

## Article

# Navigating The Influence of Electronic Devices on Kindergarten Cognitive Development

Niña Jean Barnayha

Helen Revalde

Kaitlin Marie Opingo

Randy Mangubat

Veronica Calasang

Roberto Suson

Corresponding Author: [ninajeon1415@gmail.com](mailto:ninajeon1415@gmail.com)

**Abstract:** This study investigates the impact of electronic device usage on cognitive abilities in early learners, focusing on the dimensions of educational content accessibility, learning ability, and digital literacy. Findings reveal significant positive correlations between these factors and key cognitive abilities, such as numeracy, literacy, memory, problem-solving, and social-emotional skills. High-quality educational content, particularly through interactive and multimedia-rich resources, was strongly associated with enhanced numeracy and literacy skills, suggesting that diverse digital content can effectively support foundational academic abilities. Additionally, digital literacy showed robust correlations with problem-solving and social-emotional development, indicating that early exposure to digital tools can foster critical thinking, adaptability, and empathy in young learners. Learning ability was also positively linked to cognitive outcomes, supporting the role of digital devices in promoting engagement and resilience. Overall, this study underscores the importance of integrating digital tools in early education, as they contribute significantly to cognitive development and prepare children for future learning in a technology-driven world.

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

## Introduction

The integration of technology into educational settings has profoundly transformed traditional methods of teaching and learning, offering new dimensions for engagement, accessibility, and interactivity (Asad et al., 2021). Even in early childhood education, digital tools like tablets, interactive whiteboards, and educational apps



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are increasingly prevalent, creating personalized and engaging learning environments tailored to young learners' needs (Haleem et al., 2022). This technology-driven shift aims to make learning more inclusive, accommodating diverse learning styles and providing access to a vast array of digital resources that were previously inaccessible (Kasimia & Ulum, 2023). Studies indicate that technology can significantly enhance educational outcomes, even for young children, by creating a dynamic, interactive learning atmosphere that supports foundational skills in a fun, developmentally appropriate manner, contributing to cognitive, social, and emotional growth (Chen, Li, & Xiao, 2022; Kucirkova et al., 2021).

Digital tools provide young learners with varied opportunities to explore and engage, aligning with their natural curiosity and developmental stages. Early exposure to technology not only makes learning enjoyable but also prepares children for a digitalized future. Research shows that electronic devices can foster deeper engagement and motivation, making learning more interactive and accessible (Liu & Long, 2022; Cabell et al., 2023). For instance, multimedia resources, including videos, animations, and interactive quizzes, cater to different learning preferences and promote a more inclusive classroom experience, accommodating various learning needs (Davis & Anderson, 2021). Digital tools also allow educators to deliver tailored educational content that meets individual needs, enhancing accessibility and inclusivity (Li & Zhong, 2023).

The cognitive benefits of digital tools are significant, with evidence suggesting that electronic devices help young learners develop critical skills such as numeracy, literacy, memory, attention, and problem-solving. Adaptive learning technologies, for instance, adjust difficulty levels based on the learner's progress, addressing individual learning challenges and supporting skill development (Kucirkova et al., 2021; Morrison & Chen, 2022). Interactive elements like educational games and simulations further enhance engagement and cognitive retention, leading to improved educational outcomes compared to traditional teaching methods (Garcia & Lee, 2023). Studies have demonstrated that learners who use digital tools often perform better in cognitive tasks, showcasing technology's potential to support diverse cognitive skills (Sung, Chen, & Hong, 2020).

Early childhood is a critical period for cognitive development, during which foundational abilities—such as numeracy, literacy, memory, attention, and problem-solving—are cultivated. These skills are essential for academic success and broader intellectual growth, as strong cognitive abilities enable young learners to process information efficiently, adapt to new situations, and solve problems effectively (Morrison, 2022). Supporting these skills in kindergarten sets the foundation for lifelong learning and academic achievement, highlighting the importance of fostering cognitive growth at an early

age through targeted educational interventions (Peng et al., 2019; Thompson & Rose, 2021).

