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Unplugged Coding in Preschool: Tiny Hands Coding Project Sample

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ABSTRACT

This study aims to investigate the effects of unplugged coding activities on various skills of preschool children. In today's world, where the role of technology in education is increasingly significant, the importance of coding skills in early childhood education is emphasized. Coding supports the development of 21st-century skills such as problem-solving, logical thinking, and creativity. In this study, unplugged coding activities conducted with 4- and 5-year-old children in a preschool in Ankara were evaluated for their effects on children's computational thinking, geometry, numbers and counting, opposites, seasons, language, and motor skills. The research was conducted using a single-group pre-test and post-test model. The participation and development of the participants in the activities were systematically evaluated using observation forms. The data obtained indicate that unplugged coding activities significantly improve children's cognitive, language, and motor skills. Notably, there were significant advancements in computational thinking, geometry, and numbers and counting skills. These results suggest that unplugged coding activities contribute to the cognitive and social development of children and that acquiring these skills at an early age positively impacts their future academic success. The findings of the study highlight the need for educators and policymakers to develop strategies for integrating coding and computational thinking skills into early childhood education. Based on the study's findings, it is recommended to expand unplugged coding activities, enhance teacher training, and promote family involvement. Integrating such activities into educational programs is considered an effective method for developing children's 21st-century skills.

KEYWORDS: Preschool, unplugged coding, computational thinking, 21st-century skills

1. INTRODUCTİON

In the information age we live in, the impact of technology on education is rapidly increasing, and the integration of technology and coding skills in early childhood education has become a significant focus of interest (Bers, 2008; Clements & Sarama, 2011). Coding supports the development of 21st-century skills such as problem-solving, logical thinking, and creativity, contributing to children's academic, social, and emotional success while preparing them for the digital world of the future (Wing, 2006; Brennan & Resnick, 2012; Grover & Pea, 2013).

While coding education for preschool children is often delivered through computer-based tools and games, unplugged coding activities have emerged as an increasingly popular alternative in recent years. Unplugged coding enables children to learn coding concepts through physical activities and games, offering a more balanced and healthy learning experience by reducing screen dependency (Bell, Alexander, Freeman, & Grimley, 2009; Straker, Abbott, Collins, & Campbell, 2014). This approach not only addresses technology addiction but also fosters an interactive and engaging learning environment.

Early childhood is a critical period for the rapid development of cognitive, linguistic, and motor skills (Piaget, 1952; Vygotsky, 1978). Coding education during this phase supports not only cognitive growth but also the development of social skills, such as collaboration and communication (Fisher, Hirsh-Pasek, Newcombe, & Golinkoff, 2013). In particular, unplugged coding activities encourage children to engage with tangible materials and actively participate in the learning process (Papert, 1980; Resnick et al., 2009). This approach enhances problem-solving abilities while fostering creativity and innovative thinking (Sullivan & Bers, 2016).

This study investigates the impact of unplugged coding activities conducted in a preschool in Ankara on computational thinking, problem-solving, and other cognitive skills of preschool children. The research aims to determine how these activities contribute to developing early technology and coding skills among children, while also exploring their role in fostering creative and innovative thinking processes (Sullivan & Bers, 2016; Bers, 2018). The findings are expected to provide valuable insights for educators and policymakers to effectively integrate technology and coding into early childhood education.

Problem Statement

The advancements and innovations brought by the information age and technological progress necessitate the adoption of new approaches in education systems. Within this context, implementing unplugged coding activities in preschool education offers a significant opportunity for children to develop 21st-century skills (Bers, 2010; Grover & Pea, 2013). Technology and coding skills play a critical role in supporting young children's problem-solving, logical thinking, creativity, and collaboration abilities (Wing, 2006; Brennan & Resnick, 2012). However, research in this area remains limited, particularly within the context of Turkey, highlighting the need for further investigation (Kazakoff, Sullivan, & Bers, 2013).

