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Technology Learning Integration in Kindergarten: From Play to Programming with ScratchJr

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Abstract: *The rapid advancement of 21st-century technology necessitates that young children become not only digital consumers but also develop 5C (Creative thinking, Critical thinking, Communication, Collaboration, and Computational thinking). One innovative approach to fostering these abilities is through early exposure to programming. However, in the context of Surakarta, Indonesia, programming learning has not yet been widely or systematically implemented in kindergarten. This study aims to explore the programming practices of children aged 5–6 using ScratchJr, a visual programming application designed specifically for young learners. A qualitative case study method was employed, involving 20 children from a Kindergarten in Surakarta. Data were gathered through direct observation and documentation of children's project outcomes during individual 30-45-minute sessions. Findings revealed that the majority of children were capable of exploring ScratchJr features and constructing basic programming sequences to create animated story projects. The children exhibited high levels of engagement, curiosity, and creativity throughout the activity. Many demonstrated an understanding of debugging and symbolic thinking. Moreover, ScratchJr served as an effective medium to support artistic expression, indicating the development of creativity and cognitive growth through interactive digital experiences. In conclusion, programming activities facilitated by ScratchJr offer a developmentally appropriate and engaging approach to enhancing computational thinking and creativity. The study recommends increased investment in digital infrastructure and professional development for educators to enable the broader implementation of programming in kindergarten for preparing young learners to thrive in an increasingly digital global world.*

Keywords: *Early childhood; Kindergarten; Programming; ScratchJr; Technology*

Abstrak: *Kemajuan pesat teknologi abad ke-21 menuntut anak-anak usia dini untuk tidak hanya menjadi konsumen digital, tetapi juga mengembangkan 5C (Berpikir kreatif, Berpikir kritis, Komunikasi, Kolaborasi, dan Berpikir komputasional). Salah satu pendekatan inovatif untuk mengembangkan kemampuan ini adalah melalui paparan awal terhadap pemrograman. Namun, dalam konteks Surakarta, Indonesia, pembelajaran pemrograman belum diterapkan secara luas atau sistematis di taman kanak-kanak. Penelitian ini bertujuan untuk mengeksplorasi praktik pemrograman anak usia 5–6 tahun menggunakan ScratchJr, sebuah aplikasi pemrograman visual yang dirancang khusus untuk pelajar muda. Metode studi kasus kualitatif digunakan, melibatkan 20 anak dari sebuah Taman Kanak-kanak di Surakarta. Data dikumpulkan melalui observasi langsung dan dokumentasi hasil proyek anak-anak selama sesi individual berdurasi 30-45 menit. Temuan menunjukkan bahwa mayoritas anak mampu mengeksplorasi fitur-fitur ScratchJr dan menyusun urutan pemrograman dasar untuk membuat proyek cerita animasi. Anak-anak menunjukkan tingkat keterlibatan, rasa ingin tahu, dan kreativitas yang tinggi selama kegiatan. Banyak yang menunjukkan pemahaman tentang debugging dan berpikir simbolik. Lebih lanjut, ScratchJr berfungsi sebagai media yang efektif untuk mendukung ekspresi*

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artistik, yang menunjukkan perkembangan kreativitas dan pertumbuhan kognitif melalui pengalaman digital interaktif. Kesimpulannya, aktivitas pemrograman yang difasilitasi melalui ScratchJr menawarkan metode yang sesuai dan menarik bagi perkembangan anak untuk meningkatkan pemikiran komputasional dan kreativitas. Studi ini merekomendasikan peningkatan investasi dalam infrastruktur digital dan pengembangan profesional bagi para pendidik untuk memungkinkan implementasi pemrograman yang lebih luas di taman kanak-kanak guna mempersiapkan anak-anak untuk berkembang di dunia global yang semakin digital.

