ISSN: 2945-4190

***World Journal on Education and Humanities Research***
*Creative Commons Attribution 4.0 International*
Vol. 4, Issue 4, pp. 74-89
*Received, September 2024; Revised October 2024;*
*Accepted October 2024*

Article

# The Digital Age: Enhancing Cognitive Skills in Kindergarten Learners

Ayesha Marie Belamide
Helen Revalde
Kaitlin Marie Opingo
Randy Mangubat
Veronica Calasang
Roberto Suson

Corresponding Author: belamideayeshamarie@gmail.com

Abstract: This study examines the impact of electronic devices on the cognitive abilities of kindergarteners. Using a descriptive research design, data were collected via a structured questionnaire adapted from validated instruments in early childhood technology integration studies. The results reveal that electronic devices significantly enhance cognitive dimensions such as numeracy, literacy, memory, attention, and problem-solving skills. Interactive and multimedia content received high ratings for fostering engagement, supporting personalized learning, and catering to diverse learning preferences. Correlation analyses highlight strong relationships between digital literacy and improved cognitive skills, emphasizing the potential of technology to strengthen foundational academic abilities. However, while cognitive gains are evident, the need for a balanced approach that combines digital learning with hands-on activities is underscored to avoid potential overstimulation and support social-emotional development. This study provides insights into effective digital tool integration in early education, highlighting the importance of evidence-based strategies to optimize young learners' cognitive growth in an increasingly digital world.

Keywords: Early childhood education, Cognitive development, Digital literacy, electronic devices

## Introduction

The digital era has significantly reshaped early childhood education, particularly in cognitive skill development for young learners such as kindergarteners. Technological tools—ranging from tablets and interactive apps to specialized educational software—have become vital in promoting skills like problem-solving, memory enhancement, attentional focus, and creative thinking (Radesky & Christakis, 2020). These digital resources offer adaptable, self-paced

learning environments where students can receive immediate feedback and engage with multimedia content, which deepens their understanding of complex and abstract concepts (Papadakis, 2020). Activities like digital storytelling, virtual simulations, and educational games enhance creativity and curiosity, fostering an exploratory learning approach that may go beyond traditional methods (Neumann, 2020). The integration of technology into early learning environments not only supports cognitive development but also equips young learners with essential digital literacy skills, which are increasingly relevant in a technology-driven society (Zheng et al., 2022).

Current trends in early childhood education emphasize the use of digital tools to support cognitive growth, with research highlighting their positive effects on learning outcomes. For instance, interactive technologies such as educational apps and games have been shown to improve cognitive functions like problem-solving, attention regulation, and memory retention in young children (Pila et al., 2019). Advances in adaptive learning platforms have enabled more personalized learning experiences, tailoring content to match each child's proficiency and enhancing both engagement and comprehension (Papadakis et al., 2021). The application of artificial intelligence (AI) in these tools has further advanced this personalization, providing real-time feedback that enhances the learning experience and fosters deeper cognitive engagement (Blumberg et al., 2021). A systematic review by Cheng et al. (2023) highlights that while digital media use can support cognitive growth, it should be balanced with experiential, hands-on learning to avoid cognitive overload and promote active, meaningful engagement.

Despite the growing prevalence of digital tools in early childhood education, comprehensive research examining their long-term effects on young learners' cognitive development remains limited. Much of the existing literature focuses on immediate engagement or skill-specific outcomes, often overlooking the broader, sustained impacts of technology use on young children's cognitive growth (Neumann & Neumann, 2020). This gap is particularly concerning given the critical nature of kindergarten years for foundational cognitive skills, which play a pivotal role in subsequent learning. Furthermore, there is limited research on potential negative impacts of screen exposure, including possible effects on social and emotional development (Strouse et al., 2019). Therefore, it is essential to conduct in-depth research on how digital tools influence kindergarteners' cognitive skills in both the short and long term to guide effective and developmentally appropriate educational practices (Radesky et al., 2020).

The present study, focusing on the influence of electronic devices on kindergarteners' cognitive skills, seeks to address these critical research gaps. Unlike general studies on technology in education, this research emphasizes early childhood, aiming to provide contextually relevant insights into how local kindergarteners interact

  

with digital tools and how these interactions affect cognitive abilities such as memory, attention, and problem-solving. Centering on young learners, this study contributes valuable data on both the advantages and potential challenges of early exposure to technology, helping to shape informed practices for integrating digital tools in early education settings.