Understanding the impact of unplugged coding activities on preschool children's cognitive, linguistic, and motor development is of vital importance for educators and policymakers. Existing studies suggest that introducing coding skills in early childhood can enhance problem-solving, creativity, and critical thinking abilities (Resnick et al., 2009; Strawhacker & Bers, 2015). Unplugged coding allows children to grasp coding concepts without reliance on digital technologies, supporting learning through physical activities, games, and tangible materials (Bell, Alexander, Freeman, & Grimley, 2009). This approach provides a balanced and healthy learning environment by reducing children's screen time (Straker, Abbott, Collins, & Campbell, 2014).

However, the specific effects of these activities on preschool children and the best practices for their implementation have not yet been fully determined (Wing, 2006; Yadav et al., 2017). Educators and policymakers need a deeper understanding of how these activities influence children's cognitive, linguistic, and motor skills. Additionally, questions remain regarding how these activities can be optimized and effectively integrated into educational programs.

This study aims to investigate the impact of unplugged coding activities on preschool children's skill development within the context of Turkey’s early childhood education. The central research problem addresses the specific effects of such activities on children’s cognitive, linguistic, and motor skills, as well as how these activities can be optimized for greater efficacy. The study also seeks to fill gaps in the existing literature, offering practical recommendations for educators and policymakers to implement these activities more effectively. By doing so, it aims to provide a deeper understanding of the potential benefits of coding education in early childhood and contribute to future research in this area.

The research seeks to answer the following question: How do unplugged coding activities contribute to preschool students’ Computational Thinking, Geometry, Counting, Directions, Opposites, Seasons, Cognitive, Linguistic, and Motor Skills?

2. RELATED STUDİES

This section presents studies on coding in early childhood and computational thinking skills in preschool education.

Studies on Coding in Early Childhood

The advancements of the information age and technological progress have necessitated the adoption of new approaches in education systems. In this context, the importance of coding education in early childhood education has been increasingly recognized. Teaching technology and coding skills at a young age plays a critical role in fostering children's 21st-century skills, such as problem-solving, logical thinking, creativity, and collaboration (Bers, 2010; Grover & Pea, 2013).

Bers (2010), in her book "Blocks to Robots: Learning with Technology in the Early Childhood Classroom," examined the learning processes of children aged 3–8 using computer-based coding tools. The study found that robotic kits and computer-based programming tools significantly improved children's problem-solving, logical thinking, and creativity. These tools not only enhanced children's interaction with technology but also supported their collaboration and communication skills (Bers, 2010).

Kazakoff, Sullivan, and Bers (2013) conducted an intensive robotics and programming workshop with children aged 4–7. The study revealed that participation in such workshops enhanced sequencing and logical thinking skills. Children demonstrated significant improvements in problem-solving abilities after engaging with LEGO robotic kits and computer-based programming tools, which facilitated active participation in the learning process (Kazakoff, Sullivan, & Bers, 2013).

Brennan and Resnick (2012), in their study "New Frameworks for Studying and Assessing the Development of Computational Thinking," explored the contributions of coding education to children’s cognitive development. Their findings indicated that coding education not only enhances technical skills but also fosters analytical thinking and problem-solving abilities. The study highlighted the role of computer-based tools and programming languages in strengthening logical thinking and creative problem-solving skills among children (Brennan & Resnick, 2012).

Wing (2006), in her seminal article "Computational Thinking," emphasized the broader benefits of coding education, such as fostering creative and analytical thinking skills. Wing argued that acquiring coding skills at an early age has a lasting positive impact on children's future academic and career success (Wing, 2006).

Haugland (1992), in her study "The Effect of Computer Software on Preschool Children's Developmental Gains," investigated the impact of computer software on preschoolers' developmental progress. The findings demonstrated that computer-based learning tools contribute to children’s cognitive, linguistic, and social skills, underscoring the importance of such tools in early education (Haugland, 1992).

