



The Influence of Game-Based Coding Learning on Creativity in Early Childhood Education

Ibnu Imam Al Ayyubi¹, Siti Rahmawati²

¹ Institut Darul Falah Bandung Barat, Indonesia; ibnuimam996@indaf.ac.id

² Sekolah Indonesia Luar Negeri (SILN) Makkah, Saudi Arabia; alice.sitirahmawati@gmail.com

ARTICLE INFO

Keywords:

Game-Based Coding Learning; Early Childhood Creativity; Early Childhood Education; Educational Technology; Creative Learning.

Article history:

Received 2025-07-06

Revised 2026-03-12

Online Date 2026-04-05

Accepted 2026-04-10

ABSTRACT

The integration of coding into early childhood education has gained increasing attention as digital literacy becomes an essential competency in the twenty-first century. However, empirical studies examining how game-based coding activities contribute to creativity development among young children remain limited. This study aims to explore how game-based coding instruction influences creativity in early childhood education settings. Using a qualitative case study approach, the research was conducted at TK Wulil Amri, an early childhood education institution that has implemented game-based coding in its learning activities. Participants included children aged 5–6 years, teachers, and parents. Data were collected through in-depth interviews, participatory observations, and document analysis, and analyzed using thematic analysis. The findings indicate that game-based coding activities support children's creative development by encouraging divergent thinking, problem-solving, and exploratory learning behaviors. Children actively experimented with different coding possibilities rather than merely following instructions, demonstrating initiative and imaginative engagement in the learning process. This study contributes to the emerging field of digital learning in early childhood education by highlighting the potential of game-based coding as a pedagogical strategy to foster creativity in young learners. The findings also suggest that developmentally appropriate educational technologies can play an important role in supporting creative learning environments in early childhood education.

This is an open access article under the [CC BY-NC](#) license.



Corresponding Author:

Ibnu Imam Al Ayyubi

Institut Darul Falah Bandung Barat; ibnuimam996@indaf.ac.id

1. INTRODUCTION

Game-based coding learning has emerged as an innovative approach in contemporary education, particularly in early childhood education, where play-based learning forms the foundation of cognitive and socio-emotional development. The rapid advancement of digital technology has encouraged educational institutions to introduce computational thinking and coding concepts from an early age¹. Coding activities are not merely related to mastering programming languages; rather, they foster essential twenty-first century skills such as logical reasoning, problem-solving, creativity, and analytical thinking². For young children, integrating coding with game elements provides an engaging and developmentally appropriate learning environment in which abstract concepts can be explored through play, exploration, and experimentation.

The importance of play in early learning is consistent with the cognitive development theory of Jean Piaget, which emphasizes that children actively construct knowledge through interaction with their environment. Within this framework, game-based learning allows children to develop cognitive structures through hands-on activities and exploratory experiences. Consequently, the integration of coding into playful learning environments has the potential to stimulate creative thinking by encouraging children to experiment with ideas, explore alternative solutions, and express their imagination through digital problem-solving tasks.

Despite the growing interest in coding education, its implementation in early childhood education remains a subject of debate. In many educational settings, coding instruction is still designed primarily for older students, often involving technical approaches that are not developmentally appropriate for young learners. As a result, early childhood educators face the challenge of adapting coding concepts into forms that are accessible, playful, and aligned with children's developmental characteristics. At the same time, concerns have emerged regarding the excessive use of digital technology in early childhood, particularly the possibility that technology-based activities might reduce opportunities for imaginative play and creativity if not designed carefully. These issues highlight the importance of exploring pedagogical approaches that combine digital learning with play-based strategies to support children's creative development.

Previous studies have examined the role of coding and game-based learning in fostering creativity and cognitive skills among children. Research on game-based coding activities has shown positive effects on students' creative thinking, including improvements in problem-solving abilities, innovative thinking, and cognitive flexibility. Interactive and challenge-based game elements can also increase children's motivation and engagement in learning processes. However, many of these studies have primarily focused on elementary school students, while empirical investigations involving early childhood learners remain relatively limited. Moreover, existing studies often emphasize technological

¹ Ellie S Han, "Comparing the Effectiveness of Game Literacy Education and Game Coding Education in Improving Problematic Internet Gaming," *Frontiers in Psychiatry* 15 (2024), <https://doi.org/10.3389/fpsyt.2024.1377231>; Sibel E Nas, "An Evaluation of the Educational Games Implementation Process From the Teacher Candidates, Students and Parents' Perspective," *Malaysian Online Journal of Educational Technology* 11, no. 4 (2023): 291–308, <https://doi.org/10.52380/mojet.2023.11.4.497>; Se-Kyo Chung et al., "The Effectiveness of Game Coding Education on Problematic Internet Gaming," *Psychiatry Investigation* 20, no. 6 (2023): 531–40, <https://doi.org/10.30773/pi.2022.0218>; Martina H Dlab and Nataša Hoić-Božić, "Effectiveness of Game Development-Based Learning for Acquiring Programming Skills in Lower Secondary Education in Croatia," *Education and Information Technologies* 26, no. 4 (2021): 4433–56, <https://doi.org/10.1007/s10639-021-10471-w>.

² Ainur Sagimbayeva et al., "Teaching Students Programming With the Help of Educational Games in the Conditions of Additional Education in Computer Science," *Cypriot Journal of Educational Sciences* 17, no. 6 (2022): 1943–56, <https://doi.org/10.18844/cjes.v17i6.7542>; Reza E Sulistyningtyas et al., "A Literature Review of Coding for Early Childhood," 2021, <https://doi.org/10.4108/eai.18-11-2020.2311709>.

or cognitive outcomes without sufficiently examining how coding activities contribute specifically to creativity development in early childhood contexts.

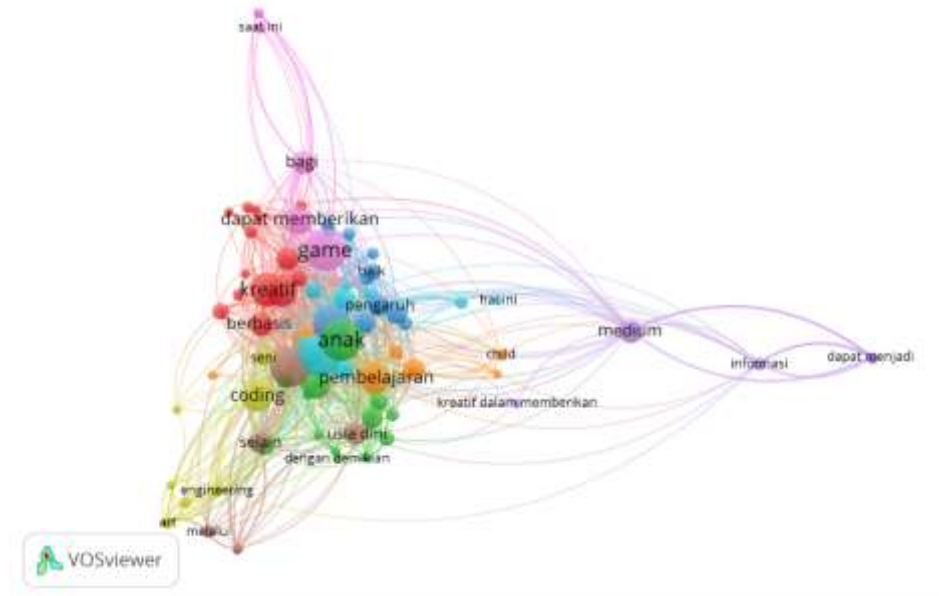


Figure 1. VOSviewer results

The keyword network visualization map image generated using VOSviewer shows the complex relationships between concepts such as "children", "learning", "games", "creative", "coding", and "influence". The keywords "children" and "learning" have large node sizes, indicating a high frequency of occurrence in the literature. Meanwhile, "coding" and "creative" are closely connected to "games", indicating a research focus on how games can be a medium for developing creativity through coding activities. However, the research gap is still seen in the limited number of studies that specifically explore the influence of game-based coding learning on early childhood creativity. The novelty of this study lies in its attempt to fill this gap by analyzing in depth how coding activities in the context of games can stimulate aspects of creativity such as problem solving, critical thinking, and innovation in early childhood.