## Methodology

This study utilized a descriptive research design to explore how electronic device usage influences cognitive abilities among kindergarteners at St. Cecilia's College Inc., a reputable institution in Minglanilla, Cebu, Philippines. St. Cecilia's is known for its commitment to holistic student development and quality education. Data collection employed a structured questionnaire derived from existing validated instruments, grounded in recent research on early childhood education and technology integration (Neumann & Neumann, 2019; Hwang et al., 2020; Richland et al., 2019; Best, 2020; Schmitt et al., 2021). The questionnaire covered dimensions related to the influence of digital tools and assessed cognitive skills like memory, attention, and problem-solving, ensuring relevance to the study's aims. Following standard protocol, a transmittal letter was sent to the school principal, requesting permission to conduct the research. Upon approval, questionnaires were distributed to teachers, who relayed them to parents for completion, ensuring participant anonymity and data confidentiality. The study employed a 5-point Likert scale for responses, with scores ranging from "Strongly Disagree" (1.00–1.80) to "Strongly Agree" (4.21–5.00), measuring levels of influence from electronic devices and cognitive skill indicators. Data were then analyzed using statistical software at a 0.05 level of significance, applying correlation analysis to examine the relationship between device usage and cognitive abilities.

The research adopted an INPUT-PROCESS-OUTPUT framework, organizing the study into structured stages that assess digital exposure's role in early cognitive development. Results served as the basis for crafting an intervention plan aimed at enhancing a globally competitive educational environment by integrating balanced digital practices. By situating the research within a local context, the study provides targeted insights into how kindergarteners in an inclusive setting interact with technology, emphasizing a balanced, intentional approach to digital integration in early learning environments.

## Results and Discussion

Table 1 shows the perceived effectiveness of electronic devices in providing accessible educational content. Electronic devices are recognized for their ability to offer a wide range of learning materials,

  

including apps, ebooks, and educational videos, which cater to diverse learning styles and preferences and devices can integrate text, audio, visuals, and animation, providing a rich, multisensory learning experience that can aid in the understanding of complex concepts both received a high mean score of 4.48, categorized as "Strongly Agree".

Table 1. Educational Content Accessibility

| Educational Content Accessibility | Mean | VD |
|---|---|---|
| Electronic devices provide access to a wide range of learning materials, including apps, ebooks, and educational videos, catering to different learning styles and preferences. | 4.48 | SA |
| Learners can access educational content anytime and anywhere, making learning opportunities more flexible and ubiquitous. | 4.32 | SA |
| Many electronic resources offer interactive features, such as games and quizzes, which can enhance engagement and retention of information. | 4.45 | SA |
| Adaptive learning technologies can tailor content to the individual learning pace and level of each student, addressing their specific needs and challenges. | 4.26 | SA |
| Devices can integrate text, audio, visuals, and animation, providing a rich, multisensory learning experience that can aid in the understanding of complex concepts. | 4.48 | SA |
| Grand Mean | 4.40 | SA |

The flexibility and ubiquity of accessing educational content anytime and anywhere also scored highly, with a mean of 4.32 also categorized as "Strongly Agree". This suggests that learners greatly appreciate the convenience and flexibility provided by electronic devices, which facilitate continuous learning outside traditional classroom settings. Interactive features like games and quizzes, which can enhance engagement and retention, were also rated positively with a mean score of 4.45 (SA). Adaptive learning technologies, which tailor content to individual learning paces and levels, received a mean score of 4.26 (SA). Moreover, the grand mean of 4.40 which is verbally described as “strongly agree” (SA) indicates a strong, positive perception of the role of electronic devices in enhancing educational content accessibility. This indicates that the strong agreement on the benefits of diverse and flexible learning materials, interactive features, adaptive technologies, and multisensory content suggests that electronic devices are not merely supplementary tools but essential components of effective teaching and learning strategies and indicates a readiness among learners and educators to embrace digital tools, which could drive further innovations and investments in educational technology. These results imply that the adoption of technology in education can lead to more personalized, engaging, and accessible learning experiences, catering to a wide range of learning styles and needs.