Resnick et al. (2009), in their work "Scratch: Programming for All," examined the role of the Scratch programming language in developing children's coding skills. The study highlighted Scratch as a user-friendly and interactive tool that allows children to express creativity and improve problem-solving skills, making it an effective method for coding education in early childhood (Resnick et al., 2009).

Grover and Pea (2013), in their review "Computational Thinking in K-12: A Review of the State of the Field," discussed the applicability and effects of coding education at the K-12 level. The study emphasized that coding education enhances children's cognitive and social skills and serves as a crucial tool in fostering analytical thinking and problem-solving abilities, preparing them for the digital world of the future (Grover & Pea, 2013).

Papert (1980), in his classic work "Mindstorms: Children, Computers, and Powerful Ideas," explored the role of computers in children's learning processes. Papert argued that computers enhance children's creative thinking and problem-solving abilities, enabling more active and independent learning experiences (Papert, 1980).

Hirsh-Pasek et al. (2015), in their study "The Promise of Playful Learning in Promoting 21st Century Skills," examined the role of play-based learning environments in developing children's 21st-century skills. The study highlighted that computer-based games and programming tools enrich the learning experience by fostering creativity, problem-solving, and collaboration skills (Hirsh-Pasek et al., 2015).

Finally, Sullivan and Bers (2016), in their study "Robotics in the Early Childhood Classroom: Learning Outcomes from an 8-Week Robotics Curriculum in Pre-Kindergarten through Second Grade," investigated the impact of robotics education on early childhood development. The study found that robotics education enhances cognitive, social, and emotional development while promoting problem-solving and collaboration skills, as well as increasing children's interest in technology (Sullivan & Bers, 2016).

These studies demonstrate that coding education in early childhood significantly contributes to children's cognitive, social, and emotional development. The use of computer-based and robotic tools supports skills such as problem-solving, logical thinking, and creativity while also enhancing collaboration and communication abilities. Consequently, promoting coding education in early childhood is vital for ensuring children's future academic and career success.

Studies on Computational Thinking in Early Childhood

Computational thinking has gained significant attention in the field of education and is increasingly recognized as an essential skill to cultivate in early childhood. This skill set focuses on problem-solving, logical thinking, and creativity, facilitated by various tools and methodologies (Wing, 2006; Brennan & Resnick, 2012). Below is a summary of key studies and their findings regarding the development of computational thinking skills in preschool children.

Bers (2010), in her study "Blocks to Robots: Learning with Technology in the Early Childhood Classroom," explored how children aged 3–8 develop computational thinking skills through the use of robotic kits and computer-based programs. The study emphasized the importance of hands-on activities, showing that tangible materials enable children to grasp coding concepts effectively while enhancing problem-solving skills. The use of robotic kits facilitated children's understanding of algorithmic thinking processes.

Fessakis, Gouli, and Mavroudi (2013), in their case study "Problem Solving by 5-6 Years Old Kindergarten Children in a Computer Programming Environment: A Case Study," examined how young children develop problem-solving skills in a programming environment. Using tools like ScratchJr, children were able to create algorithms, demonstrating significant improvements in logical thinking abilities. This study highlighted the critical role of computer-supported programming tools in fostering cognitive development.

Papert (1980), in his seminal work "Mindstorms: Children, Computers, and Powerful Ideas," delved into the role of computers in children's learning processes and their impact on computational thinking skills. Papert argued that computers not only enhance creative thinking and problem-solving abilities but also encourage active participation and independence in learning. This foundational study continues to underscore the transformative potential of technology in education.

Kazakoff, Sullivan, and Bers (2013), in their study "The Effect of a Classroom-Based Intensive Robotics and Programming Workshop on Sequencing Ability in Early Childhood," investigated the impact of intensive robotics and programming workshops on children aged 4–7. Their findings revealed that these workshops significantly improved sequencing and logical thinking skills, with notable advancements in problem-solving abilities. The integration of LEGO robotic kits and computer-based tools actively engaged children in the learning process and supported their computational thinking development.