Kata Kunci: *Anak usia dini, Taman Kanak-kanak, Pemrograman, ScratchJr, Teknologi*

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INTRODUCTION

Early childhood education is beginning to embrace the changing times as researchers and government policymakers push for an increased focus on STEAM (Science, Technology, Engineering, Art, and Mathematics) education. Several studies have highlighted the importance of introducing STEAM to early childhood to ensure they are immune to entering technology-based jobs in the future (Angeli & Valanides, 2020; Rapti & Sapounidis, 2024). Education must be able to keep up with the increasingly advanced times, standards, and curriculum needs to integrate the use of new digital technology media into early childhood learning in kindergarten. One way to integrate digital technology media in learning is through coding activities (Behnamnia et al., 2020; Israel-Fishelson & Hershkovits, 2022). The 21st century, as it is now, is an era of very rapid technological development. Technology is developing and spreading to various sectors of life to help humans solve various things. Several studies have shown that children not only consume digital media, but also need to engage in positive activities, so that programs focused on STEM (Science, Technology, Engineering, Mathematics) and programming have emerged. Researchers, educators, and practitioners agree on the importance of developing the 5Cs skills to prepare children for the challenges of the 21st century. These abilities can be taught and learned effectively by integrating technology media in learning that can start from the early childhood level.

Whether children are aware of it or not, they 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. One of the efforts to realize digital education is to introduce coding learning (Unahalekhaka & Bers, 2021). Many developed and developing countries have taken policies to utilize digital technology media in the school learning curriculum, one way is by learning coding. 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 approaches, such as how computer systems work (Yalçın & Erden, 2021). The rapid advancement of 21st-century technology necessitates that young children become not only digital consumers but also develop 5C (Creative thinking, Critical thinking, Communication, Collaboration, and Computational thinking) as a response to the Indonesian Kurikulum Merdeka objectives for early childhood. This research is related to the scope of the use and engineering of technology in daily life and the development of interest in observation, exploration, and experimentation activities using the surrounding environment and media according to the rules of the Indonesian Kurikulum Merdeka. Based on the learning outcomes of the Kurikulum Merdeka foundation, 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 digital media technology in Indonesia's education curriculum is a strategic step to prepare children for the digital era.

The availability of digital technology media in several early childhood education schools in Indonesia, especially in the city of Surakarta, actually exists, but teachers have not been able to make optimal use of digital technology media to support early childhood learning activities. Teachers have basic knowledge, but do not have a deep understanding of the design of learning implementation. One of the activities that can stimulate computational thinking skills is coding. However, the teacher did not know this. The problem in the field is in line with research that the low use of digital learning media in early childhood learning is caused by the lack of teacher competence in integrating digital media into learning (Lukman, 2023). In addition, other research shows that early childhood education teachers' understanding of coding learning is in the middle category, meaning that teachers' knowledge about coding learning is still at the level of understanding, not yet in implementation (Sugiana et al., 2023). Other research also states that early childhood education teachers' understanding is still lacking in terms of coding learning (Setianingrum & Hidayana, 2025). The phenomenon found in the field is that teachers are not ready to implement learning by integrating digital technology media in the classroom because they do not know activities that are in accordance with the stages of early childhood development.

Research related to the use of kindergarten teacher media and the relationship between early childhood development abilities emphasizes the importance of integrating digital technology media in learning. The findings suggest that if teachers are interested in digital technology media and find ways to use it positively, it will have a positive impact on the overall development of early childhood abilities (An & Shin, 2024). However, the fact in the field is that teachers have not fully utilized the availability of learning media to attract children's attention. The use of appropriate media greatly affects the learning process, so it requires alternative media that is able to attract children's attention. This problem is important to research in order to find ways to optimize the use of digital technology media to support the learning process in the early childhood education environment.

Based on the data on the problems of initial observations related to the use of digital technology media in learning activities in early childhood education, there is a need for more innovative learning activities through interesting media, so that learning activities are more fun and not boring. The selection and use of appropriate media for early childhood during the learning process greatly affects the achievement of learning goals, because the media used in learning can be used by teachers to convey abstract to concrete knowledge. This concept is in accordance with the stage of early childhood cognitive development, which is still in the concrete operational stage or concrete thinking, according to Piaget's cognitive theory (Piaget, 1959). One of them is through simple coding activities through media in the form of a computer programming application called ScratchJr. This research intends to provide simple coding activities through an interesting medium called ScratchJr. This study seeks to provide a solution to provide an overview of the implementation of ScratchJr in helping to stimulate the computational thinking skills of children aged 5-6 years. ScratchJr is a simple programming application specifically for 5-7-year-olds that has graphic features designed according to the stages of early childhood development (Bers, 2018). ScratchJr uses programming principles that are specially developed according to the stages of early childhood development. ScratchJr helps create a user-friendly environment for teachers to interact with children. This is the reason why the researcher chose ScratchJr as the research medium. In addition, at the research location, there are facilities in the form of school laptops that have not been used for learning. This research intends to introduce digital technology media in helping the process of learning activities in early childhood education, so that it can keep up with the times in the digital era.

