use those programming blocks to bring the character to life. Programming is created by dragging blocks to the coding area and putting them together. All blocks are completely graphic-based (with no text other than numbers) to make it easier to use this programming language before the child can read.

The implementation of coding activities through ScratchJr at Kindergarten Aisyiyah XI Surakarta is in line with the independent curriculum implemented in Indonesia. Early childhood education learning outcomes are in the foundation phase, consisting of elements of religious values and ethics, identity, literacy basics, mathematics, science, technology, engineering, and art (Peraturan Menteri Pendidikan, Kebudayaan, Riset, Teknologi Republik Indonesia Nomor 12 Tahun 2024 Tentang Kurikulum Pendidikan Anak Usia Dini, Pendidikan Dasar, Pendidikan Menengah, 2024). Based on the learning outcomes of the foundation of the independent curriculum, there are technological elements to prepare children to face digital challenges to develop a logical and systematic mindset, creativity, and technology-based decision-making. The use of technology in the Indonesian education curriculum is a strategic step to prepare children for the digital era. Digital technology-based learning is an option that will be applied in schools that have readiness in terms of facilities, infrastructure, and children's abilities. Learning based on digital technology media will not only improve the quality of students, but also help teachers in teaching more efficiently and creatively. Education that integrates digital technology in the curriculum can create an equitable and competitive education system, while creating greater opportunities for all Indonesian children to master skills that are relevant to global technological developments (Kemendikdasmen, 2024). Implementation of coding activities through ScratchJr is one example of digital learning. In addition, coding activities through ScratchJr can also be used as a learning digital project for children, where children can create interesting story animation projects digitally using ScratchJr. Another study proves that through ScratchJr, children learn to arrange programming blocks to create digital project works in the form of simple animations that can develop creativity (Çiftçi & Topçu, 2023). By implementing coding through ScratchJr at Aisyiyah XI Kindergarten Surakarta, it can create a more interactive, creative, interesting, and fun learning environment for early childhood.

The implementation of coding activities through ScratchJr has the potential to develop the skills needed in the 21st century, namely the 5Cs (Creative thinking, Critical thinking, Communication, Collaboration, and Computational thinking) (Hammershøj, 2021; Yalçın & Erden, 2021;Kaya et al., 2025). Developing these 5C skills is considered important to face challenges in today's world of work, education, and social life. Early childhood education is the right time to instill and develop these 5C skills. By familiarizing children with activities that practice the 5Cs, they will be better prepared to learn and develop in the future. The 5Cs are considered important for children to prepare them to answer the challenges of the 21st century. In addition, this competency will hone their ability to think critically in solving problems, so as to encourage them to become innovators who are able to be globally competitive. In its application, the 5C competency is important to be instilled in the golden period of children, which is between the ages of 0-6 years. Because, at this age, children have a very big initiative to develop themselves.

The implementation of coding activities through ScratchJr at Kindergarten Aisyiyah XI Surakarta is also in line with the Dales's Cone of Experience Theory, which explains that in the learning process, emphasis is placed on children as a reminder of events so as to emphasize the stimulus observed by children. Dale's Cone of Experience also explains that the ability to receive material in the learning process will be different; the ability that each child has is related to the use of learning media (Dale, 1976). Based on Dale's Cone of Experience Theory, how to do something (direct experience), children can remember 90% where children can learn to analyze, design, create, and evaluate. This is by Bloom's Theory at the highest level of cognitive development, namely, analyzing, evaluating, and creating. (Bloom, 1956). This hands-on experience can be either a purposeful experience or a planned experience. Learning to code is an example of an activity that simulates a direct experience, allowing children to learn in an interactive and real way, even though digitally.