Brennan and Resnick (2012), in their paper "New Frameworks for Studying and Assessing the Development of Computational Thinking," explored the contributions of computational thinking education to children's cognitive development. The study demonstrated that computational thinking education enhances not only technical skills but also analytical reasoning and problem-solving abilities. Logical thinking processes and creative problem-solving skills were observed to improve through computer-based tools and programming languages.

Grover and Pea (2013), in their review "Computational Thinking in K-12: A Review of the State of the Field," emphasized the applicability and benefits of computational thinking skills in K-12 education. Their work highlighted that computational thinking fosters both cognitive and social skills, preparing children for future challenges in the digital world.

Fisher, Hirsh-Pasek, Newcombe, and Golinkoff (2013), in their study "Taking Shape: Supporting Preschoolers' Acquisition of Geometric Knowledge Through Guided Play," examined the role of play-based learning environments in developing computational thinking skills. The study revealed that guided play supports children's acquisition of geometric knowledge and logical thinking skills, with computer-based games and programming tools enriching their learning experiences.

Hirsh-Pasek et al. (2015), in their study "The Promise of Playful Learning in Promoting 21st Century Skills," investigated the role of play-based learning in promoting creativity, problem-solving, and collaboration. Computer-based games and programming tools were identified as effective methods for enhancing children's engagement and cognitive development.

Resnick et al. (2009), in their work "Scratch: Programming for All," examined the impact of the Scratch programming language on children's computational thinking skills. The study highlighted Scratch's user-friendly interface and interactive features, which enabled children to express creativity and develop problem-solving abilities effectively.

Yadav et al. (2017), in their study "Computational Thinking for Teacher Education," explored the integration of computational thinking skills into teacher education programs. The study emphasized that equipping teachers with the knowledge and skills to teach computational thinking plays a pivotal role in fostering these abilities in young children.

3. METHODOLOGY

Research Design

This study employed a one-group pretest-posttest design, one of the quantitative research methods widely used to measure the effects of a specific intervention. This design is particularly effective in evaluating the effectiveness of educational practices (Creswell, 2014). The model aims to determine the impact of the intervention by comparing participants' conditions before and after the intervention (Campbell & Stanley, 1963).

The research was supported by classroom observations and measurements. The observation method was employed to document children's participation and interactions during unplugged coding activities (Angrosino, 2007). Structured observation forms were systematically used to evaluate children's cognitive, linguistic, and motor skills and measure the impact of the activities on them.

Participants

The study was conducted in a preschool in Ankara, involving 105 students aged 4 and 5 years (Table 1). This age group represents a critical developmental period for cognitive and motor skills (Piaget, 1952). The sample was selected using a convenience sampling method (Creswell, 2013), chosen to enhance the study's feasibility within a specific timeframe and optimize the use of available resources.

Table 1.
Distribution of Participants by Age and Gender

	Girl	Boy	Total
4 years	21	20	41
5 years	30	34	64
Total	51	54	105

Data Collection Tools

The data collection process in this study was conducted using structured pre- and post-tests filled out through observations. The observation method was employed to document children's participation, behaviors, interactions, and cognitive processes during unplugged coding activities (Angrosino, 2007). This approach provided detailed insights into how children interacted during the activities and how they adopted coding concepts, thereby enhancing the quality of the pre- and post-test evaluations.

A comprehensive observation form was developed to monitor changes before and after the intervention. This form focused on two primary variables: computational thinking skills and other skills included in the preschool curriculum. The observation form was systematically completed by the teacher for each student during classroom activities.