ScratchJr is a free digital coding playground that introduces the great ideas of computer science into early childhood education (Strawhacker et al., 2015). Just like in a playground, kids can choose different activities to do and use their creativity while working on animation projects. In addition, children can develop problem-solving in computational thinking (Portelance et al., 2016). ScratchJr allows children to create meaningful animations in a safe and fun environment. Research on computer programming

interventions in early childhood has proven that early childhood can master coding from logical sequences and causal relationships (Bers, 2018b; Misirli & Komis, 2023). Some of the results of these studies show that ScratchJr provides a more meaningful and engaging learning experience and can increase children's involvement in learning compared to conventional learning methods using boring children's worksheets without using digital technology media.

This research is important because it contributes to answering existing empirical and theoretical gaps, especially in the context of the use of digital technology media to stimulate early childhood computational thinking skills. The contribution of the results of this research is expected to provide strategic recommendations for early childhood education teachers to prepare an interesting learning plan by utilizing digital technology media available in schools to introduce digital technology media in helping the learning process in the early childhood education environment, so that it can keep up with the times in the digital era. In addition, the implementation of simple coding activities using ScratchJr can also help stimulate the development of early childhood computational thinking skills, which include aspects of algorithms, debugging, and decomposition.

METHOD

This study uses a qualitative method with a case study approach to understand and explore in depth the practice of coding through ScratchJr. This study aims to explore the practice of coding through ScratchJr in children aged 5-6 years, so that the qualitative research method is in accordance with this study. This study uses a qualitative descriptive approach by collecting and analysing data through direct observation. The researcher chose the case study to explore and examine the information in more depth. Data collection was carried out using observation, interviews, and documentation. The data collected was from children's digital art activities using ScratchJr to create simple animations. The researcher conducted interviews with teachers and collected document data in the form of written documents, photos or images, and videos during observation. Data analysis was carried out using interactive analysis techniques, which include the process of data collection, data condensation, data display, and conclusions drawn (Miles et al., 2020). The collected data is then deduced, coded, divided by theme, and classified, while the final stage is conclusion drawing and verification. The results of the interpretation of the data that have been collected are concluded and validated based on data extracted from field reports. 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. Data analysis techniques are illustrated in Figure 1.

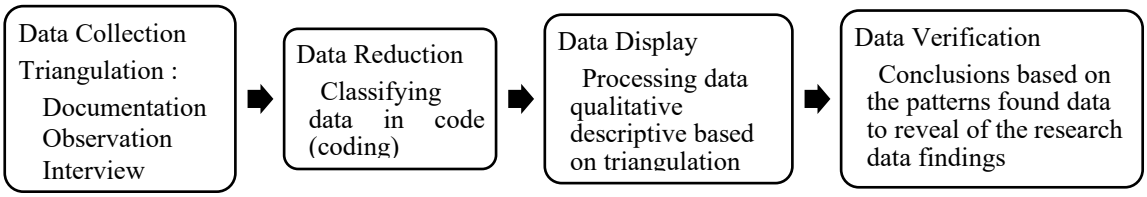

Figure 1. Data Analysis Technique

The data of this study were collected from 20 children aged 5-6 years in one of the early childhood education institutions in the city of Surakarta, Indonesia. All children have the same knowledge background, socioeconomic status, and ability to use technological media. Therefore, 20 samples of children will generate data for this study. Participants were selected based on the purposive sampling method. Purposive sampling was used in this study to select information-rich cases for in-depth analysis according to the research objectives. The data collection techniques in this study include direct observation of the activities of the ScratchJr process at Aisyiyah XI Kindergarten Surakarta for one week with 20 research subjects. The background of the school where the research is located is a private school

where children have never been introduced to digital technology media in the process of learning activities before the research was conducted. The assessment of the process of making the work of the ScratchJr animation project that has been created by the children refers to the assessment rubric adapted from the (Bers, 2018b; Bers, 2021; Bers et al., 2023) can be seen in Table 1.