Coding activities through ScratchJr can also help develop problem-solving skills. Children in the process of creating digital projects work in the form of learning animations to solve problems, such as finding ways to create certain effects or correct mistakes. These findings support research that suggests that the preschool period is a critical time to develop problem-solving skills (Bati, 2021). Other research results stated that children who were given technology-based learning were able to solve problems more creatively, and higher levels of cognitive skills, such as analysis and evaluation, were more developed compared to children who were not given technology-based learning or conventional learning (Gerosa et al., 2022). The results show that children aged 5-6 years have limited ability to understand coding, so simple features in the form of images or symbols are needed that will be easier for children to understand, such as ScratchJr (Misirli & Komis, 2023). Kids can change the look of the character, design the

background, add sounds, and then use those programming blocks to bring the character to life. Programming is created by dragging blocks to the coding area and putting them together. All blocks are completely graphic-based (with no text other than numbers) to make it easier to use this programming language before the child can read. ScratchJr can help develop children's motor skills and eye coordination, and abilities in teamwork or collaboration. Research proves that ScratchJr can develop computational thinking skills because children learn exploratively by trying out complex programming blocks (Çiftçi & Topçu, 2023). Through ScratchJr, children learn to code to design storylines that can develop computational thinking skills, because children think sequentially, explore cause and effect, develop problem-solving, and creativity. Children who are introduced to coding activities through ScratchJr from an early age are allowed to learn to start solving problems in the concrete world through systematic steps related to the coding or programming process.

The implementation of coding activities through ScratchJr at Kindergarten Aisyiyah XI Surakarta is one of the activities by Piaget's Theory of Cognitive Development. The stage of Piaget's cognitive development for children aged 5-6 years is in the pre-operational stage, where the child begins to describe their understanding of the world in the surrounding environment through words and pictures (symbols) (Piaget, 1976). Children begin to use mental images to understand the world around them. Symbolic thinking, reflected in the use of words and images (symbols), began to be used in mental depictions that went beyond the relationship of sensory information to physical action. This stage can be done when doing coding activities, where children can get to know various kinds of shapes or symbols. Learning coding is an important ability because, through learning coding, children are able to reach optimal stages of cognitive development. The preschool period seems to be a critical time to develop problem-solving skills because children at this age are in a transitional stage between concrete and abstract processes. This is important because providing an active experience that encourages children's thinking processes is known to support the transition from concrete to abstract processes (Piaget, 1976). Children aged 5-6 years in Piaget's theory are in the pre-operational stage, where children know the world through symbols, colors, and signs. The result of the ScratchJr story animation project is a representation of symbols, colors, and signs. In addition, children can learn to understand the various forms and functions of programming blocks to create story animation projects through ScratchJr. The child's process of recognizing the shapes and functions of the various features of ScratchJr helps develop children's symbolic thinking skills. This can be seen when children choose the theme of the story according to their wishes, choose the backgorund or stage background and choose the character according to the theme of the story, add sounds, and provide coding to the chosen character so that the character can move according to their wishes when making artwork in the form of attractive digital animation. This shows that early childhood can create simple animations through ScratchJr, as stated Unahalekhaka & Bers (2021) That ScratchJr is entirely block-based with images or symbols, rather than coding blocks in the form of text. Although children can't read yet, they can use ScratchJr because it's completely graphic (with no text other than numbers).

One of the benefits of coding activities through ScratchJr for children is that it can increase creativity. Children can explore a variety of digital tools and techniques to create unique works of art. This is supported by research that shows that when children compile programming blocks to create digital project works in the form of animations through *ScratchJr*, children learn to express themselves and be creative (Zeng et al., 2023). In addition, coding activities through ScratchJr can also expand children's expression media. Coding gives children a new medium to express their ideas and feelings in the form of animations. Children's success in creating digital projects in the form of interactive and interesting animations can increase confidence and the ability to be creative. Children are free to express themselves using programming blocks to create project works in the form of animations according to their creativity. This is supported by research that shows that when children create digital project works in the form of animations with *ScratchJr*, children learn to think sequentially, explore cause and effect, develop design and problem-solving skills, which can help develop creativity (Martins et al., 2023). Coding is an important skill today, because through coding, children are able to develop creativity based on the knowledge and experience gained to help achieve the next stages of children's development at the next level more optimally.