Measurement Tool

The measurement tool comprised nine subtests with a total of 198 items. A reliability test of the instrument yielded a Cronbach Alpha value of 0.9, indicating a high level of reliability. The subtests and their respective reliability coefficients are as follows:

- Computational Thinking Skills ($\alpha = 0.84$)
- Geometric Skills ($\alpha = 0.954$)
- Numbers and Counting Skills ($\alpha = 0.934$)
- Directional Understanding ($\alpha = 0.954$)
- Opposites Concepts ($\alpha = 0.994$)
- Seasonal Awareness ($\alpha = 0.979$)
- Cognitive Skills ($\alpha = 0.995$)
- Linguistic Skills ($\alpha = 0.996$)
- Motor Skills ($\alpha = 0.998$)

Item Samples

The subtests included items tailored to measure specific aspects of children's skills, such as their ability to solve problems, recognize patterns, follow directions, and engage in collaborative activities. Sample items are illustrated in Figure 1, which provides examples from the measurement tool for each skill area.

Computational Thinking Skills	Skill Acquisition				
	Level 1	Level 2	Level 3	Level 4	Level 5
Data Processing					
Decomposition					
Sequencing					
Algorithm Design					
Debugging					

Directions	Skill Acquisition				
	Level 1	Level 2	Level 3	Level 4	Level 5
Forward–Backward					
Right–Left					
Up–Down					
Front–Back					
Inside–Outside					
…					

Seasons	Skill Acquisition				
	Level 1	Level 2	Level 3	Level 4	Level 5
Winter–Summer					
Spring–Fall					
Hot/Cold Weather					
Season-Appropriate Clothing					
Season-Appropriate Accessories					
…					

Figure 1. Example Items from the Measurement Tool

Design and Implementation of Activities
The tools used during the data collection process allowed for a comprehensive evaluation of how children were influenced by unplugged coding activities. This approach facilitated the collection of in-depth and reliable data regarding children's learning experiences, offering valuable insights into the role of unplugged coding activities in early childhood education.

Activity Design and Implementation
The activities were designed to enable children to grasp unplugged coding concepts through play-based learning and exploratory methods (Papert, 1980). The primary goal was to develop children's coding skills in an engaging and interactive environment. To ensure the ethical conduct of the research, approval was obtained from the Hacettepe University Ethics Committee. Following this, volunteer participants were selected from 4- and 5-year-old students in a preschool in Ankara. Collaboration with teachers was integral to the participant selection process.

Teachers received training on coding and unplugged coding activities to enhance their ability to implement these activities effectively and guide children's learning processes. This training provided teachers with the necessary knowledge and skills to support the children throughout the activities.

Activity Planning
The activity plan was carried out in two stages:

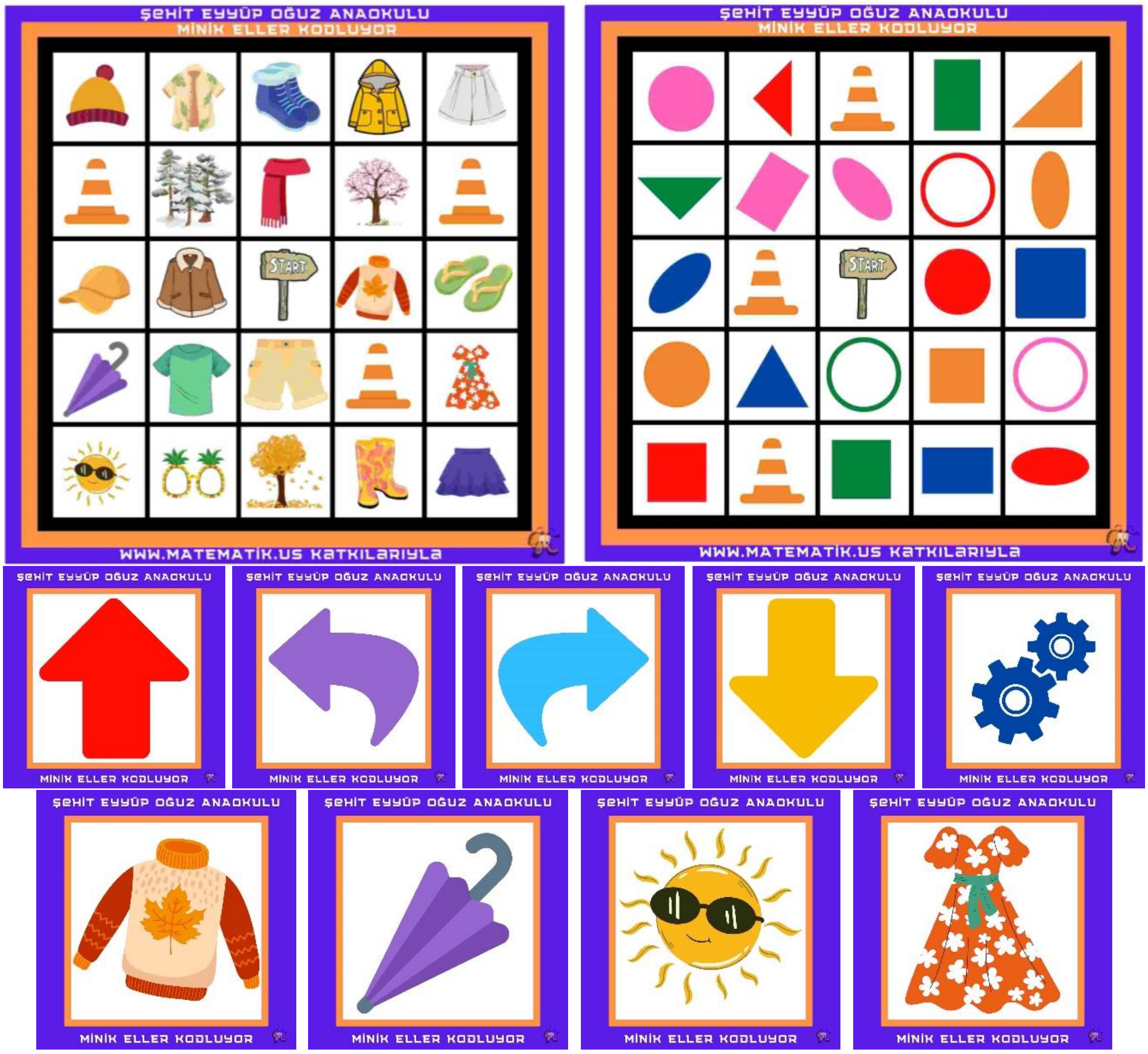
- First Stage – Physical Coding Activities:
  - In this phase, students participated in physical coding activities involving games and hands-on tasks.
  - Activities included direction games, sequencing exercises, and creating simple algorithms, all designed to introduce coding concepts in an accessible way.
- Second Stage – Robotic Programming:
  - Students used programmable robot kits to apply what they learned.
  - They programmed the robots to perform specific tasks, reinforcing their coding skills in a practical setting.

Evaluation of Activities
A custom observation form was developed to assess the activities. The form, completed by teachers at the beginning and end of the sessions, was designed to evaluate:

- Children's participation and interaction during the activities.
- Progress in computational thinking skills.
- Development in other preschool curriculum skills (e.g., cognitive, linguistic, and motor skills).

This two-step activity plan enabled children to understand unplugged coding concepts while also reinforcing these skills through robotics. By combining playful learning and hands-on application, the approach supported effective and enjoyable learning experiences.

Figure 2. Activity Mats and Visual Aids



Activities

Activity 1: Seasons

- **Objective**: In this activity, the goal is for one student to act as a "robot" while another student programs the "robot."
- **Procedure**:
  - The coding involves guiding the robot-student to collect appropriate clothing and accessories for going outside during a specific season.
  - For example, in winter, the robot might collect a sweater, boots, and an umbrella.

Figure 3. Implementation Process of the Seasons Activity

Activity 2: Geometry

- **Objective**: This activity aims to use a programmable robot kit to write codes for completing assigned tasks on geometric shapes.
- **Procedure**:
    - The robot is programmed to move over geometric shapes and complete specific tasks associated with each shape.