Table 1 Rubric Assessment of the ScratchJr Animation Project Work Assessment Process

Aspects	Indicator
Algoritmhs	Can follow step by step, according to the commands given to create an animation
Debugging	Children can understand the troubleshooting process using the cross-mark feature to remove errors and try to correct them in the process of creating animations
Decomposition	The child divides the different blocks of ScratchJr programming so that the programming script can be executed to create a ScratchJr animation project

This qualitative data can be used to design a larger-scale pilot program in accordance with the learning curriculum indicators applied in each early childhood education school in the process of coding learning activities using ScratchJr, because this media is free and can be used by anyone.

RESULT AND DISCUSSION

The ScratchJr used in this study was integrated with a larger exploration unit on early childhood learning as part of the standard learning in kindergarten. This learning lasts about ten hours of work over five days (about two hours a day). The implementation of this research is an intensive experience where early childhood will delve into the basic concepts of the coding process using ScratchJr for one week. During this period, early childhood spends one week focusing on designing, creating, and programming ScratchJr ideas that can help with the child's development. The learning presented in this paper provides a learning experience where children can use ScratchJr as a medium to develop a sense of competence in the ability to use technology. ScratchJr also fosters creativity in creating animation projects, from generating ideas to implementation, and ultimately allowing users to share them with the community. The curriculum focuses on learning the basics of coding to create simple animations using a variety of programming blocks. The researcher adapted the curriculum to suit the stages of children's development.

The researcher adjusts the curriculum to the learning principles that the teacher has applied in his class. Researchers provide an opportunity for children to discuss ideas about daily activities, share new ideas, and offer feedback to one another. The teacher stated that in his class, it was important to talk about what happened, what worked, and what didn't work. Children are free to pour their creative ideas into making animation more meaningful and interesting. Teachers find it more effective to integrate ScratchJr with pre-designed curriculum and feel comfortable teaching children. Each learning activity ranges in length from about an hour to more than two hours and is divided into four sections: create a new work animation, add a background, add characters, make the character move, and tell the animation.

Create a new work animation
- Children observe and listen to the teacher's explanation in ScratchJr
- The teacher gives an example using blocks to create animations
- Children create animations using different blocks

Add a background (story theme)
- The teacher gives an example of how to add a background
- Children observe and listen to how to add backgrounds
- Children add background based on their creativity

Add characters and make the character move
- The teacher guides in adding characters according to theme and making the characters move by dragging and arranging programming blocks
- Children are free to choose characters based on the theme
- Children select blocks that are arranged to make characters move by dragging and arranging blocks

Tell the animation (display project or presentation)
- Children share and tell the story of their digital animation project
- Children appreciate the work of a friend's digital animation project

Figure 1. Stages of Programming Learning through ScratchJr

The implementation of ScratchJr as a whole involves ten sessions over one week, with one day consisting of two sessions. Each warm-up and closing activity lasts about twenty minutes, and each main activity lasts about one hour. Researchers set up regular meetings each day to teach coding through ScratchJr, and allocated additional time for the final project. Of the ten sessions, five focused on learning the basics of coding to create simple animations through ScratchJr, while five of them were devoted to children working on their final projects. At the end of the session, the children shared their animation project work by presenting it to teachers and friends in the classroom. The researcher adjusted the coding learning curriculum through ScratchJr with the principles of early childhood development stages and divided it into several activities over a single day. ScratchJr is a storytelling programming language that allows children aged five to seven to create their own interactive stories, collages, and games. The ScratchJr programming language is divided into six categories of on-screen blocks. Children can use a variety of graphic programming blocks, such as trigger blocks (yellow), motion blocks (blue), display blocks (purple), sound blocks (green), control flow blocks (orange), and end blocks (red) to create animation projects. A blue palette containing programming instructions is located along the center of the editor. Children display one category of instructions at a time by clicking the selector on the left.