This limitation indicates a clear research gap in the literature, particularly concerning how game-based coding learning can be adapted to the developmental characteristics of children aged 5–6 years and how such activities influence their creative thinking processes. Addressing this gap is important because early childhood represents a critical period for nurturing creativity, curiosity, and exploratory learning behaviors that form the foundation for later cognitive development. The purpose of this study was to analyze the effect of game-based coding learning on early childhood creativity. This study aims to identify how elements in game-based coding can stimulate various aspects of children's creativity, such as divergent thinking skills, innovation, and problem solving. In addition, this study also aims to explore factors that can influence the effectiveness of this learning, including game design, teaching approaches, and individual characteristics of children. Thus, the results of this study are expected to provide significant contributions in developing more effective and innovative learning strategies to support children's cognitive and creative development from an early age.

2. METHODS

This study employed a qualitative approach using a case study design to explore how game-based coding learning influences creativity in early childhood education. The case study approach was selected to allow an in-depth investigation of children's learning experiences within a real educational context where coding activities were integrated into classroom practice. The participants consisted of 15 individuals, including eight children aged 5–6 years, three kindergarten teachers, and four parents. Participants were selected using purposive sampling, with the criteria that children had participated in game-based coding activities for at least one semester, teachers were directly involved in implementing coding learning, and parents were actively engaged in supporting their children's learning at home.

Data were collected through three main techniques: in-depth interviews, participatory observations, and documentation. In-depth interviews were conducted with teachers and parents to explore their perceptions of children's creativity development after participating in coding-based learning activities. Interviews with children were conducted using developmentally appropriate techniques, including simple guided conversations and interactive questioning during coding activities. Participatory observations were carried out during classroom coding sessions to examine how children explored ideas, solved challenges, and demonstrated creative behavior while interacting with coding games. Observations focused particularly on indicators of creativity such as experimentation, divergent thinking, and problem-solving strategies. In addition, documentation was collected in the form of children's coding project outputs, teacher assessment records, and visual documentation such as photographs and video recordings of learning sessions.

Data analysis was conducted using thematic analysis through several stages. First, all interview recordings and observation notes were transcribed and organized into a systematic dataset. Second, the researcher conducted initial coding to identify meaningful segments related to creativity development during coding activities. Third, similar codes were grouped into categories to generate broader themes. Fourth, the themes were reviewed and interpreted to understand patterns of how game-based coding learning influenced children's creative thinking processes. Finally, the themes were synthesized to produce an analytical explanation of the relationship between coding-based learning activities and early childhood creativity. To ensure data credibility, this study employed source triangulation, which involved comparing information obtained from interviews, observations, and documentation. This process helped verify the consistency of the findings and strengthened the validity of the interpretations. Through these procedures, the study aimed to provide a comprehensive understanding of how game-based coding learning contributes to the development of creativity among young learners in early childhood education settings.

3. FINDINGS AND DISCUSSION

Findings

The results of the study showed that game-based coding learning has a positive impact on early childhood creativity. Based on interviews with teachers at Wulil Amri Kindergarten, children involved in coding learning tend to be more explorative and able to find alternative solutions in solving game challenges. Mrs. Asseng, one of the teachers who teaches coding, stated:

"I see that children who learn game-based coding are more courageous in trying new things. They are not afraid to make mistakes, but are more interested in finding other ways when they experience difficulties. For example, when they are asked to compose commands to move characters in a game, some

children immediately find a solution, while others try various combinations until they succeed. This shows that they are starting to think creatively and are not fixated on just one way."

In line with the teacher's statement, interviews with several parents also revealed that children who participated in coding learning became more active in asking questions and had creative ideas in playing. Mrs. Azkira, one of the parents, said:

"Before learning to code, my child often followed directions without asking many questions. Now he often asks 'why is this happening?' or 'if I try this, can it happen?'. He also started to create his own stories while playing coding games and often invites me to see the results he makes."

The results of observations during the learning process also support the interview findings. Children who participated in game-based coding sessions showed improvements in several aspects of creativity, including: 1) Children were able to find various ways to solve coding challenges in the game, such as changing the order of commands or trying new patterns. 2) Some children seemed enthusiastic about trying additional features in the coding application used, without waiting for instructions from the teacher. 3) Children not only followed the examples given, but also developed their own solutions when faced with errors in coding.

For example, in one learning session, a child named Daffa (5 years old) tried to make a character in a game move in an unusual direction. Instead of following the path that had been taught, he experimented with various combinations of commands until he finally found a new way that his friends had not thought of. When asked why he did that, Daffa answered:

"I'll try another way, who knows it might be faster!"

This shows that children do not only follow instructions, but begin to think more flexibly and independently in finding solutions. Thus, this study shows that game-based coding learning not only helps children understand technological concepts from an early age, but also stimulates their creativity in thinking, exploring, and solving problems. Children's activeness in asking questions, trying new solutions, and their interest in exploring various possibilities in the game are indications that this learning method is effective in developing early childhood creativity.

Discussion

The findings showing an increase in early childhood creativity in game-based coding learning reinforce the view that children learn optimally when they are involved in a fun exploration process. According to Jean Piaget³, children learn through an active process involving exploration and interaction with their environment. In the context of game-based coding, children are not only recipients of information, but also the main actors in constructing knowledge through experimentation, observation, and reflection on their actions. Games that involve the compilation of logical commands in coding, such as moving characters or completing digital challenges, provide children with the opportunity to develop computational thinking.⁴states that computational thinking includes the ability to solve complex problems, recognize patterns, create abstractions, and create algorithms, abilities that are also closely related to the creative process of thinking. Even in early childhood, the initial form of this ability can be honed through simple coding games.

³ Nur Indah Purnamasari Nurhikmah, "Sharpening Kindergarten Children ' s Creativity by Learning Numbers Through Plasticine," *Abdurrauf Social Science* 2, no. 1 (2025): 1–12, <https://doi.org/10.70742/arsos.v2i1.64>.

⁴ Ahmad S Sitorus, "Kepercayaan Diri, Keterampilan Sosial Dan Emosional Anak; Studi Korelasional Dan Stimulasi," *Jurnal Pendidikan Anak Usia Dini Undiksha* 11, no. 1 (2023): 1–7, <https://doi.org/10.23887/paud.v11i1.54350>.

Furthermore,⁵ emphasizes that children's creativity develops through social interaction and support from adults (scaffolding). In game-based coding learning at Wulil Amri Kindergarten, support from teachers who act as facilitators and the role of parents who are responsive to children's enthusiasm have proven to be important factors in fostering children's self-confidence and courage to be creative. The learning process is not instructive, but rather dialogic and open to children's ideas. Thus, the learning experience becomes more meaningful and stimulates creativity socially and individually. From a neuroscience perspective, game-based coding activities also stimulate various areas of the child's brain, including the prefrontal cortex area which plays a role in executive functions such as planning, cognitive flexibility, and decision-making. Jensen⁶ in his book *Teaching with the Brain in Mind* explains that fun problem solving activities, especially in the context of play, are very effective in improving the brain's executive function and creative thinking skills in children. Furthermore, the game-based learning approach itself has been proven to be one of the most effective methods in early childhood education. According to⁷, learning through games encourages children to become active learners, increases intrinsic motivation, and creates a positive emotional atmosphere in learning. All of these factors are very important to encourage the emergence of creativity.