Figure 4. Implementation Process of the Geometry Activity

Data Analysis

The collected data were analyzed using Jamovi software. Normality tests were conducted to determine whether the data followed a normal distribution. Based on the results, either parametric or non-parametric tests were utilized. For comparing independent groups, the Mann-Whitney U test was applied, while the Wilcoxon Signed-Rank test was used to compare pre-test and post-test results of dependent groups. All analyses were performed considering a significance level of 0.05. This approach ensured a rigorous evaluation of the data and provided reliable insights into the effects of the unplugged coding activities on children's developmental skills.

4. FİNDİNGS AND DİSCUSSİON

This study examined the effects of unplugged coding activities on various skill areas in preschool children. The performance of students in these skill areas was evaluated using pre- and post-tests. Detailed findings for each skill area are presented below.

Computational Thinking (CT)

The results of the pre- and post-test comparison for computational thinking skills are shown in Table 2.

Table 2:
Computational Thinking (CT)

Measurement	Pre-Test Mean	Post-Test Mean	Wilcoxon Test Result
CT	3.2	4.5	Z = 6.0 (p < 0.0001)

Analysis of Table 2 indicates that the increase in computational thinking skills is statistically significant. This improvement demonstrates the development of children's problem-solving and logical thinking abilities. These findings align with Wing's (2006) conceptualization of computational thinking and are consistent with findings reported by Resnick et al. (2009) and Brennan and Resnick (2012). This skill development forms the foundation for coding and technological proficiency, as highlighted by Papert (1980) and Grover and Pea (2013).

Geometric Shapes
The results of the pre- and post-test comparison for geometric shapes are shown in Table 3.

Table 3:
Geometric Concepts (GEO)

Measurement	Pre-Test Mean	Post-Test Mean	Wilcoxon Test Result
Geometry (GEO)	2.8	4.3	Z = 15.0 (p < 0.0001)

Table 3 shows that the increase in geometry skills is statistically significant. Progress in this area indicates improvements in spatial perception and mathematical thinking abilities. These findings are supported by studies from Clements and Sarama (2011) and Baroody (2004), which emphasize the importance of these skills in mathematics education. The results also align with research by Sarama and Clements (2009) and Van Hiele (1986), underscoring the value of teaching geometric concepts at an early age.

Numbers and Counting
The results of the pre- and post-test comparison for numbers and counting skills are shown in Table 4.

Table 4:
Numbers

Measurement	Pre-Test Mean	Post-Test Mean	Wilcoxon Test Result
Numbers	3.0	4.6	Z = 65.0 (p = 0.00004)

Analysis of Table 4 indicates that the improvement in numbers and counting skills is statistically significant. This development reflects the establishment of foundational early mathematics skills, as noted by Baroody (2004) and Clements (2004). These findings are consistent with research by Ginsburg, Lee, and Boyd (2008) and the National Council of Teachers of Mathematics (2000), emphasizing the importance of these skills in fostering advanced mathematical abilities. Research by Starkey and Klein (2008) supports these results, providing insights into how children develop number concepts and counting skills.

Opposites Concepts
The results of the pre- and post-test comparison for opposites concepts are shown in Table 5.

Table 5:
Opposite Concepts

Measurement	Pre-Test Mean	Post-Test Mean	Wilcoxon Test Result
Opposite Concepts	2.9	4.1	Z = 14.5 (p = 0.0055)

Table 5 shows that the improvement in understanding opposites is statistically significant. Progress in this area indicates enhancements in linguistic skills and abstract thinking abilities. These findings align with Bialystok's (1999) research on cognitive complexity and attention control in multilingual children, highlighting the importance of language development. The results also parallel Berk's (2006) broader studies on child development, emphasizing the role of language and abstract reasoning in early childhood.

Seasons
The results of the pre- and post-test comparison for seasons concepts are shown in Table 6.