The use of digital technology media in the learning process can provide good benefits in developing aspects of child development as a whole, especially it can also develop cognitive aspects. This is supported by the results of research that the average child who participates in learning and uses digital technology as a learning medium has a positive impact on the development of cognitive, social, emotional, and physical aspects. Children's abilities in cognitive aspects in terms of language, literacy, mathematics, science, and digital literacy have developed very well (Pellas, 2024). The development of early childhood abilities in learning through digital technology media must continue to be carried out with the concept of learning while playing. The implementation of coding activities through ScratchJr at Kindergarten Aisyiyah XI Surakarta is one of the learning activities through digital technology media with the concept of learning while playing. In addition, coding activities through ScratchJr that have been implemented at Aisyiyah XI Surakarta Kindergarten are effective activities to develop creativity in early childhood. Several studies have proven the positive impact of using ScratchJr as a learning medium in an early childhood education environment (Gerosa et al., 2022; Amante et al., 2023; Bers et al., 2023; Misirli & Komis, 2023; Konstantina & Stamatios, 2024). Overall, the research findings support the integration of ScratchJr as an effective and engaging learning medium, as it is an application created specifically for children aged 5-7 years in the form of graphics,

developing children's creativity, and creating a positive digital learning environment. Coding activities through ScratchJr support the learning of today's generation of children in the 21st century, called digital natives.

This research resulted in the finding that coding activities through ScratchJr can develop children's creativity. ScratchJr provides tools to create interesting story animations by composing a sequence of graphic programming blocks. In addition to coding blocks, ScratchJr also has a painting tool to edit and characters according to the desired color. Therefore, children are free to express themselves using coding blocks or painting tools to create animations according to their creativity. In addition, this research also produced findings on how to invite children to learn coding, including: (1) Recognizing children's interests. Teachers find ways to connect children's interests with coding by inviting children to create interactive digital story animations through ScratchJr. (2) Make creativity the focus. The teacher emphasized that coding learning activities can also be a form of creative expression that strengthens the ability of art to stimulate children's creativity. (3) Choose a child-friendly application. Teachers should look for coding learning applications that attract children's attention so that activities are more fun and children do not feel bored. One of the kid-friendly coding learning apps is ScratchJr. ScratchJr is a computer programming application made specifically for children aged 5-7 years old that features graphics (without text other than numbers) to make it easier for children to use this programming language before children can read to create story animation projects through coding activities. Children aged 5-6 years have limited ability to understand coding languages, so it is necessary to have an application with simple features in the form of images or symbols that will be easier for children to understand, such as ScratchJr.

This research has limitations in using facilities in the form of computers. This is due to the limited number of computers owned by schools. Schools do not have the same number of computers, so children need to take turns to be able to learn using computers. Another limitation is that the school does not have computer-specific teachers who support the implementation of coding learning through ScratchJr. The availability of resources and technical support poses challenges for the implementation of coding learning through ScratchJr widely within the Aisyiyah XI Surakarta Kindergarten institution. Limited access to facilities, such as a lack of computer availability in schools, can hinder the implementation of effective programs in schools. Furthermore, the variation in the level of ability to use digital technology devices between teachers and children can affect the smooth learning process of coding through ScratchJr. Teachers need support and training to utilize resources to use digital learning media effectively, and children need guidance to explore the coding process through ScratchJr.

5. Conclusion

This study shows that coding activities through ScratchJr can effectively foster creativity while introducing basic programming concepts and systematic thinking in early childhood. Children are excited and express their feelings with confidence in creating animation project works through ScratchJr. Overall, the children's coding process is very interactive, creative, and engaging. Children are able to create digital project works in the form of animations independently by compiling simple programming blocks that are visual, even though children cannot read yet. This process encourages exploration, imagination, and self-expression in a fun and developmental manner for the child. From an academic perspective, these findings provide evidence that digital technology-based learning can not only be introduced from an early age but also bring real benefits in developing creative, logical, and systematic thinking skills in early childhood. In terms of policy, the results of this study reinforce the importance of integrating digital literacy and the STEAM (Science, Technology, Engineering, Art, and Mathematics) approach into the early childhood education curriculum, as directed in the Independent Curriculum. The integration of STEAM coding activities combines Science (how the program works), Technology (devices and applications), Engineering (compiling logic blocks), Art (editing characters and settings), and Mathematics (step sequence), thus supporting holistic learning according to the STEAM framework. In addition, ScratchJr introduces children to the concept of digital literacy and programming logic, so that from an early age, children become digitally literate and not only as content consumers, but also as simple content creators. The main contribution of this research is to present a coding learning model that is child-friendly, easy to implement by teachers, and able to enrich children's learning experiences in the digital era. ScratchJr is proven not only as a technological medium but also as a bridge that connects children to the digital creative world in a safe and fun way. This research provides a practical and theoretical foundation to support the transformation of early childhood education towards 21st-century learning. Thus, integrating ScratchJr in the early childhood education curriculum is not just about adding new material, but preparing young people who are creative, adaptive, and ready to face the digital challenges of the future.