In practice, the results of this study provide an important message for educators and early childhood curriculum designers that coding learning does not need to be postponed until children are older. As long as the approach is adjusted to the child's cognitive and affective developmental stage, coding can be a very potential educational medium. By providing an environment rich in stimulation, providing freedom to explore, and supporting a learning process that does not emphasize the end result, early childhood creativity can develop optimally. In addition, the child's courage to experiment and not be afraid of failure is an important indicator of a growth mindset as stated by⁸. When children feel that mistakes are part of the learning process, they are more open to challenges and more likely to generate new ideas. This shows that game-based coding not only trains technical skills, but also forms a mindset that supports long-term creativity.

Thus, the results of this study not only strengthen previous findings on the benefits of digital learning for early childhood, but also provide new contributions in the local context, namely that with the right approach, digital technology can be a powerful tool for developing creativity even from an early age. This is very relevant in facing the demands of 21st century education that emphasizes creativity, critical thinking, collaboration, and communication (4C).

Understanding Coding

Coding, also known as computer programming, is the process of writing, testing, and maintaining instructions that a computer can understand to perform a specific task. These instructions are written using a programming language designed to communicate commands efficiently to the computer's hardware. Coding allows users to create applications, games, websites, and various other technology programs. In the context of early childhood education, coding does not always mean writing complex code, but rather understanding basic logic and algorithmic thinking patterns that are simple and easy

⁵ Karmila P. Lamadang et al., "Metode Pembelajaran Untuk Meningkatkan Potensi Peserta Didik Melalui Pemahaman Gaya Belajar Pada Taman Kanak-Kanak Kelompok B," *KHIRANI: Jurnal Pendidikan Anak Usia Dini* 2, no. 1 (2024): 97–115.

⁶ Ibnu Imam Al Ayyubi et al., "Comparative Analysis of Islamic Religious Education Teaching Methods and Their Impact on Mathematical Thinking Skills," *International Journal of Education Management and Religion* 2, no. 2 (2025): 72–88, <https://doi.org/https://doi.org/10.71305/ijemr.v2i2.170>.

⁷ Dadan Suryana and Desmila, "Mengembangkan Kreativitas Anak Melalui Kegiatan Bermain Balok," *PAUD Lectora: Jurnal Pendidikan Anak Usia Dini* 5, no. 02 (2022): 143–53, <https://doi.org/10.31849/paud-lectura.v5i02.8632>.

⁸ Ernawulan Syaodih, "Desain Pembelajaran Project Insektarium Mengembangkan Literasi Anak Usia Dini Dalam," *Jurnal Pendidikan Anak* 10, no. 2 (2024): 167–77.

to understand. In addition, coding can also be interpreted as a creative process in which children learn how a system works, encouraging them to think systematically and structured⁹.

Coding helps children develop a variety of cognitive skills, including logical thinking, problem solving, and creativity.¹⁰ Through coding activities, children learn how to break down large problems into smaller, more manageable parts, organize steps systematically, and find efficient solutions. In addition, coding also trains critical and analytical thinking skills, because children must analyze every step they make to ensure the program runs correctly. This activity can also increase children's perseverance and mental toughness, because they learn to try, fail, and try again until they find the right solution. Thus, coding not only trains technical skills, but also forms a character that is resilient in facing challenges.

In game-based learning, coding is often taught through platforms specifically designed for children, such as Scratch, Blockly, or similar apps. These platforms use an intuitive visual interface, where children can drag and arrange code blocks to create simple programs. This approach makes the process of learning to code more fun and interactive, so that children feel like they are playing while learning. In addition, the use of interesting visual elements and varied challenges can increase children's interest in continuing to explore and develop new ideas. This is important to keep their motivation to learn high, while providing a meaningful and enjoyable learning experience.

Overall, coding is not just about teaching children how to create computer programs, but also developing a computational mindset that is useful in various aspects of life. By understanding the basics of coding from an early age, children are not only ready to face challenges in the digital era, but also have the ability to think creatively, innovatively, and adaptively in solving various problems they face in the future. Coding also encourages collaboration, because many programming projects involve teamwork, so children learn how to work together, share ideas, and appreciate the contributions of others. Therefore, introducing coding from an early age is an important investment in building a generation that is ready to face global changes and challenges in the future.

Game-Based Coding in Early Childhood

Game-based coding is an innovative approach to introducing programming concepts to young children through fun and interactive activities.¹¹ This method utilizes game elements such as challenges, rewards, and engaging storylines to build a basic understanding of logic, algorithms, and

⁹ Elena Macrides, Ourania Miliou, and Charoula Angeli, "Programming in Early Childhood Education: A Systematic Review," *International Journal of Child-Computer Interaction* 32 (2022): 100396, <https://doi.org/10.1016/j.ijcci.2021.100396>; Laura d. Ruiter and Marina U Bers, "The Coding Stages Assessment: Development and Validation of an Instrument for Assessing Young Children's Proficiency in the ScratchJr Programming Language," *Computer Science Education* 32, no. 4 (2021): 388–417, <https://doi.org/10.1080/08993408.2021.1956216>; Manar S Alotaibi, "Game-Based Learning in Early Childhood Education: A Systematic Review and Meta-Analysis," *Frontiers in Psychology* 15 (2024), <https://doi.org/10.3389/fpsyg.2024.1307881>.

¹⁰ Ari Sofia, "Interactive Media for Increasing Logical-Mathematical Intelligences in Differentiated Instruction Practice," *Jurnal Obsesi Jurnal Pendidikan Anak Usia Dini* 7, no. 6 (2023): 7445–52, <https://doi.org/10.31004/obsesi.v7i6.5593>; Laila Maharani et al., "Constructive Games Increase Children's Creativity," *Al-Athfaal Jurnal Ilmiah Pendidikan Anak Usia Dini* 5, no. 1 (2022): 76–83, <https://doi.org/10.24042/ajipaud.v5i1.12713>; Joohi Lee et al., "Algorithm Design for Young Children," *Contemporary Issues in Early Childhood* 23, no. 2 (2021): 198–202, <https://doi.org/10.1177/14639491211033663>; Choirudin Choirudin et al., "Mathematical Games Using Real-World Approaches Increasing Kindergarten Students' Learning Creativity," *Journal of Childhood Development* 1, no. 2 (2021), <https://doi.org/10.25217/jcd.v1i2.1861>; Şaide Özbey and Mehlika Köyceğiz, "A Study on the Effect of the Social Skill Education on the Academic Self Respect and Problem Solving Skills of the Pre-School Children," *International E-Journal of Educational Studies* 4, no. 8 (2020): 176–89, <https://doi.org/10.31458/iejcs.727590>.

¹¹ Ana Justicia-Arráez et al., "Can We Manage Behavioral Problems Through the Development of Children's Social-Emotional Regulated Behavior? Longitudinal Study of a Preschool Program," *International Journal of Environmental Research and Public Health* 18, no. 16 (2021): 8447, <https://doi.org/10.3390/ijerph18168447>; Nofi M Siregar et al., "The Basic Learning Model of Traditional Motion Based Games for Early Childhood (5-6) Years," *International Journal of Human Movement and Sports Sciences* 9, no. 1 (2021): 81–88, <https://doi.org/10.13189/saj.2021.090111>.

problem solving. Children are encouraged to understand these abstract concepts through concrete play experiences, making the learning process more natural and intuitive. By using specially designed physical applications or games, such as coding puzzles, educational robots, or interactive applications, children can learn basic programming concepts such as command sequences, loops, and branches without having to deal with complicated syntactic complexities. This allows children to explore their ideas in a creative and fun way.