Table 6:
Seasons

Measurement	Pre-Test Mean	Post-Test Mean	Wilcoxon Test Result
Seasons	3.1	4.4	Z = 10.0 (p = 0.0024)

Analysis of Table 6 indicates that the improvement in understanding seasons is statistically significant. This progress reflects the development of environmental awareness and temporal understanding in children. French's (2004) work on science education in early childhood supports the importance of these findings, demonstrating how they contribute to children's perception of the world and scientific thinking abilities. Diamond's (2000) research further corroborates these results, highlighting key aspects of cognitive development.

Language and Motor Skills
The results of the pre- and post-test comparison for language and motor skills are shown in Table 7.

Table 7:
Language and Motor Skills

Measurement	Pre-Test Mean	Post-Test Mean	Wilcoxon Test Result
Language	3.4	4.7	Z = 10.0 (p = 0.00098)
Motor	3.3	4.8	Z = 0.0 (p = 0.00086)

Table 7 shows that the improvements in language and motor skills are statistically significant. Progress in these areas aligns with Berk's (2006) and Diamond's (2000) findings, which emphasize the contributions of language and motor development to overall child growth. These results also support the importance of language and motor skill development in early childhood education, as highlighted by Ginsburg et al. (2008) and the National Council of Teachers of Mathematics (2000). Language development enhances communication and expression abilities, while motor skill development strengthens physical coordination and fine motor abilities.

5. CONCLUSİON

This study investigated the effects of unplugged coding activities on various skills in preschool children. The findings revealed significant improvements in areas such as computational thinking, geometry, numbers and counting, opposites concepts, seasons, language, and motor skills. These results indicate that unplugged coding activities are effective in supporting children’s cognitive, linguistic, and motor skill development.

Unplugged coding activities were found to enhance children’s 21st-century skills, such as problem-solving, logical thinking, and creativity. This finding supports the importance of computational thinking skills, as highlighted by Wing (2006) and Brennan and Resnick (2012). Furthermore, the results align with the emphasis on the early acquisition of mathematical and geometric skills by Clements and Sarama (2011) and Baroody (2004).

The study also demonstrated notable improvements in language and motor skills, findings that are consistent with the work of Berk (2006) and Diamond (2000). These studies emphasize the contribution of language and motor development to children’s overall cognitive growth.

In conclusion, this research underscores the effectiveness of integrating unplugged coding activities into preschool education programs to foster cognitive, linguistic, and motor skills. The findings suggest that educators and policymakers should develop strategies to promote coding and computational thinking skills in early childhood. The widespread adoption of such activities could contribute to children’s future academic and social success.

6. RECOMMENDATİONS

Based on the findings of this study, the following recommendations are proposed to guide future research and practice:

1. **Promoting Unplugged Coding Activities:** The results of this study demonstrate that unplugged coding activities effectively develop cognitive, linguistic, and motor skills in children. Therefore, incorporating unplugged coding activities into preschool education programs is essential. Educators can use various games, physical activities, and robotic kits to support children's problem-solving and logical thinking skills.

2. **Teacher Training and Professional Development Programs:** Teachers play a crucial role in equipping children with coding and computational thinking skills. Thus, coding education and professional development programs should be organized for teachers. These programs should help educators learn how to integrate coding activities into their teaching to support children's cognitive and social development effectively.

3. **Integration into Curricula and Development of Supporting Materials:** Coding and computational thinking skills should be integrated into early childhood education curricula. To ensure the success of this integration, educational materials and resources should be developed. Simple and effective coding kits, games, and activities tailored to students' needs should be provided to support teachers in delivering these skills.

4. **Parental Involvement and Awareness:** Parents play a significant role in children's learning processes. Therefore, awareness should be raised about the importance of coding and computational thinking skills among families. Workshops and information sessions for parents can be organized to enhance their involvement. Parents should also be informed about simple activities and games that can help their children develop these skills at home.

5. **Encouraging Research and Development Activities:** To better understand the long-term effects of unplugged coding activities on children's development, further research in this area should be encouraged. Universities and research institutions should conduct studies on the impact of coding education in preschool and contribute to the body of knowledge in this field. Moreover, findings from these studies should be translated into actionable strategies to inform educational policies and practices.