The first lesson of the programming with ScratchJr, which is divided into two sessions, is devoted to introducing ScratchJr. Instead of visiting the playground for warm-up activities, researchers showed the graphic programming blocks inside ScratchJr to the children. This session meeting is very energetic because the child discovers something new in the classroom. After the teacher demonstrated how to make animations using programming blocks. The next activity was that the children were asked to create

an animation project using the programming blocks. ScratchJr is a storytelling programming language that allows children aged five to seven to create their own interactive stories, collages, and games. With Scratch Jr., children combine graphics programming blocks to make characters move, jump, and dance. Children can modify characters and add their sounds. Children display one category of instructions at a time by clicking the selector on the left. Dragging the instruction block from the palette to the script area below it activates it. Putting the blocks together will create a program that is read and played from left to right. ScratchJr asks children to create code from left to right, just as they are learning to read and write.

After completing the animation, children have the opportunity to present their animated work to their friends, explain the animated themes that have been created, and tell the characters in the animation. Letting children speak for themselves about their work and showing what they are proud of brings joy to teachers. Children enjoy interacting with friends, and this allows them to help develop their language and social skills. The children take turns showing their animation programs and perfecting them if they encounter problems. At the end of each activity, children have a presentation where they can communicate and share ideas from their animation projects with teachers and friends. Children can see the work of their friends' animation projects and can give their appreciation for their friends' animation. This activity provides tangible evidence that coding through ScratchJr can develop children's language and social-emotional skills. Children and teachers sit together in a circle time to discuss the activities that have been carried out, share ideas, discuss what happened, what worked, what didn't, and provide each other with feedback on the work project, children's animations to make them meaningful and interesting.

The skills that a kindergarten teacher needs to facilitate the use of ScratchJr are the ability to use digital technology media to provide direction and guidance when teaching coding to early childhood students. In addition, teachers also need to give children the freedom to express themselves and develop creativity when creating animation projects using various features in ScratchJr. Successful teachers are teachers who are able to recognize children's emotional responses during the debugging process as part of the development of children's self-regulation skills when creating ScratchJr animation projects. Teachers can teach a sense of persistence and never give up when learning to code using ScratchJr, so that children do not feel burdened when learning, because it is made with the concept of play.

ScratchJr is a block-based programming language that supports children to explore great ideas in computer science, such as algorithms, debugging, modularization, control structures, and design processes, in a fun and developmentally appropriate way for children. (Relkin et al., 2021; Yang et al., 2022). ScratchJr introduces computational concepts such as sequencing, looping, occurrence, and operators, and engages the child in cognitive processes related to problem-solving. ScratchJr invites early childhood to engage in coding as 21st-century literacy and develop the ability to use symbols (language) to understand, generate, communicate, and express ideas or thoughts by producing products that can be shared with others (Lin et al., 2020; Tuli & Mantri, 2020). As a form of literacy, coding can help develop a new way of thinking, namely computational thinking, and a new way of producing animations in the coding process to help develop problem-solving skills and creativity in early childhood at work. Implementing ScratchJr in kindergarten can expand the scope of concepts and basic coding. ScratchJr allows children to drag and drop blocks to create a program for each character they choose. Children combine motion blocks, sounds, and displays to program their own stories and games. Further, children can create their own stories with a maximum of four pages in each project that has a beginning, middle, and end. ScratchJr is described as a tech playground for early childhood in kindergarten. Like a playground, the environment is open and allows for child-directed exploration and the creation of projects that express the child's unique interests and individuality (Pellas, 2024; Yang et al., 2022). ScratchJr users are encouraged to learn through experimentation, fix errors, fix bugs, and troubleshoot. ScratchJr is a block programming language that has visual properties that correspond to syntactic properties (Delacruz, 2020; Govind et al., 2020). This helps prevent syntax errors and allows young users to focus

their entire attention on the project their child is working on. ScratchJr, as an introductory programming language, allows children to express themselves and develop creativity.