These findings support the need for further research on the effectiveness of ScratchJr to build 21st-century competencies in early childhood that include the 5Cs (Creative thinking, Critical thinking, Communication, Collaboration, and Computational thinking). Future research is suggested to examine the relationship between the socioeconomic level of the family and children's coding activities, as it can affect children's use of technology. Higher education institutions and early childhood education study programs should include educational technology modules with ScratchJr in teaching methodology courses, so that prospective teachers are ready to integrate coding in the classroom. The preparation of the national curriculum of the education office and ministries can formulate policies so that digital literacy, including the introduction of simple coding, becomes a mandatory part of the early childhood

education curriculum. The government needs to provide adequate computer or laptop devices in every kindergarten and provide training budgets for teachers to ensure that the coding implementation runs smoothly.

6. Acknowledgement

The authors would like to thank all the teachers and children at Aisyiyah XI Kindergarten in Surakarta City for their participation in this research. The authors would also like to thank the Indonesia Endowment Fund for Education (LPDP) and the Ministry of Finance of the Republic of Indonesia for funding this research.

7. References

Amante, L., Souza, E. B., Quintas-Mendes, A., & Miranda-Pinto, M. (2023). Designing a mooc on computational thinking, programming and robotics for early childhood educators and primary school teachers: a pilot test evaluation. *Education Sciences*, *13*(9). https://doi.org/10.3390/educsci13090863

Angeli, C., & Valanides, N. (2020). Developing young children's computational thinking with educational robotics: an interaction effect between gender and scaffolding strategy. *Computers in Human Behavior*, *105*(1), 1–16. https://doi.org/10.1016/j.chb.2019.03.018

Anwar, C., Sofyan, H., Ratnaningsih, N., & Muh. Asriadi, A. M. (2024). Digital technology practices for vocational teachers in the industrial revolution 4.0: mediating technology self-efficacy. *Journal of Pedagogical Research*, *8*(1), 172–190. https://doi.org/10.33902/JPR.202424585

Asmara, A., Judijanto, L., Hita, I. P. A. D., & Saddhono, K. (2023). Media pembelajaran berbasis teknologi: apakah memiliki pengaruh terhadap peningkatan kreativitas pada anak usia dini? *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *7*(6), 7253–7261. https://doi.org/10.31004/obsesi.v7i6.5728

Bakala, E., Gerosa, A., Hourcade, J. P., & Tejera, G. (2021). Preschool children, robots, and computational thinking: a systematic review. *International Journal of Child-Computer Interaction*, *29*, 1–24. https://doi.org/10.1016/j.ijcci.2021.100337

Bati, K. (2021). A systematic literature review regarding computational thinking and programming in early childhood education. *Education and Information Technologies*, *27*(2), 2059–2082. https://doi.org/10.1007/s10639-021-10700-2

Behnamnia, N., Kamsin, A., & Ismail, M. A. B. (2020). The landscape of research on the use of digital game-based learning apps to nurture creativity among young children: a review. *Thinking Skills and Creativity*, *37*(1), 1–12. https://doi.org/10.1016/j.tsc.2020.100666

Behnamnia, N., Kamsin, A., Ismail, M. A. B., & Hayati, A. (2020). The effective components of creativity in digital game-based learning among young children: a case study. *Children and Youth Services Review*, *116*(July), 105227. https://doi.org/10.1016/j.childyouth.2020.105227

Bers, M. U., Blake-West, J., Kapoor, M. G., Levinson, T., Relkin, E., Unahalekhaka, A., & Yang, Z. (2023). Coding as another language: research-based curriculum for early childhood computer science. *Early Childhood Research Quarterly*, *64*(1), 394–404. https://doi.org/10.1016/j.ecresq.2023.05.002

Bloom, B. (1956). *Taxonomy of education objectives the clasification of educational gools handbook 1 : cognitive domain*. Longman Inc.