Table 2 reflects the impact of interactive and multimedia content on learners' engagement and attitudes towards learning activities. Data revealed that Learners show active participation in tasks that involve electronic devices, indicating heightened interest and engagement got

  

the highest mean score of 4.26 or verbal described as “Strongly agree” followed by learners exhibit a strong willingness to invest more time in learning activities when these activities involve interactive and multimedia elements, received a mean score of 4.26, categorized as "Strongly Agree".

Table 2. Learning Ability

| Learning Ability | Mean | VD |
|---|---|---|
| Learners are willing to spend more time on learning activities when engaged with interactive and multimedia content. | 4.26 | SA |
| Learners show active participation in tasks that involve electronic devices, indicating heightened interest and engagement. | 4.29 | SA |
| There is a noticeable eagerness among learners to engage with new digital learning materials. | 4.13 | A |
| Children develop positive attitudes towards learning when they experience it through fun and interactive means. | 4.23 | SA |
| Encourage children to persist with challenging tasks, boosting their resilience in learning. | 4.17 | A |
| Grand Mean | 4.22 | SA |

This suggests that the dynamic nature of such content significantly enhances learners' engagement levels and can capture and maintain learners' interest effectively. There is also a noticeable eagerness among learners to explore new digital learning materials, with a mean score of 4.13, which falls under "Agree". Furthermore, children develop favorable attitudes towards learning when it is presented in a fun and interactive manner, reflected by a mean score of 4.23 (SA). This implies that enjoyment and interactivity are crucial factors in fostering a love for learning. Encouraging children to persist with challenging tasks, with a mean score of 4.17 (A), highlights the importance of resilience in the learning process. This indicates that learners are more likely to develop perseverance and a growth mindset when they are motivated to tackle difficult tasks. The grand mean of 4.22, classified as "Strongly Agree", underscores the overall positive influence of interactive and multimedia content on learners' engagement and attitudes towards learning. This indicates the high mean scores for learners' willingness to spend more time and their active participation suggest that such content significantly boosts engagement.

Table 3 shows level of influence of kindergarten education on the digital literacy. Data revealed that opportunities to use simple digital tools for creating art, music, or stories develop creative skills and digital fluency got the highest mean of 4.32 followed by learners become familiar with operating devices, using touchscreens, and navigating interfaces with mean of 4.29 which were both verbally described as “strongly agree”. Children also start to develop research skills, as shown by the mean score of 3.97. This indicates a strong agreement

  

highlighting that early education introduces basic research skills and information literacy.

Table 3. Digital Literacy

| Digital Literacy | Mean | VD |
|---|---|---|
| Learners become familiar with operating devices, using touchscreens, and navigating interfaces. | 4.29 | SA |
| Even at a basic level, children learn to access information online under guidance, laying the groundwork for research skills. | 3.97 | SA |
| Introduction to discerning reliable from unreliable digital content, fostering critical evaluation skills from an early age. | 3.61 | A |
| Opportunities to use simple digital tools for creating art, music, or stories develop creative skills and digital fluency. | 4.32 | SA |
| Education on using devices safely can begin, including understanding privacy settings and recognizing inappropriate content. | 4.03 | A |
| Grand Mean | 4.04 | A |

The introduction to discerning reliable from unreliable digital content, fostering critical evaluation skills from an early age got a mean score of 3.61, which verbally describes as "Agree". This indicates that kindergartens are beginning to teach children how to discern reliable from unreliable information, although this score is slightly lower, it still shows a notable impact on fostering critical thinking regarding digital content from an early age. Moreover, the aspect of education on safe device use got a mean score of 4.03, reflects agreement and the grand mean of 4.04 in which also indicates "agree" that kindergartens have a substantial influence on the digital literacy of young learners. This indicates that that kindergartens serve as crucial environments for introducing children to digital tools, cultivating research, ensuring that children develop essential skills and safe practices that will support their future academic and personal growth in a digital world. Children who received early exposure to digital technologies in preschool and kindergarten showed higher levels of digital competence and confidence in later years compared to those who did not have such experiences.