Despite the observed benefits, there are still research gaps in understanding the full impact of electronic devices on young children's cognitive skills. Current studies often focus on the general advantages of technology in education, with limited attention to specific cognitive outcomes, such as memory, attention, social and emotional skills, and problem-solving. Additionally, the roles of content accessibility, individual learning capabilities, and digital literacy on these cognitive skills are less explored, warranting further research to provide a clearer understanding.

This research seeks to address these gaps by examining the specific cognitive effects of electronic devices in early childhood education. It focuses on the impact of digital content accessibility, learning abilities, and digital literacy on cognitive skills, such as numeracy, literacy, memory and recall, attention and concentration, social and emotional development, and problem-solving. The results of this study will contribute to the current body of knowledge in early childhood education, offering practical insights for educators and policymakers on effectively incorporating digital tools to support cognitive development. This research will inform strategies aimed at enhancing educational experiences and learning outcomes for young learners in an increasingly digital world.

## Methodology

This study employed a descriptive research design to examine the effects of electronic device usage on young children's cognitive abilities. Data collection was conducted through a structured questionnaire, which was adapted from established, validated instruments based on recent studies on technology use in early childhood education (Neumann & Neumann, 2019; Hwang et al., 2020; Richland et al., 2019; Best, 2020; Schmitt et al., 2021). The questionnaire targeted cognitive skills, including memory, attention, and problem-solving, to specifically assess the impact of digital tools in line with the study's objectives. A preliminary letter was sent to the school principal requesting permission to conduct the research. Once approved, questionnaires were distributed to teachers, who then relayed them to parents, ensuring that participant anonymity and confidentiality were maintained. Responses were recorded using a 5-point Likert scale, ranging from "Strongly Disagree" (1.00–1.80) to "Strongly Agree" (4.21–5.00), capturing perceptions of electronic devices' effects on cognitive skills. Statistical analysis, with a significance level of 0.05, was conducted to explore correlations between device usage and cognitive abilities, revealing notable patterns and relationships. The study utilized an INPUT-PROCESS-OUTPUT framework to structure each research phase systematically, allowing for a comprehensive

evaluation of how digital exposure contributes to early cognitive development.

## Results and Discussion

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.	4.5	SA
Learners can access educational content anytime and anywhere, making learning opportunities more flexible and ubiquitous.	4.26	SA
Many electronic resources offer interactive features, such as games and quizzes, which can enhance engagement and retention of information.	4.43	SA
Adaptive learning technologies can tailor content to the individual learning pace and level of each student, addressing their specific needs and challenges.	4.19	A
Devices can integrate text, audio, visuals, and animation, providing a rich, multisensory learning experience that can aid in the understanding of complex concepts.	4.33	SA
Grand Mean	4.34	SA

The data in Table 1 highlights the high perceived accessibility of educational content through electronic devices, with overall strong agreement on the advantages these devices offer for learning. The highest mean rating of 4.5 (Strongly Agree) indicates that electronic devices are valued for providing access to a wide range of learning materials, including apps, ebooks, and educational videos, effectively catering to diverse learning styles and preferences. Additionally, the accessibility of content anytime and anywhere receives a high rating of 4.26, suggesting that learners appreciate the flexibility that digital resources afford in creating learning opportunities beyond traditional classroom settings. Interactive features, such as games and quizzes, are also highly rated (4.43), reflecting the perceived benefit of these features in enhancing engagement and information retention. Adaptive learning technologies that adjust content based on individual learner needs scored slightly lower at 4.19, indicating agreement on their effectiveness but with slightly less enthusiasm than other features. Finally, the integration of multisensory elements, such as text, audio, visuals, and animation, is also strongly supported with a mean of 4.33, underscoring the value placed on rich, varied content for understanding complex concepts. The grand mean of 4.34 (Strongly Agree) suggests an overall consensus that electronic devices significantly improve access to high-quality, engaging educational content that meets diverse learning needs.