Çiftçi, A., & Topçu, M. S. (2023). Improving early childhood pre-service teachers' computational thinking skills through the unplugged computational thinking integrated stem approach. *Thinking Skills and Creativity*, *49*(1), 1–14. https://doi.org/10.1016/j.tsc.2023.101337

Clarke-Midura, J., Lee, V. R., Shumway, J. F., Silvis, D., Kozlowski, J. S., & Peterson, R. (2023). Designing formative assessments of early childhood computational thinking. *Early Childhood Research Quarterly*, *65*(January 2022), 68–80. https://doi.org/10.1016/j.ecresq.2023.05.013

Dale, E. (1976). *Audio visual methods in teaching*. Dyden Press.

del Olmo-Muñoz, J., Cózar-Gutiérrez, R., & González-Calero, J. A. (2020). Computational thinking through unplugged activities in early years of primary education. *Computers and Education*, *150*(1), 1–19. https://doi.org/10.1016/j.compedu.2020.103832

Delacruz, S. (2020). Starting from scratchjr: integrating code literacy in the primary grades. *Reading Teacher*, *73*(6), 805–812. https://doi.org/10.1002/trtr.1909

Gerosa, A., Koleszar, V., Tejera, G., Gómez-Sena, L., & Carboni, A. (2022). Educational robotics intervention to foster computational thinking in preschoolers: effects of children's task engagement. *Frontiers in Psychology*, *13*(1), 1–13. https://doi.org/10.3389/fpsyg.2022.904761

Hammershøj, L. G. (2021). Creativity in children as play and humour: indicators of affective processes of creativity. *Thinking Skills and Creativity*, *39*(December 2020), 1–10. https://doi.org/10.1016/j.tsc.2020.100784

Karmila, D. (2024). Pemanfaatan karya digital dalam menstimulus pengembangan kreativitas anak usia dini. *Jurnal Basicedu*, *8*(6), 4606–4615. https://doi.org/10.31004/basicedu.v8i6.8913

Kaya, D., Yaşar, A. Ö., Çetin, İ., & Kutluca, T. (2025). The relationship between the 21st-century skills and computational thinking skills of prospective mathematics and science teachers. *Journal of Pedagogical Research*, *9*(1), 73–95. https://doi.org/10.33902/JPR.202531498

Kemendikdasmen. (2024). *Kemendikdasmen siapkan pembelajaran coding dan kecerdasan buatan untuk siswa sekolah dasar*. Kementerian Pendayagunaan Aparatur Negara Dan Reformasi Birokrasi. https://www.menpan.go.id/site/berita-terkini/berita-daerah/kemendikdasmen-siapkan-pembelajaran-coding-dan-kecerdasan-buatan-untuk-siswa-sekolah-dasar

Kong, S. C., & Wang, Y. Q. (2020). Formation of computational identity through computational thinking perspectives development in programming learning: a mediation analysis among primary school students. *Computers in Human Behavior*, *106*(1), 1–12. https://doi.org/10.1016/j.chb.2019.106230

Konstantina, L., & Stamatios, P. (2024). Enhancing computational thinking in early childhood education through scratchjr integration. *Heliyon*, *10*(10), e30482. https://doi.org/10.1016/j.heliyon.2024.e30482

Kucirkova, N., Evertsen-Stanghelle, C., Studsrød, I., Jensen, I. B., & Størksen, I. (2020). Lessons for child–computer interaction studies following the research challenges during the covid-19 pandemic. *International Journal of Child-Computer Interaction*, *26*(1), 1–12. https://doi.org/10.1016/j.ijcci.2020.100203

Kyza, E. A., Georgiou, Y., Agesilaou, A., & Souropetsis, M. (2022). A cross-sectional study investigating primary school children's coding practices and computational thinking using scratchjr. *Journal of Educational Computing Research*, *60*(1), 220–257. https://doi.org/10.1177/07356331211027387

Lukman. (2023). Rendahnya pemanfaatan media pembelajaran digital pada pembelajaran anak usia dini. *Al-Athfal*, *4*(2), 87–96. https://doi.org/10.58410/al-athfal.v4i2.810

Martins, E. C., da Silva, L. G. Z., & Neris, V. P. de A. (2023). Systematic mapping of computational thinking in preschool children. *International Journal of Child-Computer Interaction*, *36*, 100566. https://doi.org/10.1016/j.ijcci.2023.100566

Miles, matthew B., Huberman, M., & Saldana, J. (2020). *Qualitative data analysis a methods sourcebook* (4th ed.). Sage.