Table 4. Numeracy Skills

| Numeracy Skills | Mean | VD |
|---|---|---|
| Demonstrating the ability to count objects and understand that the last number represents the total quantity. | 3.90 | A |
| Being able to recognize and name numbers up to at least 20. | 3.97 | A |
| Starting to grasp simple addition and subtraction using physical objects or visual aids. | 4.16 | A |
| Ability to identify and create simple patterns, recognizing sequences in their environment. | 4.19 | A |
| Basic understanding of measurement concepts such as big/small, more/less, and comparisons between objects. | 4.26 | SA |
| Grand Mean | 4.10 | A |

 

Table 4 shows level of cognitive abilities among kindergarteners in terms of numeracy skills. Data revealed that basic understanding of measurement concepts such as big/small, more/less, and comparisons between objects got the highest mean of 4.26 which is verbally described as "strongly agree" (SA), indicating a high level of cognitive development in understanding spatial relationships and quantitative comparisons, which are critical skills for mathematical reasoning and problem-solving. Additionally, the ability to count objects and understand quantity representation, kindergarteners exhibit a mean score of 3.90, and their capability to recognize and name numbers up to at least 20 is high, with a mean score of 3.97 which both verbally described as "agree". indicating a solid grasp of this fundamental skill. Moving beyond mere recognition, kindergarteners demonstrate a burgeoning capacity for arithmetic, as evidenced by their mean score of 4.16 in grasping simple addition and subtraction concepts using physical objects or visual aids. This suggests a readiness to engage with basic mathematical operations in a tangible, hands-on manner. Moreover, their ability to identify and create simple patterns and recognize sequences in their environment is particularly notable, with a mean score of 4.19, which verbally describes as "Agree". This signifies an emerging aptitude for recognizing and understanding abstract mathematical concepts, laying a strong foundation for more advanced mathematical thinking in the future. Moreover, the grand mean of 4.10 across all assessed numeracy skills reaffirms the advanced cognitive abilities of kindergarteners in this domain, positioning them well for further mathematical learning and development as they progress through their academic journey. This suggests that even at an early age, children possess innate cognitive mechanisms that enable them to comprehend and engage with fundamental mathematical concepts, such as counting, number recognition, and basic arithmetic.

Table 5. Literacy Skills

| Digital Literacy | Mean | VD |
|---|---|---|
| Recognizing and naming letters of the alphabet in both uppercase and lowercase forms. | 4.35 | SA |
| Understanding that words are made up of sounds and being able to play with sounds (e.g., rhyming, beginning sounds). | 4.48 | SA |
| Starting to read simple words or sentences, and recognizing some sight words. | 4.26 | SA |
| Writing their own name and other simple words with assistance. | 4.26 | SA |
| Demonstrating understanding of simple stories through pictures or texts, answering questions about what they've read or heard. | 4.39 | SA |
| Grand Mean | 4.35 | SA |

Table 5 presents a comprehensive assessment of kindergarteners' literacy skills. Data revealed that kindergarteners exhibit a high level of phonemic awareness, as reflected in the mean score of 4.48, "strongly

  

agree" for understanding that words are composed of sounds and their ability to manipulate these sounds through activities such as rhyming and identifying beginning sounds. This indicates a readiness to engage with phonics instruction and develop decoding skills necessary for reading fluency. Followed by the mean score of 4.39 for demonstrating comprehension of simple stories through pictures or texts and answering questions about what they've read or heard which suggests an ability to engage with and extract meaning from written texts important in literacy development. On the other hand, demonstrating understanding of simple stories through pictures or texts, answering questions about what they've read or heard, got a mean score of 4.35 which is verbally described as "strongly agree". In terms of reading proficiency, kindergarteners display a commendable mean score of 4.26, "strongly agree" in starting to read simple words or sentences and recognizing sight words and demonstrate emerging writing skills, with a mean score of 4.26 for writing their own name and other simple words with assistance, suggests an early aptitude for decoding and comprehension and demonstrate emerging writing skills and progress in fine motor skills and an understanding of basic writing conventions which is essential for effective communication. Moreover, the grand mean of 4.35 indicates a strong overall proficiency in literacy which suggest the importance of assessing and supporting literacy development in the early years of schooling, as it lays the foundation for future academic achievement as to early identification of literacy difficulties and implementation of evidence-based interventions can effectively support children's literacy development and mitigate potential learning difficulties.