This approach is effective because children tend to be highly curious and more responsive to exploratory learning. Coding-based games such as "ScratchJr," "Lightbot," or "Code.org" are designed with intuitive interfaces, allowing children to learn independently or with minimal guidance.¹² In addition, colorful visual features and interesting animated characters are able to maintain children's attention longer, making it easier for them to understand the concepts being taught. This activity not only sharpens their cognitive abilities but also encourages children to think logically, develop critical thinking skills, and improve their ability to solve problems systematically. Thus, children become not only users of technology, but also creators who understand how technology works.

In addition to cognitive benefits, game-based coding can also stimulate children's creativity. In the process of designing or modifying games, children are invited to make decisions about characters, storylines, and visual designs. They can create their own virtual worlds, design challenges, and organize interactions between characters, all of which encourage them to think imaginatively and innovatively. This activity allows them to express ideas freely and connect abstract concepts with real experiences, such as creating interactive stories that reflect their personal experiences. Thus, coding is not only seen as a technical skill, but also as a means to develop imagination and innovation, which are very important in forming a creative mindset in the future.

The implementation of game-based coding in early childhood requires an approach that is tailored to their developmental characteristics. Teachers and parents have an important role in supporting this process, both by providing a supportive learning environment and providing positive reinforcement. An environment full of visual aids, interactive devices, and an atmosphere that supports exploration will increase children's interest and motivation in learning to code. This activity should be carried out in a fun, pressure-free, and exploratory atmosphere so that children feel comfortable and motivated. In addition, it is important to provide constructive feedback and celebrate children's small achievements so that they feel appreciated and continue to be enthusiastic about learning. With the right approach, game-based coding can be a strong foundation for developing digital literacy and 21st-century skills from an early age, including critical thinking, collaboration, and adaptability in the digital era.

Guilford's Theory of Creativity

Developed by JP Guilford, it is one of the theories widely used in understanding the creative thinking process. Guilford argues that creativity is not only about producing something new, but also involves the process of divergent thinking, namely the ability to see various possible solutions in solving a problem. In his theory, Guilford identified four main dimensions of creativity, namely fluency (fluency of ideas), flexibility (flexibility of thinking), originality (uniqueness of ideas), and elaboration

¹² Konstantina Louka, "Enhancing Computational Thinking in Early Childhood Education Through ScratchJr Integration," *Heliyon* 10, no. 10 (2024): e30482, <https://doi.org/10.1016/j.heliyon.2024.e30482>; Konstantina Louka, "Programming Environments for the Development of CT in Preschool Education: A Systematic Literature Review," *Advances in Mobile Learning Educational Research* 3, no. 1 (2022): 525–40, <https://doi.org/10.25082/amler.2023.01.001>; Zahrotul Khusniah, Yulia Linguistika, and Erif Ahdhianto, "Analisis Peningkatan Minat Belajar Siswa Dengan Menggunakan Model Game-Based Learning Pada Pembelajaran Matematika Materi Pecahan Kelas v SDN Pw 01," *Primary Jurnal Pendidikan Guru Sekolah Dasar* 11, no. 2 (2022): 613, <https://doi.org/10.33578/jpkip.v11i2.8808>.

(development of details). Each of these dimensions has an important role in measuring and developing a person's creativity. One effective way to stimulate children's creativity is through game-based coding activities, because an interactive and exploratory programming environment can encourage children to develop various creative thinking skills. In this context, each dimension of Guilford's creativity can be discovered and developed through the process of playing while learning to code¹³.

The fluency dimension refers to a person's ability to generate many ideas in a relatively short time. The more ideas that can be generated, the higher the level of fluency of a person's thinking. In game-based coding activities, fluency can be honed when children are asked to create various solutions or scenarios in the games they design. For example, when given the challenge of creating various ways for a character in a game to complete a level, children will learn to come up with as many alternative solutions as possible. The more they practice, the more fluent they will be in connecting various ideas and concepts. In addition, coding platforms designed for children, such as Scratch or Blockly, give them the freedom to experiment with various programming commands and logic, which directly improves their creative thinking skills. By getting used to facing challenges that require many alternative solutions, children also develop confidence in thinking creatively without fear of making mistakes.

The flexibility dimension or flexibility of thinking is related to a person's ability to move from one perspective to another, and adapt to changes in a problem. Flexibility is very important in the world of coding, because programming often involves a trial and error process. When children fail to compile an algorithm or design a game mechanism, they must find another way to solve the problem. For example, if a command in the game does not produce the desired effect, children must try another approach, such as changing the command, changing the programming logic, or even combining various new concepts. This flexibility helps them develop critical thinking skills and the ability to solve problems in innovative ways. In addition, by getting used to adapting their approach to solving programming problems, children also learn to think more openly and not be fixated on just one way of thinking, which is a key characteristic of creative individuals.

The originality dimension in creativity refers to a person's ability to generate unique and unusual ideas. In game-based coding, children have the opportunity to show their originality by creating new elements that do not simply follow existing patterns. For example, when asked to create a character or storyline in a game, they can add innovative features that are different from previous games. They might create a character with unique abilities, develop a game setting that has never been created before, or combine various game mechanics that are rarely used. The more often they are given the freedom to experiment, the more likely they are to produce truly original work. In addition, game-based coding encourages them to think outside the box by combining various elements of creativity, such as visual design, music, and interactions in the game. This process not only helps hone creativity in programming, but also in various other aspects of life that require innovation and unique thinking.

The elaboration dimension or development of details relates to a person's ability to expand, refine, and enrich existing ideas to make them more complex and more interesting. In game-based coding, elaboration is seen in the process of enriching the game with various additional features that enhance

¹³ Erkan Çalışkan, "The Effects of Robotics Programming on Secondary School Students' Problem-Solving Skills," *World Journal on Educational Technology Current Issues* 12, no. 4 (2020): 217–30, <https://doi.org/10.18844/wjet.v12i4.5143>; Meryem Ş Özcan et al., "Does Learning to Code Influence Cognitive Skills of Elementary School Children? Findings From a Randomized Experiment," *British Journal of Educational Psychology* 91, no. 4 (2021): 1434–55, <https://doi.org/10.1111/bjep.12429>.

the user experience.¹⁴ For example, once children have successfully created a basic game, they can develop the game by adding sound effects, more complex animations, or even more challenging game mechanics. In this way, they are not only thinking creatively in creating the initial idea, but also in developing and refining the idea into something more interesting and more mature. This ability to pay attention to detail is very important in the world of programming, where small errors in code can have a big impact on the entire system. By getting used to developing ideas in depth, children also learn to be patient and persistent in completing their creative projects.

Overall, game-based coding activities provide ample opportunities for children to develop the four dimensions of creativity according to Guilford's theory. Through coding, they learn to think fluently by generating many ideas, be flexible in adapting to change, be original in creating new concepts, and be thorough in developing and refining their projects. In addition, game-based coding also teaches children to face challenges in a fun way, reduce the fear of failure, and increase self-confidence in exploring creative ideas. Thus, learning to code is not only beneficial in technical aspects, but also has a significant impact on the development of creative thinking skills that can be applied in various areas of life.

Multiple Intelligences Theory

Howard Gardner stated that human intelligence is not limited to one type, but consists of various complementary aspects. In the context of game-based coding learning, this theory is relevant because coding activities can stimulate various types of intelligence, especially logical-mathematical intelligence and creative intelligence. Logical-mathematical intelligence includes the ability to think analytically, solve problems, and understand patterns and cause-and-effect relationships. When children are involved in coding activities, they are faced with logical challenges, such as creating simple algorithms, predicting the results of a series of commands, and fixing errors (debugging). This process trains them to think systematically and develop strong analytical skills.