Misirli, A., & Komis, V. (2023). Computational thinking in early childhood education: the impact of programming a tangible robot on developing debugging knowledge. *Early Childhood Research Quarterly*, *65*(January 2022), 139–158. https://doi.org/10.1016/j.ecresq.2023.05.014

Olszewski, B., & Crompton, H. (2020). Educational technology conditions to support the development of digital age skills. *Computers and Education*, *150*(1), 1–9. https://doi.org/10.1016/j.compedu.2020.103849

Pellas, N. (2024). Enhancing computational thinking, spatial reasoning, and executive function skills: the impact of tangible programming tools in early childhood and across different learner stages. *Journal of Educational Computing Research*, *0*(0), 1–30. https://doi.org/10.1177/07356331241292767

Peraturan menteri pendidikan, kebudayaan, riset, teknologi republik indonesia nomor 12 tahun 2024 tentang kurikulum pendidikan anak usia dini, pendidikan dasar, pendidikan menengah, Pub. L. No. 12 (2024). https://peraturan.bpk.go.id/Details/281847/permendikbudriset-no-12-tahun-2024

Piaget, J. (1976). *The child and reality: Problems of genetic psychology*. Penguin Books.

Rahmawati, I. G. A. Y., & Tirtayani, L. A. (2021). Media e-scrapbook untuk menstimulasi kreativitas anak usia dini. *Jurnal Pendidikan Anak Usia Dini Undiksha*, *9*(2), 141. https://doi.org/10.23887/paud.v9i2.35404

Rapti, S., & Sapounidis, T. (2024). "Critical thinking, communication, collaboration, creativity in kindergarten with educational robotics": a scoping review (2012–2023). *Computers and Education*, *210*(1), 1–29. https://doi.org/10.1016/j.compedu.2023.104968

Shin, H., & Gweon, G. (2020). Supporting preschoolers' transitions from screen time to screen-free time using augmented reality and encouraging offline leisure activity. *Computers in Human Behavior*, *105*(1), 1–12. https://doi.org/10.1016/j.chb.2019.106212

Singhal, V. (2022). Precoding skills-teaching computational thinking to preschoolers in singapore using unplugged activities. *Proceedings of International Conference on Computational Thinking Education*, 86–87. https://doi.org/10.34641/ctestem.2022.452

Terroba, M., Ribera, J. M., Lapresa, D., & Anguera, M. T. (2022). Observational analysis of the development of computational thinking in early childhood education (5 years old) through an intervention proposal with a ground robot of programmed directionality. *European Early Childhood Education Research Journal*, *30*(3), 437–455. https://doi.org/10.1080/1350293X.2022.2055102

Unahalekhaka, A., & Bers, M. U. (2021). Taking coding home: analysis of scratchjr usage in home and school settings. *Educational Technology Research and Development*, *1*(1), 1–20. https://doi.org/10.1007/s11423-021-10011-w

Yalçın, V., & Erden, Ş. (2021). The effect of stem activities prepared according to the design thinking model on preschool children's creativity and problem-solving skills. *Thinking Skills and Creativity*, *41*(1), 1–14. https://doi.org/10.1016/j.tsc.2021.100864

Yang, W., Ng, D. T. K., & Gao, H. (2022). Robot programming versus block play in early childhood education: effects on computational thinking, sequencing ability, and self-regulation. *British Journal of Educational Technology*, *53*(6), 1817–1841. https://doi.org/10.1111/bjet.13215

Yildiz, C., & Guler Yildiz, T. (2021). Exploring the relationship between creative thinking and scientific process skills of preschool children. *Thinking Skills and Creativity*, *39*(1), 1–12. https://doi.org/10.1016/j.tsc.2021.100795

Zeng, Y., Yang, W., & Bautista, A. (2023). Teaching programming and computational thinking in early childhood education: a case study of content knowledge and pedagogical knowledge. *Frontiers in Psychology*, *14*(1), 1–13. https://doi.org/10.3389/fpsyg.2023.1252718