Table 6. Memory and Recall

| Memory and Recall | Mean | VD |
|---|---|---|
| Ability to remember information over short periods, such as following simple instructions or recalling recently learned words. | 4.13 | A |
| Remembering the sequence of daily activities or routines. | 4.17 | A |
| Being able to retell a simple story in their own words after hearing it. | 4.10 | A |
| Recognizing previously seen items or images when presented among new ones. | 4.29 | SA |
| Remembering where objects are usually stored or where they were last placed. | 4.16 | A |
| Grand Mean | 4.17 | A |

Table 6 shows the kindergarteners' memory and recall abilities. Data revealed that recognizing previously seen items or images when presented among new one got the highest mean of 4.29, which is verbally described as "strongly agree", followed by remembering the sequence of daily activities or routines, with a mean score of 4.17 and remembering where objects are usually stored or where they were last placed got a mean score of 4.16 which were both verbally described as "agree", indicates an understanding of temporal order and the ability to anticipate and navigate through familiar routines, which contributes

  

to organizational skills and independence in daily activities. Furthermore, ability to remember information over short periods, such as following simple instructions or recalling recently learned words., as evidenced by the mean score of 4.13, which is verbally described as "agree". This suggests a capacity for retaining and processing information in real-time, which is essential for academic learning and daily functioning. In terms of narrative memory, kindergarteners display competence in retelling a simple story in their own words after hearing it, as reflected by the mean score of 4.10 which suggests an ability to comprehend and recall narrative content, laying the groundwork for comprehension and critical thinking skills in literacy development. The grand mean of 4.17 suggests an overall agreement of the indicators, understanding and supporting memory development in early childhood is important in later academic success, indicating the interconnectedness of memory skills to language development, executive functioning, and overall cognitive ability.

Table 7. Attention and Concentration

| Attention and Concentration | Mean | VD |
|---|---|---|
| Can focus on a task or activity for increasing periods, showing interest in details. | 3.87 | A |
| Ability to switch attention from one activity to another with minimal adult assistance. | 3.81 | A |
| Can concentrate on a specific task even with distractions present in the environment. | 3.48 | A |
| Capable of following two- to three-step directions. | 3.83 | A |
| Shows ability to listen and participate in group settings, like story time or group discussions. | 3.93 | A |
| Grand Mean | 3.78 | A |

Table 7 presents the assessment of the level of cognitive abilities of kindergarteners concerning attention and concentration. Data revealed that kindergarten are showing ability to listen and participate in group settings, like story time or group discussions got the highest mean score of 3.93, verbally described as "agree" (A), indicating the kindergarten's social and cognitive development in engaging with peers and group activities. The mean score of 3.87 indicates that on average, kindergarteners can focus on a task or activity for increasing periods, displaying interest in details. This suggests that they possess a commendable attention span and curiosity in exploring tasks. Similarly, with a mean score of 3.81, the ability to switch attention from one activity to another with minimal adult assistance is demonstrated, implying a fluidity in transitioning between tasks and Capable of following two- to three-step directions with a mean score of 3.83, which were all verbally described as "agree". Moreover, the mean score of 3.48 suggests that kindergarteners are capable of concentrating on a specific task even when distractions are present in the environment, showcasing a foundational ability to maintain focus amidst external

  

stimuli. Additionally, the grand mean of 3.78 underscores the robust cognitive abilities of the observed kindergarteners in terms of attention, concentration, and participation in various activities, setting a positive foundation for their educational journey. This suggest that at this developmental stage, children are demonstrating essential cognitive skills necessary for successful engagement in learning activities. Their ability to focus on tasks for increasing periods and to switch attention between activities with minimal adult assistance indicates the development of executive functions such as cognitive flexibility and inhibitory control.

Table 8. Social and Emotional Development

| Social and Emotional Development | Mean | VD |
|---|---|---|
| Beginning to manage emotions with some support, can express feelings using words. | 3.91 | A |
| Showing understanding or concern for the feelings of others. | 3.91 | A |
| Engaging in play that involves sharing, taking turns, and collaborating with peers. | 3.97 | A |
| Recognizing basic facial expressions and social cues of others. | 4.10 | A |
| Showing increasing independence in personal care and in making choices. | 3.81 | A |
| Grand Mean | 3.94 | A |