The data in Table 2 demonstrates a strong agreement on the positive impact of electronic devices on learners' engagement and learning abilities. The highest mean rating of 4.47 (Strongly Agree) reflects that learners are particularly willing to spend more time on educational

activities when they involve interactive and multimedia content, suggesting that digital elements enhance sustained interest and commitment to learning tasks. Active participation in tasks involving electronic devices is also rated highly at 4.36, indicating that these tools significantly increase learners' involvement and enthusiasm.

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.	4.47	SA
Learners show active participation in tasks that involve electronic devices, indicating heightened interest and engagement.	4.36	SA
There is a noticeable eagerness among learners to engage with new digital learning materials.	4.31	SA
Children develop positive attitudes towards learning when they experience it through fun and interactive means.	4.31	SA
Encourage children to persist with challenging tasks, boosting their resilience in learning.	4.29	SA
Grand Mean	4.35	SA

Additionally, both the eagerness to engage with new digital learning materials and the development of positive attitudes toward learning through interactive experiences receive mean ratings of 4.31, reflecting consistent support for the role of fun, engaging content in promoting a love of learning. The encouragement of persistence with challenging tasks, rated at 4.29, suggests that electronic devices help build resilience, enabling learners to approach difficulties with greater determination. The grand mean of 4.35 (Strongly Agree) indicates an overall consensus that electronic devices effectively enhance learners' willingness to engage, participate actively, and approach learning with positive attitudes and resilience.

Table 3. Digital Literacy

Digital Literacy	Mean	VD
Learners become familiar with operating devices, using touchscreens, and navigating interfaces.	4.23	SA
Even at a basic level, children learn to access information online under guidance, laying the groundwork for research skills.	4.19	A
Introduction to discerning reliable from unreliable digital content, fostering critical evaluation skills from an early age.	4.02	A
Opportunities to use simple digital tools for creating art, music, or stories develop creative skills and digital fluency.	4.21	SA
Education on using devices safely can begin, including understanding privacy settings and recognizing inappropriate content.	4.21	SA
Grand Mean	4.17	A

The data in Table 3 reflects a high level of agreement on the role of electronic devices in fostering digital literacy skills among learners. The highest ratings, both at 4.23 (Strongly Agree), indicate that learners readily become familiar with operating devices, using touchscreens,

and navigating digital interfaces, suggesting that these foundational digital skills are quickly acquired. Additionally, opportunities to use digital tools for creating art, music, or stories (mean = 4.21) and learning safe usage practices, including privacy settings and recognizing inappropriate content, are also highly valued, reflecting the importance placed on creativity and responsible use in building digital fluency. Even at a basic level, learners gain exposure to accessing information online under guidance (mean = 4.19), laying essential groundwork for future research skills. Although the introduction to evaluating digital content critically received a slightly lower rating of 4.02, it still indicates agreement on the importance of teaching discernment skills. The grand mean of 4.17 (Agree) shows an overall consensus that digital tools support essential skills in digital literacy, promoting both practical usage and critical digital awareness among learners.

Table 4. Numeracy Skills

Numeracy Skills	Mean	VD
Demonstrating the ability to count objects and understand that the last number represents the total quantity.	4.07	A
Being able to recognize and name numbers up to at least 20.	4.26	SA
Starting to grasp simple addition and subtraction using physical objects or visual aids.	4.21	SA
Ability to identify and create simple patterns, recognizing sequences in their environment.	4.17	A
Basic understanding of measurement concepts such as big/small, more/less, and comparisons between objects.	4.19	A
Grand Mean	4.18	A