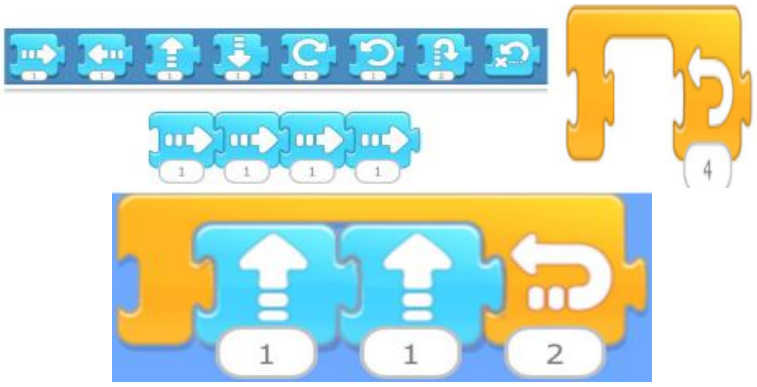

Figure 2. Example of ScratchJr programming block arrangement

Based on Figure 2, the ScratchJr programming blocks are in the form of puzzles that involve movements such as moving forward and backward or left and right turns, as well as repetition blocks. The programming blocks are organized into six categories represented by different types of colors. A forever-repeating block (orange block) can only appear at the end of the program because it requires commands from the previous program. When a script consisting of three programming blocks is executed, the characters that have been selected in the script will go up four times because there are two blue blocks with the up arrow in the repeat block with the number of repetitions twice. These blocks are the technical difficulty points where children have the most difficulty because they have to insert the blue motion block into the orange repetition block to move the character over and over again. This is supported by the results of previous research that stated that the steps of using ScratchJr adapted to the early childhood education curriculum are designed to teach the ScratchJr programming blocks, then ask the child to apply them to the creation of meaningful projects (Bers, 2018b; Bers, 2021; Bers et al., 2023). Learning in early childhood education is simplified to align with developmental stages and age groups. Learning methods vary with the complexity of the programming blocks used. Portelance et al. (2016) explained that the ScratchJr teaching method is divided into three blocks, namely beginner block, intermediate block, and advanced block. The steps of the ScratchJr teaching method, which are divided into three different levels, aim to distinguish the complexity of using the programming blocks that children use in creating an animation project.

The programming block-based language in ScratchJr offers an open setup to create projects of any choice, while engaging with great ideas from computer science. ScratchJr encourages children to explore and practice certain aspects of programming, such as cause and effect, logical sequences, and problem-solving. ScratchJr is like a playground and invites creativity and conflict resolution, constructed according to certain cognitive mechanisms structured in such a way as to allow children to develop certain great ideas or intellectual abilities (Kyza et al., 2022; Konstantina & Stamatios, 2024). One of the main differences between the ScratchJr programming language and other games is that ScratchJr provides a tool for children to come up with their projects openly, and not just to play around with games that are already in development. Through the process of creating animations, children become programmers or producers of animation, also being able to develop problem-solving ability in early childhood in kindergarten. The implementation of the coding curriculum through ScratchJr in kindergarten classrooms aims to invite early childhood to discover, explore, and develop great ideas from computer science concepts that are appropriate to their development. Seymour Papert uses the term great idea to refer to the concept of computer science as a meaningful and useful discipline (del Olmo-Muñoz et al., 2020; Metin, 2020). Bers explained seven great ideas from computer science that can be learned by every early childhood educator, according to its development, namely algorithms, modularity, control structures,

representations, design processes, and debugging (Saxena et al., 2020; Bakala et al., 2021). These great ideas can be connected to many curricular areas of the experience domain outside of computer science, one of which is through a coding-based curriculum. The implementation of this coding curriculum is consistent with the content proposed by the policies of the Ministry of Basic Education and national government regulations in the State of Indonesia.