In addition, learning to code also plays a significant role in increasing creative intelligence. This intelligence is not only related to art or visual expression, but also includes the ability to find innovative solutions and think outside conventional boundaries. Through coding-based games, children are given the freedom to design their own projects, create characters, determine storylines, and develop simple applications. This activity stimulates their imagination and encourages the exploration of new ideas, so that creativity develops along with the technical skills they master.

The relationship between logical-mathematical intelligence and creative intelligence in coding learning shows that these two aspects do not run separately, but rather support each other. Children who are able to solve logical problems with a creative approach tend to be more flexible in thinking and more adaptive to new challenges. Thus, the application of game-based coding learning not only improves children's technical abilities, but also develops their intelligence potential holistically according to Gardner's Multiple Intelligences concept. This shows that coding is not just a technological activity, but also an effective tool to empower various dimensions of children's intelligence from an early age¹⁵.

¹⁴ Georgia E Kalyva, "Study on the Implementation of the CAL (Coding as Another Language) Curriculum in Early Childhood Education," *Advances in Mobile Learning Educational Research* 4, no. 2 (2024): 1224–41, <https://doi.org/10.25082/amler.2024.02.015>.

¹⁵ Munise S Kapucu, "Studies on Robotic Coding Education in Science Education: A Systematic Literature Review," *Journal of Education in Science Environment and Health*, 2023, 74–84, <https://doi.org/10.55549/jeseh.1239093>; Syarifuddin Syarifuddin, Junaidi F Efendi, and Faiz A Fauzia, "Pemahaman Mitigasi Bencana Alam Siswa Berbasis Permainan Tradisional Pada Pembelajaran Matematika Di Sekolah Darurat Semeru," *Teorema Teori Dan Riset Matematika* 8, no. 1 (2023): 152,

Game-Based Coding Implementation Design in Early Childhood Education

The implementation of game-based coding in early childhood education requires a design that is in accordance with the characteristics of children's cognitive and emotional development. At this stage, the approach used must be exploratory, fun, and interactive to maintain children's interest and curiosity. Basic coding concepts, such as sequence, loop, and simple logic (conditional), can be introduced through play activities that involve manipulating physical or digital objects. For example, games such as coding puzzles or simple robots can help children understand how sequential instructions can produce a certain action.¹⁶

Strategies for implementing coding in early childhood learning environments involve a play-based learning approach that emphasizes hands-on experience. Teachers or facilitators need to integrate coding activities into daily routines, such as using interactive board games, command cards, or educational applications specifically designed for children. In addition, the use of tools such as Bee-Bot or Cubetto allows children to program robot movements through simple instructions without the need to understand complex programming syntax. This makes the learning process more concrete and easier to understand.

To support implementation in the field, there are various books specifically designed to teach coding concepts to children. Books such as "Hello Ruby: Adventures in Coding" by Linda Liukas introduce programming through creative adventure stories, so that children learn basic logic without having to rely on a screen. Meanwhile, "Coding Games in Scratch" by Jon Woodcock provides a practical guide to creating simple games with the Scratch platform, which is very suitable for children. Other books, such as "Teach Your Kids to Code" by Bryson Payne, help parents and teachers understand how to teach the basics of Python programming in a fun way. With references from these books, teachers and parents can design coding activities that are more varied, interactive, and in line with the developmental needs of early childhood.

The Influence of Coding Games on Children's Creativity Aspects

Coding games have a significant influence on the development of children's creativity aspects. One of the main elements that plays a role is the challenges presented in the game. These challenges encourage children to think critically and find innovative solutions in solving various problems faced during play. When children are faced with situations that require certain strategies, they learn to design, test, and improve solutions independently. This process not only improves problem-solving skills but also sharpens children's imagination in creating new, more effective approaches.¹⁷

In addition to challenges, the imagination element in coding games also plays an important role in stimulating children's creativity. Through games, children are given the freedom to explore a virtual

<https://doi.org/10.25157/teorema.v8i1.9786>; Tatang Aulia Rahman, Nur Lailatul Fitri, and Ana Aulia, "Implementasi Model Pembelajaran Sentra Untuk Mengoptimalkan Kecerdasan Majemuk," *Al-Hikmah: Indonesian Journal of Early Childhood Islamic Education* 6, no. 02 (2022): 145–57, <https://doi.org/10.35896/ijecie.v6i02.411>; Catherine C Chase et al., "Can Typical Game Features Have Unintended Consequences? A Study of Players' Learning and Reactions to Challenge and Failure in an Educational Programming Game," *British Journal of Educational Technology* 52, no. 1 (2020): 57–74, <https://doi.org/10.1111/bjet.13021>.

¹⁶ Benedicta A P Trisnadewi, "Meningkatkan Aspek-Aspek Perkembangan Anak Usia Dini Melalui Permainan Congklak: Studi Literatur," *Jurnal Jendela Pendidikan* 4, no. 01 (2024): 48–57, <https://doi.org/10.57008/jjp.v4i01.688>; Aulia Rahman, Fitri, and Aulia, "Implementasi Model Pembelajaran Sentra Untuk Mengoptimalkan Kecerdasan Majemuk."

¹⁷ Evrim D Şakrucu, Samet Ata, and Şule Kışla, "Fathers' Views and Understandings on Promoting Creativity in Children Aged 24-36 Months: A Qualitative Study," *Primenjena Psikologija* 16, no. 3 (2023): 297–324, <https://doi.org/10.19090/pp.v16i3.2436>; Yongjian Wu and Yu Sun, "An Autochess Game Designed to Improve the Critical Thinking Skills of Its Players," 2023, <https://doi.org/10.5121/csit.2023.130612>; Ratu N Khalidah, "Development of Children's Creativity Through Traditional Games Ba-a-Anakan and Ba-Ka-Kapalan," *Jurnal Indria (Jurnal Ilmiah Pendidikan Prasekolah Dan Sekolah Awal)* 7, no. 2 (2022), <https://doi.org/10.24269/jin.v7i2.5715>; Sulistyanyngtyas et al., "A Literature Review of Coding for Early Childhood."

world full of endless possibilities. They can design characters, set storylines, and determine game rules according to their imagination. This activity allows children to develop divergent thinking skills, namely the ability to generate various unique and original ideas or solutions. Well-stimulated imagination will help children develop broader creativity, not only in the context of games but also in everyday life.

Exploration is also an important aspect in coding games that contributes to the development of children's creativity. In the exploration process, children are given the opportunity to try various features, experiment with code, and evaluate the results directly. This activity encourages high curiosity and a desire to continue learning new things. Continuous exploration helps children understand that failure is part of the learning process, which ultimately forms an attitude of never giving up and the ability to think creatively in facing challenges.

Theoretically, the influence of coding games on children's creativity can be explained through Vygotsky's constructivism theory, which emphasizes the importance of social interaction and direct experience in the learning process. Coding games provide an interactive and collaborative environment where children can share ideas, discuss, and work together to solve problems. This interaction enriches their learning experience and expands their creative horizons through the exchange of ideas with peers or educators. Thus, coding games not only develop individual creativity but also improve collaborative skills that are important in children's social lives.

Overall, coding games contribute significantly to developing children's creativity through challenges, imagination, and exploration. These elements work synergistically to create a fun and meaningful learning experience. Children not only learn about basic programming concepts but also develop critical, innovative, and adaptive thinking skills. Therefore, integrating coding games into early childhood education curriculum can be an effective strategy to support their cognitive and creative development holistically.