The data in Table 4 indicates strong agreement regarding the role of electronic devices in enhancing learners' numeracy skills. The highest mean rating of 4.26 (Strongly Agree) reflects learners' proficiency in recognizing and naming numbers up to at least 20, suggesting that digital tools effectively support foundational counting skills. The ability to perform simple addition and subtraction using physical objects or visual aids follows closely, with a mean of 4.21, highlighting the value of interactive, hands-on learning resources in developing early arithmetic skills. Skills related to pattern recognition and sequence identification receive a mean rating of 4.17, indicating agreement on the benefit of digital tools in reinforcing these cognitive abilities, which are essential in mathematical reasoning. Basic measurement concepts, such as understanding size and quantity comparisons, also score highly (4.19), suggesting that learners can grasp fundamental concepts of measurement through digital activities. The grand mean of 4.18 (Agree) confirms an overall consensus that electronic devices play a positive role in supporting the development of key numeracy skills, contributing to early mathematical competence.



The data in Table 5 highlights strong agreement on the positive impact of electronic devices on the development of literacy skills among learners. The highest mean rating of 4.33 (Strongly Agree) shows that digital tools effectively help learners understand that words are composed of sounds, facilitating early phonemic awareness, such as rhyming and recognizing beginning sounds.

Table 5. Literacy Skills

Digital Literacy	Mean	VD
Recognizing and naming letters of the alphabet in both uppercase and lowercase forms.	4.19	A
Understanding that words are made up of sounds and being able to play with sounds (e.g., rhyming, beginning sounds).	4.33	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.	4.20	A
Demonstrating understanding of simple stories through pictures or texts, answering questions about what they've read or heard.	4.26	SA
Grand Mean	4.25	SA

Reading simple words or sentences, including recognizing sight words, is also rated highly at 4.26, suggesting that electronic devices support early reading skills and vocabulary acquisition. Similarly, understanding simple stories through pictures or text, as reflected in another mean of 4.26, demonstrates the role of digital tools in enhancing comprehension skills by encouraging children to engage with narrative content actively. Learners also show strong agreement (4.20) with the effectiveness of digital tools in supporting early writing skills, such as writing their names and simple words with guidance. Recognizing and naming both uppercase and lowercase letters has a mean of 4.19, indicating that digital devices aid alphabetic recognition, essential for literacy foundations. With a grand mean of 4.25 (Strongly Agree), the data suggests a consensus that electronic devices positively influence literacy skill development, aiding in foundational literacy abilities and early engagement with reading and writing activities.

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.	4.14	A
Remembering the sequence of daily activities or routines.	4.12	A
Being able to retell a simple story in their own words after hearing it.	4.14	A
Recognizing previously seen items or images when presented among new ones.	4.19	A
Remembering where objects are usually stored or where they were last placed.	4.14	A
Grand Mean	4.15	A

The data in Table 6 shows strong agreement on the positive influence of electronic devices on learners' memory and recall abilities. With a grand mean of 4.15 (Agree), the data reflects a consensus that digital

tools support essential memory functions in young learners. Specifically, the highest mean rating of 4.19 indicates that learners can effectively recognize previously seen items or images when they appear again, suggesting that digital resources reinforce visual memory. Additionally, learners' ability to remember information over short periods, such as recalling recently learned words or following instructions, and their capacity to retell simple stories in their own words both receive mean ratings of 4.14, indicating agreement on the role of digital tools in bolstering these memory-related skills. Remembering sequences of daily routines, with a mean rating of 4.12, also reflects the benefit of digital devices in enhancing sequential memory, helping learners retain and understand order in daily tasks. Similarly, a rating of 4.14 for remembering the location of objects further supports the effectiveness of digital tools in strengthening spatial memory and recall abilities. Overall, these findings suggest that electronic devices play a constructive role in reinforcing memory skills crucial for early cognitive development.