The use of programming blocks is in harmony with most early childhood curricula that invite children to explore depicted characters of humans and animals (Relkin et al., 2021; Singhal, 2022). ScratchJr's programming blocks can develop a child's potential to be imaginative and creative, imagining projects that can move into meaningful and engaging animations. Children can identify mistakes and complete the steps to correct them. Problem-solving skills are one of the most important skills that need to be emphasized in early childhood education (Yang et al., 2023; Zurnacı & Turan, 2024). The implementation of the coding curriculum through ScratchJr in kindergarten, in addition to learning problem-solving strategies, also provides new ways to express oneself, such as language and art. ScratchJr offers coding activities using a variety of digital programming blocks that can develop children's self-expression through the creation of meaningful and engaging animation projects (Dittert et al., 2021; Critten et al., 2022). ScratchJr is an expressive medium of self-expression, similar to writing, speaking, and art. ScratchJr gives children the opportunity to express their ideas in a meaningful, creative, and expressive way in a personal way. ScratchJr offers easy and challenging activities for early childhood. The implementation of the ScratchJr coding curriculum needs to adjust to the development and cognitive abilities of the child. Early childhood basically needs to be given stimulation and challenges to learn new things.

The selection of ScratchJr for the implementation of the coding curriculum in this study was due to three different factors. This research answers specific needs following the national education policy in Indonesia and provides a unique learning experience for early childhood, so that it can be integrated, integrated, and adjusted according to the needs of the curriculum in kindergarten and teacher professional development. However, regardless of the choice of media, the successful implementation of a children's coding curriculum in a kindergarten classroom must be appropriate for early childhood development, develop rapid problem-solving skills, and be able to provide flexible media that is easy to use for early childhood (Clarke-Midura et al., 2023; Masarwa et al., 2024). It's important to note that the benefits of implementing a coding curriculum aren't limited to technology literacy. ScratchJr can support the development of language, cognitive, physical, motor, math, socio-emotional, and art skills. The problem faced by the field of learning technology education today is not whether to teach coding in early childhood, but how best to choose media that are by the stages of early childhood development.

CONCLUSION AND SUGGESTIONS

Based on the study's results, integrating ScratchJr into the kindergarten coding curriculum does not require teachers to allocate time outside of their teaching hours. Because early childhood learning values personal exploration and achieving goals from any path that makes sense for each child, ScratchJr offers a unique way for children to create new ideas with their imagination and creativity. Traditional learning is typically explored through reading books, discussing in class, and working on children's worksheets. Learning to code through ScratchJr can be another way to understand material in a new, more modern way, as it utilizes digital technology media that gives children the opportunity to create moving images in the form of interesting animation projects. As technology becomes increasingly important in a global society, ScratchJr could become a new way to teach coding in kindergarten classrooms. Teachers integrate the principles of early childhood learning with the use of digital technology media. The teacher pointed out that ScratchJr can be used as a medium that allows early childhood learners to learn basic concepts of simple coding. Although ScratchJr is relatively new in early childhood education, this study shows that the implementation of a learning curriculum that utilizes the use of digital

technology media can be applied in other kindergartens, on the condition that learning should be tailored to the stages of early childhood development. Overall, the findings of this study provide early evidence that the coding curriculum through ScratchJr has a positive impact on early childhood development in the cognitive, social-emotional, and creativity domains. In addition, the 5C skills that were most improved through this intervention were computational thinking skills and creativity.

Based on the results of the research that has been conducted, it is recommended that the Surakarta City Education Office include creative programming into the local curriculum choice subjects at the early childhood education level or kindergarten, and provide training to teachers to develop digital technology-based learning media that are in accordance with the Indonesian cultural context. In addition, teachers can also design hybrid models where programming is integrated with physical games or arts and crafts. Recommendations for parental involvement strategies to expand programming activities at home can also be done with boundary rules that are appropriate to the stages of early childhood development. Parents can be a discussion buddy for children when creating programming through ScratchJr to create meaningful and engaging interactive story animation projects.

Future research should combine the implementation of the coding curriculum through ScratchJr with instruments for assessing children's abilities. The combination of qualitative and quantitative assessments collected from classroom teachers can further expand research findings informing best practices for integrating the ScratchJr curriculum in kindergarten classrooms. In addition, future research will use control groups to compare ScratchJr with conventional learning through traditional storytelling.

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