Table 8 presents the level of cognitive abilities of kindergarteners regarding their Social and Emotional Development. Data shows that recognizing basic facial expressions and social cues of others got the highest mean score of 4.10, which is verbally described as “agree”. Engaging in play that involves sharing, taking turns, and collaborating with peers which has a mean score of 3.97 and followed by both, beginning to manage emotions with some support, can express feelings using words and showing understanding or concern for the feelings of others which scored 3.91, showing increasing independence in personal care and in making choices scored the lowest mean of 3.81 which were all verbally described as “agree”. The grand mean for Social and Emotional Development across these indicators is 3.94. These results suggest that kindergarteners, on average, demonstrate a high level of social and emotional development. They are beginning to manage their emotions with some support and can express their feelings using words, indicating an early stage of emotional regulation. Additionally, they show understanding and concern for the feelings of others, engage in collaborative play, and can recognize basic social cues, all of which are important skills for social interaction and empathy development. However, there is slight variability in the level of independence in personal care and decision-making, with some children showing more progress than others. This implies that the development of social and emotional skills in early childhood may follow a relatively predictable trajectory, influenced by both intrinsic factors such as biological maturation and extrinsic factors such as socialization experiences within the home and school environments.

  

Table 9. Problem Solving Skills

| Problem Solving Skills | Mean | VD |
|---|---|---|
| Can recognize a simple problem and express it in their own words. | 3.81 | A |
| Comes up with basic solutions to simple problems, often through trial and error. | 3.70 | A |
| Making choices between two or more options in play or learning tasks. | 3.77 | A |
| Beginning to use tools or materials (e.g., puzzles, building blocks) for their intended purpose in problem-solving. | 4.00 | A |
| Recognizing when they need help and asking for it appropriately. | 4.03 | A |
| Grand Mean | 3.86 | A |

Table 9 presents data on the level of cognitive abilities of kindergarteners concerning problem-solving skills. Data shows that on average, kindergarteners demonstrate a high level of proficiency in problem-solving skills, as evidenced by the grand mean of 3.86, indicating a generally strong performance across the board. Specifically, kindergarteners are increasingly recognizing when they need help and asking for it appropriately got the highest mean score of 4.03 which is verbally described as "agree". Followed by beginning to use tools or materials (e.g., puzzles, building blocks) for their intended purpose in problem-solving scored 4.00, can recognize a simple problem and express it in their own words scored 3.81 and making choices between two or more options in play or learning tasks indicated by a mean score of 3.77, which were all verbally described as "agree" while kindergarten comes up with basic solutions to simple problems, often through trial and error got the lowest mean score of 3.70 which is also verbally described as "agree". These findings suggest that kindergarteners exhibit a commendable proficiency in problem-solving skills, demonstrating an understanding of problem identification, solution generation, tool utilization, and seeking assistance when needed. These abilities lay a strong foundation for their cognitive development and learning journey. According to Vygotsky, children's problem-solving skills develop through interaction with more knowledgeable others, such as parents, teachers, and peers, as well as using cultural artifacts and tools.

Table 10. Significant Relationship Between Education Content quality and dimension of cognitive abilities

| Cognitive Ability | r-value | t-value | p-value | Remarks | Decision |
|---|---|---|---|---|---|
| Numeracy Skills | 0.731366 | 5.098444 | 0.000 | Significant | Reject |
| Literacy Skills | 0.650018 | 4.30154 | 0.000 | Significant | Reject |
| Memory and Recall | 0.528837 | 2.66175 | 0.000 | Significant | Reject |
| Attention and Concentration | 0.369592 | 1.699981 | 0.000 | Significant | Reject |
| Social and Emotional Development | 0.337899 | 1.665863 | 0.063 | Not Significant | Do not Reject |
| Problem-Solving Skills | 0.487871 | 2.549344 | 0.005 | Significant | Reject |

  

The data from Table 10 highlights the significant relationships between education content quality and various dimensions of cognitive abilities. The correlations are generally strong, with r-values ranging from 0.338 to 0.731, indicating positive relationships. Numeracy skills exhibit the highest correlation with education content quality (r = 0.731), followed by literacy skills (r = 0.650), memory and recall (r = 0.529), problem-solving skills (r = 0.488), attention and concentration (r = 0.370), and social and emotional development (r = 0.338). The t-values support these correlations, with numeracy skills showing the highest t-value of 5.098, emphasizing the strength of this relationship. All p-values, except for social and emotional development, are 0.000, confirming their statistical significance. Social and emotional development has a p-value of 0.063, indicating a non-significant relationship. These results suggest that high-quality educational content is significantly associated with enhanced cognitive abilities, particularly in numeracy, literacy, memory, attention, and problem-solving skills. However, the relationship with social and emotional development is not statistically significant.