Table 7. Attention and Concentration

Attention and Concentration	Mean	VD
Can focus on a task or activity for increasing periods, showing interest in details.	4.09	A
Ability to switch attention from one activity to another with minimal adult assistance.	3.93	A
Can concentrate on a specific task even with distractions present in the environment.	3.83	A
Capable of following two- to three-step directions.	4.02	A
Shows ability to listen and participate in group settings, like story time or group discussions.	4.12	A
Grand Mean	3.40	A

The data in Table 7 suggests that electronic devices positively impact attention and concentration skills among learners, with an overall grand mean of 4.00 (Agree). The highest mean rating of 4.12 indicates that learners show a strong ability to listen and participate actively in group settings, such as story time or group discussions, suggesting that digital tools may support attentiveness and cooperative engagement in social learning environments. Similarly, focusing on tasks for extended periods, with a mean rating of 4.09, reflects learners' sustained interest and ability to engage with digital content in detail. The ability to follow multi-step directions scores a mean of 4.02, indicating that digital tools may help reinforce comprehension and sequential focus. Learners also demonstrate the ability to switch attention between activities with minimal assistance (mean = 3.93), a skill that digital tools can foster through varied, interactive content. Concentrating amid distractions receives a slightly lower rating (3.83), suggesting that while digital tools support focus, maintaining attention in noisy environments may still pose challenges. Overall, these ratings affirm that electronic devices aid



in developing attention and concentration skills, essential for academic and social participation.

Table 8. Social and Emotional Development

Social and Emotional Development	Mean	VD
Beginning to manage emotions with some support, can express feelings using words.	4.00	A
Showing understanding or concern for the feelings of others.	3.95	A
Engaging in play that involves sharing, taking turns, and collaborating with peers.	4.02	A
Recognizing basic facial expressions and social cues of others.	4.05	A
Showing increasing independence in personal care and in making choices.	4.00	A
Grand Mean	4.004	A

The data in Table 8 indicates a general agreement on the positive impact of electronic devices on learners' social and emotional development, with a grand mean of 4.004 (Agree). Learners demonstrate a strong ability to recognize basic facial expressions and social cues, reflected in the highest mean rating of 4.05. This suggests that digital tools, perhaps through interactive activities or social-emotional learning content, may help learners become more aware of and responsive to others' emotions and non-verbal cues. The capacity to engage in collaborative play, which involves sharing, taking turns, and working with peers, has a mean rating of 4.02, indicating that digital platforms with cooperative games or group activities contribute to social skills development. Similarly, learners show agreement (mean = 4.00) in beginning to manage emotions with support, expressing feelings verbally, and demonstrating increasing independence in personal care and decision-making. Showing understanding or concern for others' feelings, with a mean of 3.95, also highlights empathy development through digital experiences. Overall, these findings suggest that electronic devices positively contribute to fostering essential social and emotional skills, supporting learners' ability to engage empathetically and independently in social interactions.

Table 9. Problem Solving Skills

Problem Solving Skills	Mean	VD
Can recognize a simple problem and express it in their own words.	3.98	A
Comes up with basic solutions to simple problems, often through trial and error.	4.05	A
Making choices between two or more options in play or learning tasks.	4.02	A
Beginning to use tools or materials (e.g., puzzles, building blocks) for their intended purpose in problem-solving.	4.12	A
Recognizing when they need help and asking for it appropriately.	4.06	A
Grand Mean	4.04	A

The data in Table 9 shows strong agreement on the role of electronic devices in enhancing problem-solving skills among learners, with a grand mean of 4.04 (Agree). The highest mean rating of 4.12 reflects

learners' ability to use tools or materials, such as puzzles or building blocks, effectively for problem-solving. This suggests that digital tools and interactive content may provide valuable practice in applying objects or resources for specific purposes, thereby strengthening hands-on problem-solving skills. Additionally, learners are rated highly (4.06) for recognizing when they need help and appropriately seeking assistance, indicating that digital experiences may encourage independence while promoting awareness of one's limitations. The mean rating of 4.05 for coming up with basic solutions through trial and error suggests that digital environments allow learners to experiment safely, fostering resilience and adaptability. Making choices between options (mean = 4.02) and recognizing and articulating problems (mean = 3.98) also receive positive ratings, highlighting the role of digital activities in developing decision-making and verbal problem expression skills. Overall, these findings indicate that electronic devices contribute meaningfully to building foundational problem-solving abilities in young learners.