Benefits of Coding Learning for Early Childhood

1. Develop Critical Thinking and Problem Solving Skills

Learning to code encourages children to develop critical thinking and problem-solving skills from an early age. In the process of creating a simple program, children are faced with various challenges that require them to analyze the problem in depth, identify the source of the error, and think of an effective solution. They learn to break down complex problems into smaller, more manageable steps, an approach known as decomposition. In addition, coding teaches the concept of logical reasoning, where children must determine the right sequence of instructions to achieve the desired goal. This process trains them to not only focus on the end result, but also understand each step needed to achieve it. Thus, children's critical and analytical thinking skills develop naturally, which can later be applied in various aspects of everyday life.¹⁸

2. Improve Computational Thinking Skills

Computational thinking skills are an important foundation in learning coding. Children are taught to understand how computers work to complete tasks, including how data is processed and how algorithms are used to produce certain outputs.¹⁹ Through coding, they learn to recognize patterns, make predictions, and develop simple algorithms to solve problems. For example, in creating an

¹⁸ Damla Kalyenci, Şermin Metin, and Mehmet Başaran, "Test for Assessing Coding Skills in Early Childhood," *Education and Information Technologies* 27, no. 4 (2021): 4685–4708, <https://doi.org/10.1007/s10639-021-10803-w>.

¹⁹ Nurhikmah; Nursalam; "Representasi Kalimat Pada Tuturan Anak Usia 3,6 Tahun," *RETORIKA: Jurnal Bahasa, Sastra, Dan Pengajarannya* 11, no. 2 (2018): 175, <https://doi.org/10.26858/retorika.v11i2.6210>.

interactive game, children must determine how the characters in the game move, react to commands, and interact with other objects. This activity involves not only logic but also creativity in designing efficient solutions. Computational thinking skills that are formed early on will be valuable capital in facing challenges in the digital era, where understanding technology and data is becoming increasingly important.²⁰

3. Train Perseverance and Resilience

The process of learning to code is often full of challenges, such as facing errors, bugs, or program results that are not as expected. This condition teaches children to be persistent and never give up.²¹ They learn that failure is a normal part of the learning process and provides an opportunity to understand mistakes, analyze their causes, and try different approaches. Children also learn the importance of trial and error, where they must continue to experiment until they find the right solution. This resilience helps them develop a positive mentality towards failure, turning it into a valuable learning experience. Thus, learning to code not only hones technical skills, but also forms a child's character that is resilient, patient, and able to manage frustration well.²²

4. Encourage Collaboration and Teamwork

Although coding is often thought of as an individual activity, many programming projects actually involve teamwork. Children are taught to collaborate, discuss, and share ideas with their peers in developing a simple program or game. They learn how to divide tasks according to their abilities, manage time effectively, and appreciate the contributions of each team member. In addition, through group discussions, children can develop good communication skills, such as explaining their programming logic, providing constructive feedback, and accepting criticism positively. This collaborative learning environment not only improves the final outcome of the project, but also strengthens social skills that are essential in everyday life and in the future workplace.

5. Improving Digital Literacy

In today's digital age, digital literacy is an essential skill. Learning to code provides a basic understanding of how technology works behind the scenes. Children learn that the apps, games, and software they use every day did not just appear out of thin air, but rather the result of a series of codes written by programmers. This understanding helps them become more critical and wise users of technology. In addition, coding also teaches basic principles of digital security, such as the importance of maintaining data privacy and understanding potential risks in cyberspace. With good digital literacy, children can develop a more responsible attitude in using technology, and be better prepared to face the challenges of the ever-evolving digital age.

6. Sharpen Math Skills

Coding learning indirectly helps children understand mathematical concepts in a more interesting and applicable way. In creating programs, they often deal with logical operations, numerical

²⁰ M G Supiarmo, Turmudi Turmudi, and Elly Susanti, "Proses Berpikir Komputasional Siswa Dalam Menyelesaikan Soal Pisa Konten Change and Relationship Berdasarkan Self-Regulated Learning," *Numeracy Journal* 8, no. 1 (2021): 58–72, <https://doi.org/10.46244/numeracy.v8i1.1378>; M G Supiarmo, Liny Mardhiyattirrahmah, and Turmudi Turmudi, "Pemberian Scaffolding Untuk Memperbaiki Proses Berpikir Komputasional Siswa Dalam Memecahkan Masalah Matematika," *Jurnal Cendekia Jurnal Pendidikan Matematika* 5, no. 1 (2021): 368–82, <https://doi.org/10.31004/cendekia.v5i1.516>.

²¹ Eko Prayetno et al., "Application of Geogebra in Mathematics Learning Using a Realistic Mathematics Education Model," *JTL: Journal of Teaching and Learning* 1, no. 2 (2024): 121–34.

²² Dhiya A Purwanti and Erin R Kustanti, "Hubungan Antara Resiliensi Dengan Psychological Well-Being Pada Ibu Yang Memiliki Anak Dengan Gangguan Autis," *Jurnal Empati* 7, no. 1 (2020): 283–87, <https://doi.org/10.14710/empati.2018.20219>.

calculations, and pattern recognition and data structures.²³ For example, when creating a game, children must calculate coordinates to move characters or determine scores based on certain rules. This activity teaches basic mathematical concepts such as geometry, arithmetic, and mathematical logic without making children feel burdened. In addition, coding also develops analytical thinking skills that are important in solving mathematical problems. With an interactive and fun approach, children can change their perception of mathematics, from a difficult subject to something challenging and fun.

7. Developing Abstract Thinking and Imagination Skills

Coding encourages children to think abstractly, which is the ability to understand and manipulate concepts that are not physically visible. When writing code, children must imagine how the instructions they create will be translated into actions on the computer screen. They learn to design program logic, predict the results of certain commands, and understand cause-and-effect relationships in the digital world. In addition, coding also stimulates children's imagination in creating something new, such as designing games, creating animations, or developing interactive stories. This process allows them to express their creative ideas in digital form, which is not only entertaining but also expands the boundaries of their imagination. Thus, coding becomes a bridge that connects logical thinking skills with unlimited creativity.

8. Increase self-confidence

Every time a child successfully completes a program or solves a difficult coding problem, they feel a significant sense of personal accomplishment. This success provides a huge boost to their self-confidence. Children learn that with effort, persistence, and the right mindset, they can overcome challenges that initially seemed overwhelming. In addition, coding gives children the opportunity to show off their work to others, whether they are friends, teachers, or family, which further strengthens their sense of self-worth. This process helps them develop a positive attitude toward learning, increases intrinsic motivation, and builds a belief that they have the ability to achieve their goals, not only in coding but in other aspects of life as well.

9. Provides a Foundation for Future Skills

In a world that is increasingly connected to technology, coding is becoming one of the most valuable future skills. While not all children will become professional programmers, understanding the basics of coding opens up many opportunities in various fields. Coding teaches analytical thinking and problem-solving skills that are relevant in almost every profession, from science, engineering, design, to business. In addition, with the development of technologies such as artificial intelligence, robotics, and data analysis, coding skills are becoming an asset that can provide a competitive advantage in the global job market. Therefore, introducing coding at an early age not only prepares children for future challenges but also gives them the freedom to explore their interests and potential in various fields.