Table 11. Significant Relationship Between Learning Ability and dimension of cognitive abilities

| Cognitive Ability | r-value | t-value | p-value | Remarks | Decision |
|---|---|---|---|---|---|
| Numeracy Skills | 0.637914 | 4.088438 | 0.000 | Significant | Reject |
| Literacy Skills | 0.641622 | 4.367236 | 0.000 | Significant | Reject |
| Memory and Recall | 0.578021 | 3.141392 | 0.000 | Significant | Reject |
| Attention and Concentration | 0.412698 | 2.010358 | 0.021 | Significant | Reject |
| Social and Emotional Development | 0.482701 | 2.655067 | 0.006 | Significant | Reject |
| Problem-Solving Skills | 0.657455 | 4.13191 | 0.000 | Significant | Reject |

The data from Table 15 demonstrates a significant relationship between learning ability and various dimensions of cognitive abilities. The r-values, indicating the strength of these correlations, range from 0.413 to 0.657, suggesting moderate to strong positive relationships. Problem-solving skills exhibit the highest correlation with learning ability (r = 0.657), followed by literacy skills (r = 0.642), numeracy skills (r = 0.638), memory and recall (r = 0.578), social and emotional development (r = 0.483), and attention and concentration (r = 0.413). The t-values further support these correlations, with problem-solving skills showing the highest t-value of 4.132, emphasizing the strength of this relationship. All p-values are significant, with the highest being 0.021 for attention and concentration, indicating strong statistical significance across all dimensions. These findings suggest that enhanced learning abilities are closely associated with improved cognitive abilities, particularly in problem-solving, literacy, numeracy, memory, and social and emotional development, underscoring the importance of fostering learning skills for overall cognitive development.

 

Table 12. Significant Relationship Between Digital Literacy and dimension of cognitive abilities

| Cognitive Ability | r-value | t-value | p-value | Remarks | Decision |
|---|---|---|---|---|---|
| Numeracy Skills | 0.588824 | 3.935678 | 0.000 | Significant | Reject |
| Literacy Skills | 0.478595 | 3.114804 | 0.006 | Significant | Reject |
| Memory and Recall | 0.57533 | 3.414488 | 0.001 | Significant | Reject |
| Attention and Concentration | 0.487705 | 2.713164 | 0.005 | Significant | Reject |
| Social and Emotional Development | 0.376372 | 2.142013 | 0.037 | Significant | Reject |
| Problem-Solving Skills | 0.576788 | 3.659782 | 0.001 | Significant | Reject |

The data from Table 12 illustrates the significant relationships between digital literacy and various dimensions of cognitive abilities. The r-values, which measure the strength of these correlations, range from 0.376 to 0.589, indicating moderate positive relationships. Numeracy skills have the highest correlation with digital literacy (r = 0.589), followed by problem-solving skills (r = 0.577), memory and recall (r = 0.575), literacy skills (r = 0.479), attention and concentration (r = 0.488), and social and emotional development (r = 0.376). The t-values are also substantial, with numeracy skills showing the highest t-value of 3.936, indicating robust statistical significance. All p-values are below the threshold of 0.05, confirming the statistical significance of these relationships. These findings suggest that higher levels of digital literacy are significantly associated with enhanced cognitive abilities, particularly in numeracy, problem-solving, memory, literacy, attention, and social and emotional development. This underscores the importance of digital literacy in fostering overall cognitive development.

## Discussion

The results of this study reveal a significant positive impact of electronic devices on various cognitive abilities among kindergarteners, highlighting the benefits of integrating digital tools into early learning environments. Kindergarteners' engagement, learning abilities, digital literacy, and specific cognitive skills, including numeracy, literacy, memory, attention, and problem-solving, are positively influenced by exposure to interactive and multimedia content. For instance, children demonstrated a high level of phonemic awareness, numeracy, and foundational problem-solving skills when engaging with digital content tailored to their developmental needs, supporting findings by Radesky and Christakis (2020), who noted the potential of technology in enhancing early cognitive skills through interactive, engaging formats. Furthermore, the role of adaptive and multisensory digital content in fostering a flexible learning environment, where children can learn at their own pace, aligns with Papadakis (2020), who emphasized that technology-rich settings can

 

improve engagement and retention in young learners by catering to diverse learning styles.

Moreover, the significant correlations between digital literacy and cognitive abilities such as numeracy, memory, and problem-solving suggest that early exposure to technology not only enhances digital fluency but also supports critical thinking and foundational academic skills. Neumann (2020) observed similar trends, where digital interactions foster early research skills and information literacy, setting a foundation for lifelong learning competencies. However, it is essential to balance screen time with hands-on, experiential learning to mitigate potential drawbacks such as overstimulation and decreased face-to-face social interactions (Strouse et al., 2019). While social and emotional development did not show a statistically significant correlation with educational content quality in this study, the integration of digital tools remains crucial for preparing children for the increasingly digital landscape of future educational settings. Thus, these findings underscore the importance of carefully curated digital learning experiences that prioritize cognitive development and digital literacy, providing a well-rounded approach to early childhood education.

## Conclusion

This study demonstrates that the integration of electronic devices in kindergarten education has a significant positive influence on various dimensions of cognitive abilities, including numeracy, literacy, memory, attention, and problem-solving skills. The data indicate that interactive and multimedia content not only enhances engagement and interest in learning but also fosters foundational cognitive skills essential for academic success. The high mean scores for access to diverse educational content, flexible learning, and adaptive technologies highlight the potential of digital tools to cater to individual learning needs, supporting personalized and accessible learning experiences. Furthermore, the results suggest that early exposure to digital literacy skills prepares young learners for a technology-driven world, promoting digital fluency that will benefit them in their future educational journey. However, the findings also emphasize the need for a balanced approach in integrating technology within early childhood education. While electronic devices provide substantial benefits in cognitive development, considerations around screen time and the potential impact on social-emotional growth remain important. Encouraging the thoughtful use of digital tools alongside experiential, hands-on activities can maximize cognitive benefits while minimizing risks. This balanced approach will help ensure that technology serves as a supportive tool, enhancing traditional learning methods rather than replacing them.

 

**References**

Best, J. R. (2020). The impact of digital learning on child development: A meta-analysis. *Educational Psychology Review*, 32(3), 591-610.

Blumberg, F. C., & Brooks, P. J. (2021). AI-powered interactive media in cognitive development. *Child Development*, 92(1), 12-25.

Cheng, C. P., Lu, Y. C., & Lee, S. (2023). Balancing digital and hands-on learning in early childhood: A systematic review. *Journal of Early Childhood Research*, 21(3), 229-245.

Hwang, G.-J., Wu, P.-H., & Chen, C.-C. (2020). A critical review of technology-supported approaches for early childhood education. *Educational Technology & Society*, 23(3), 14-26.

Neumann, M. M. (2020). The role of digital media in early literacy and learning for young children. *Computers in Human Behavior*, 109, 106349.

Neumann, M. M., & Neumann, D. L. (2020). The effects of screen exposure on early literacy and language development in young children. *Australian Journal of Education*, 64(1), 26-39.

Papadakis, S. (2020). Apps to promote creativity and digital skills in early childhood education. *Education Sciences*, 10(10), 317.

Papadakis, S., Kalogiannakis, M., & Zaranis, N. (2021). Adaptive learning technologies in preschool education. *Technology, Knowledge and Learning*, 26(2), 379-391.

Pila, S., Alper, R. M., & Katz, J. (2019). Enhancing problem-solving skills with technology in early education. *Early Childhood Education Journal*, 47(5), 509-518.

Radesky, J. S., & Christakis, D. A. (2020). Increased screen time and developmental delays in young children: Evidence-based practices for digital engagement. *Journal of Pediatrics*, 209, 239-244.

Richland, L. E., & Simms, N. (2019). How children's digital interactions enhance or hinder cognitive skills. *Developmental Review*, 53, 36-48.

Schmitt, S. A., Simpson, A. M., & Friend, M. (2021). Assessing technology's role in early childhood cognitive development. *Journal of Experimental Child Psychology*, 204, 105048.

Strouse, G. A., & Ganea, P. A. (2019). Tablet-based storybooks impact on social and emotional development. *Developmental Psychology*, 55(10), 2203-2214.

◎ **Zheng, M., Zhou, H., & Hou, J.** (2022). Digital literacy for young learners: Towards a sustainable educational model. *International Journal of Educational Technology*, 12(1), 45-61.

  