4. CONCLUSION

Based on the research results, it can be concluded that game-based coding learning has a positive impact on the development of creativity in early childhood. Children show divergent thinking skills, courage in experimenting, and a tendency to seek alternative solutions when facing challenges in coding games. The creativity that emerges is not only seen in the results of digital works, but also in the thinking process and social interactions during learning. These findings strengthen theories of child

²³ Sainee Tamphu et al., "Building Bridges to the Future of Learning : Exploring Artificial Intelligence Research Using R-Studio Assisted Bibliometrics," *Cogent Education* 11, no. 1 (2024), <https://doi.org/10.1080/2331186X.2024.2417623>.

development and creativity, such as the views of Piaget, Vygotsky, and Torrance, which emphasize the importance of a learning environment that supports active exploration, social interaction, and freedom of expression. Coding as a form of constructionist learning allows children to become active and creative learners from an early age. With a fun approach and in accordance with developmental stages, digital technology can function as an effective medium in stimulating cognitive and affective functions that support creativity. The practical implications of this study point to the importance of integrating game-based coding learning into the early childhood education curriculum. Teachers and parents are encouraged to provide sufficient space for exploration, appreciate children's thinking processes, and not put too much emphasis on the final result. Teacher training programs and the provision of age-appropriate learning resources are key to ensuring that technology truly serves as a learning tool that liberates and develops children's creative potential from an early age.

REFERENCES

- Ahmad Mukhtar, Ruslaini, Sukma Erita, Rahmawati Shoufiah, Wakib Kurniawan, and Naufal Qadri Syarif. *Metode Penelitian Pendidikan*. Jln. Sungai Lareh No.26, Kel. Lubuk Minturun, Kec. Koto Tengah, Kota Padang, Sumatera Barat: AIKOMEDIA PRESS, 2024.
- Alotaibi, Manar S. "Game-Based Learning in Early Childhood Education: A Systematic Review and Meta-Analysis." *Frontiers in Psychology* 15 (2024). <https://doi.org/10.3389/fpsyg.2024.1307881>.
- Aulia Rahman, Tatang, Nur Lailatul Fitri, and Ana Aulia. "Implementasi Model Pembelajaran Sentra Untuk Mengoptimalkan Kecerdasan Majemuk." *Al-Hikmah : Indonesian Journal of Early Childhood Islamic Education* 6, no. 02 (2022): 145–57. <https://doi.org/10.35896/ijecie.v6i02.411>.
- Ayyubi, Ibnu Imam Al, Eko Prayetno, Indri Saputri, and Akhbar Susilo. "Comparative Analysis of Islamic Religious Education Teaching Methods and Their Impact on Mathematical Thinking Skills." *International Journal of Education Management and Religion* 2, no. 2 (2025): 72–88. <https://doi.org/https://doi.org/10.71305/ijemr.v2i2.170>.
- Çalışkan, Erkan. "The Effects of Robotics Programming on Secondary School Students' Problem-Solving Skills." *World Journal on Educational Technology Current Issues* 12, no. 4 (2020): 217–30. <https://doi.org/10.18844/wjet.v12i4.5143>.
- Chase, Catherine C, Laura J Malkiewicz, Alison Lee, Stefan Slater, Ahram Choi, and Chenmu Xing. "Can Typical Game Features Have Unintended Consequences? A Study of Players' Learning and Reactions to Challenge and Failure in an Educational Programming Game." *British Journal of Educational Technology* 52, no. 1 (2020): 57–74. <https://doi.org/10.1111/bjet.13021>.
- Choirudin, Choirudin, Masrurotul Mahmudah, Muhammad S Anwar, Yuli A S Dewi, and Dhita P Ningtyas. "Mathematical Games Using Real-World Approaches Increasing Kindergarten Students' Learning Creativity." *Journal of Childhood Development* 1, no. 2 (2021). <https://doi.org/10.25217/jcd.v1i2.1861>.
- Chung, Se-Kyo, Sol I Kim, Hyunchan Hwang, and Doug H Han. "The Effectiveness of Game Coding Education on Problematic Internet Gaming." *Psychiatry Investigation* 20, no. 6 (2023): 531–40. <https://doi.org/10.30773/pi.2022.0218>.
- Dlab, Martina H, and Nataša Hoić-Božić. "Effectiveness of Game Development-Based Learning for Acquiring Programming Skills in Lower Secondary Education in Croatia." *Education and Information Technologies* 26, no. 4 (2021): 4433–56. <https://doi.org/10.1007/s10639-021-10471-w>.
- Han, Ellie S. "Comparing the Effectiveness of Game Literacy Education and Game Coding Education in Improving Problematic Internet Gaming." *Frontiers in Psychiatry* 15 (2024).

- <https://doi.org/10.3389/fpsy.2024.1377231>.
- Justicia-Arráez, Ana, M C Pichardo, Miriam R López, and Guadalupe A Corredor. "Can We Manage Behavioral Problems Through the Development of Children's Social-Emotional Regulated Behavior? Longitudinal Study of a Preschool Program." *International Journal of Environmental Research and Public Health* 18, no. 16 (2021): 8447. <https://doi.org/10.3390/ijerph18168447>.
- Kalyenci, Damla, Şermin Metin, and Mehmet Başaran. "Test for Assessing Coding Skills in Early Childhood." *Education and Information Technologies* 27, no. 4 (2021): 4685–4708. <https://doi.org/10.1007/s10639-021-10803-w>.
- Kalyva, Georgia E. "Study on the Implementation of the CAL (Coding as Another Language) Curriculum in Early Childhood Education." *Advances in Mobile Learning Educational Research* 4, no. 2 (2024): 1224–41. <https://doi.org/10.25082/amler.2024.02.015>.
- Kapucu, Munise S. "Studies on Robotic Coding Education in Science Education: A Systematic Literature Review." *Journal of Education in Science Environment and Health*, 2023, 74–84. <https://doi.org/10.55549/jeseh.1239093>.
- Khalidah, Ratu N. "Development of Children's Creativity Through Traditional Games Ba-a-Anakan and Ba-Ka-Kapalan." *Jurnal Indria (Jurnal Ilmiah Pendidikan Prasekolah Dan Sekolah Awal)* 7, no. 2 (2022). <https://doi.org/10.24269/jin.v7i2.5715>.
- Khusniah, Zahrotul, Yulia Linguistika, and Erif Ahdhianto. "Analisis Peningkatan Minat Belajar Siswa Dengan Menggunakan Model Game-Based Learning Pada Pembelajaran Matematika Materi Pecahan Kelas v SDN Pw 01." *Primary Jurnal Pendidikan Guru Sekolah Dasar* 11, no. 2 (2022): 613. <https://doi.org/10.33578/jpkip.v11i2.8808>.
- Lamadang, Karmila P., Anik Mufarrihah, Annisatul Iftitah, and Mawaddah Mawaddah. "Metode Pembelajaran Untuk Meningkatkan Potensi Peserta Didik Melalui Pemahaman Gaya Belajar Pada Taman Kanak-Kanak Kelompok B." *KHIRANI: Jurnal Pendidikan Anak Usia Dini* 2, no. 1 (2024): 97–115.
- Lee, Joohi, Candace Joswick, Kathryn Pole, and Robin Jocius. "Algorithm Design for Young Children." *Contemporary Issues in Early Childhood* 23, no. 2 (2021): 198–202. <https://doi.org/10.1177/14639491211033663>.
- Louka, Konstantina. "Enhancing Computational Thinking in Early Childhood Education Through ScratchJr Integration." *Heliyon* 10, no. 10 (2024): e30482. <https://doi.org/10.1016/j.heliyon.2024.e30482>.
- — —. "Programming Environments for the Development of CT in Preschool Education: A Systematic Literature Review." *Advances in Mobile Learning Educational Research* 3, no. 1 (2022): 525–40. <https://doi.org/10.25082/amler.2023.01.001>.
- Macrides, Elena, Ourania Miliou, and Charoula Angeli. "Programming in Early Childhood Education: A Systematic Review." *International Journal of Child-Computer Interaction* 32 (2022): 100396. <https://doi.org/10.1016/j.ijcci.2021.100396>.
- Maharani, Laila, Untung Nopriansyah, Widia Rahmawati, Haryanti J Harjani, and Ajijah S Nufus. "Constructive Games Increase Children's Creativity." *Al-Athfaal Jurnal Ilmiah Pendidikan Anak Usia Dini* 5, no. 1 (2022): 76–83. <https://doi.org/10.24042/ajipaud.v5i1.12713>.
- Nas, Sibel E. "An Evaluation of the Educational Games Implementation Process From the Teacher Candidates, Students and Parents' Perspective." *Malaysian Online Journal of Educational Technology* 11, no. 4 (2023): 291–308. <https://doi.org/10.52380/mojet.2023.11.4.497>.

- Nurhikmah, Nur Indah Purnamasari. "Sharpening Kindergarten Children ' s Creativity by Learning Numbers Through Plasticine." *Abdurrauf Social Science* 2, no. 1 (2025): 1–12. <https://doi.org/10.70742/arsos.v2i1.64>.
- Nursalam, Nurhikmah; "Representasi Kalimat Pada Tuturan Anak Usia 3,6 Tahun." *RETORIKA: Jurnal Bahasa, Sastra, Dan Pengajarannya* 11, no. 2 (2018): 175. <https://doi.org/10.26858/retorika.v11i2.6210>.
- Özbey, Şaide, and Mehlika Köyceğiz. "A Study on the Effect of the Social Skill Education on the Academic Self Respect and Problem Solving Skills of the Pre-School Children." *International E-Journal of Educational Studies* 4, no. 8 (2020): 176–89. <https://doi.org/10.31458/iejes.727590>.
- Özcan, Meryem Ş, Esra Çetinkaya, Tilbe Göksun, and Yasemin Kisbu-Sakarya. "Does Learning to Code Influence Cognitive Skills of Elementary School Children? Findings From a Randomized Experiment." *British Journal of Educational Psychology* 91, no. 4 (2021): 1434–55. <https://doi.org/10.1111/bjep.12429>.
- Prayetno, Eko, Ai Sri Masfuroh, Raed Awadh Saeed Al-ghatnaini, and Tasnim Saelaemae. "Application of Geogebra in Mathematics Learning Using a Realistic Mathematics Education Model." *JTL: Journal of Teaching and Learning* 1, no. 2 (2024): 121–34.
- Purwanti, Dhiya A, and Erin R Kustanti. "Hubungan Antara Resiliensi Dengan Psychological Well-Being Pada Ibu Yang Memiliki Anak Dengan Gangguan Autis." *Jurnal Empati* 7, no. 1 (2020): 283–87. <https://doi.org/10.14710/empati.2018.20219>.
- Ruiter, Laura d., and Marina U Bers. "The Coding Stages Assessment: Development and Validation of an Instrument for Assessing Young Children's Proficiency in the ScratchJr Programming Language." *Computer Science Education* 32, no. 4 (2021): 388–417. <https://doi.org/10.1080/08993408.2021.1956216>.
- Sagimbayeva, Ainur, Nadira Niyetbayeva, Bolat Tassuov, Tuyenbayeva Kalima, and Arystanova A Bekbulatovna. "Teaching Students Programming With the Help of Educational Games in the Conditions of Additional Education in Computer Science." *Cypriot Journal of Educational Sciences* 17, no. 6 (2022): 1943–56. <https://doi.org/10.18844/cjes.v17i6.7542>.
- Şakrucu, Evrim D, Samet Ata, and Şule Kışla. "Fathers' Views and Understandings on Promoting Creativity in Children Aged 24-36 Months: A Qualitative Study." *Primenjena Psihologija* 16, no. 3 (2023): 297–324. <https://doi.org/10.19090/pp.v16i3.2436>.
- Siregar, Nofi M, Eka F N Sari, Marlinda Budiningsih, and Zulham. "The Basic Learning Model of Traditional Motion Based Games for Early Childhood (5-6) Years." *International Journal of Human Movement and Sports Sciences* 9, no. 1 (2021): 81–88. <https://doi.org/10.13189/saj.2021.090111>.
- Sitorus, Ahmad S. "Kepercayaan Diri, Keterampilan Sosial Dan Emosional Anak; Studi Korelasional Dan Stimulasi." *Jurnal Pendidikan Anak Usia Dini Undiksha* 11, no. 1 (2023): 1–7. <https://doi.org/10.23887/paud.v11i1.54350>.
- Sofia, Ari. "Interactive Media for Increasing Logical-Mathematical Intelligences in Differentiated Instruction Practice." *Jurnal Obsesi Jurnal Pendidikan Anak Usia Dini* 7, no. 6 (2023): 7445–52. <https://doi.org/10.31004/obsesi.v7i6.5593>.
- Sulistyaningtyas, Reza E, Prasetyo Yuliantoro, Dian Astiyani, and Chomisah Nugraheni. "A Literature Review of Coding for Early Childhood," 2021. <https://doi.org/10.4108/eai.18-11-2020.2311709>.
- Supiarmono, M G, Liny Mardhiyatirrahmah, and Turmudi Turmudi. "Pemberian Scaffolding Untuk Memperbaiki Proses Berpikir Komputasional Siswa Dalam Memecahkan Masalah Matematika." *Jurnal Cendekia Jurnal Pendidikan Matematika* 5, no. 1 (2021): 368–82. <https://doi.org/10.31004/cendekia.v5i1.516>.

- Supiarmo, M G, Turmudi Turmudi, and Elly Susanti. "Proses Berpikir Komputasional Siswa Dalam Menyelesaikan Soal Pisa Konten Change and Relationship Berdasarkan Self-Regulated Learning." *Numeracy Journal* 8, no. 1 (2021): 58–72. <https://doi.org/10.46244/numeracy.v8i1.1378>.
- Suryana, Dadan, and Desmila. "Mengembangkan Kreativitas Anak Melalui Kegiatan Bermain Balok." *PAUD Lectura: Jurnal Pendidikan Anak Usia Dini* 5, no. 02 (2022): 143–53. <https://doi.org/10.31849/paud-lectura.v5i02.8632>.
- Syaodih, Ernawulan. "Desain Pembelajaran Project Insektarium Mengembangkan Literasi Anak Usia Dini Dalam." *Jurnal Pendidikan Anak* 10, no. 2 (2024): 167–77.
- Syarifuddin, Syarifuddin, Junaidi F Efendi, and Faiz A Fauzia. "Pemahaman Mitigasi Bencana Alam Siswa Berbasis Permainan Tradisional Pada Pembelajaran Matematika Di Sekolah Darurat Semeru." *Teorema Teori Dan Riset Matematika* 8, no. 1 (2023): 152. <https://doi.org/10.25157/teorema.v8i1.9786>.
- Tamphu, Sainee, Imam Suyitno, Gatut Susanto, Nia Budiana, and M Rais Salim. "Building Bridges to the Future of Learning : Exploring Artificial Intelligence Research Using R- Studio Assisted Bibliometrics." *Cogent Education* 11, no. 1 (2024). <https://doi.org/10.1080/2331186X.2024.2417623>.
- Trisnadewi, Benedicta A P. "Meningkatkan Aspek-Aspek Perkembangan Anak Usia Dini Melalui Permainan Congklak: Studi Literatur." *Jurnal Jendela Pendidikan* 4, no. 01 (2024): 48–57. <https://doi.org/10.57008/jjp.v4i01.688>.
- Wu, Yongjian, and Yu Sun. "An Autochess Game Designed to Improve the Critical Thinking Skills of Its Players," 2023. <https://doi.org/10.5121/csit.2023.130612>.