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	0.642619	5.304553	0.000	Significant	Reject
Literacy Skills	0.604881	4.804129	0.000	Significant	Reject
Memory and Recall	0.545765	4.119305	0.000	Significant	Reject
Attention and Concentration	0.424481	2.965041	0.005	Significant	Reject
Social and Emotional Development	0.453879	3.221521	0.003	Significant	Reject
Problem-Solving Skills	0.486253	3.519424	0.001	Significant	Reject

The data in Table 10 presents the significant relationships between the quality of educational content and various dimensions of cognitive abilities. All cognitive abilities show statistically significant positive correlations with educational content quality, as indicated by p-values of 0.005 or lower. The strongest correlation is with numeracy skills ( $r = 0.643$ ), suggesting that high-quality educational content is particularly influential in enhancing numerical understanding and related skills. Literacy skills follow closely with an r-value of 0.605, highlighting the impact of quality content on foundational reading and writing skills. Memory and recall skills ( $r = 0.546$ ) and problem-solving skills ( $r = 0.486$ ) also demonstrate substantial correlations, indicating that well-designed educational content aids in retaining information and supports learners' ability to navigate and resolve challenges. Attention and concentration, though slightly lower in correlation ( $r = 0.424$ ), show a significant relationship with content quality, suggesting that engaging materials contribute to maintaining focus. Social and

emotional development, with an r-value of 0.454, indicates that quality educational content may foster empathy and social skills. These results underscore the importance of high-quality educational content in supporting various cognitive domains, with a particularly notable impact on numeracy and literacy.

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

Cognitive Ability	r-value	t-value	p-value	Remarks	Decision
Numeracy Skills	0.621464	5.016935	0.000	Significant	Reject
Literacy Skills	0.577005	4.468129	0.000	Significant	Reject
Memory and Recall	0.540257	4.06047	0.000	Significant	Reject
Attention and Concentration	0.515862	3.808458	0.000	Significant	Reject
Social and Emotional Development	0.529046	3.942973	0.000	Significant	Reject
Problem-Solving Skills	0.570547	4.393778	0.000	Significant	Reject

The data in Table 11 highlights the significant relationships between learning ability and various dimensions of cognitive abilities, with all p-values showing significance at 0.000. Numeracy skills have the strongest correlation with learning ability ( $r = 0.621$ ), indicating that enhanced learning abilities are closely linked to improvements in numerical comprehension and related skills. Literacy skills follow with an r-value of 0.577, emphasizing the role of strong learning abilities in supporting foundational reading and writing proficiency. Memory and recall ( $r = 0.540$ ) and problem-solving skills ( $r = 0.571$ ) also show significant positive correlations with learning ability, suggesting that learners with better learning capabilities are more adept at retaining information and navigating challenges through logical reasoning. Attention and concentration ( $r = 0.516$ ) and social and emotional development ( $r = 0.529$ ) also correlate significantly with learning ability, indicating that learners who are able to engage deeply with content are likely to exhibit better focus and social skills. These findings suggest that strong learning abilities contribute positively across cognitive domains, particularly in numeracy, literacy, and problem-solving, thereby supporting well-rounded cognitive development in learners.

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

Cognitive Ability	r-value	t-value	p-value	Remarks	Decision
Numeracy Skills	0.809586	8.722761	0.000	Significant	Reject
Literacy Skills	0.634292	5.189046	0.000	Significant	Reject
Memory and Recall	0.710185	6.379984	0.000	Significant	Reject
Attention and Concentration	0.653231	5.456448	0.000	Significant	Reject
Social and Emotional Development	0.712248	6.417542	0.000	Significant	Reject
Problem-Solving Skills	0.720128	6.564164	0.000	Significant	Reject

The data in Table 12 shows strong, statistically significant positive correlations between digital literacy and various cognitive abilities, with all p-values at 0.000, affirming the impact of digital literacy on cognitive development. The highest correlation is with numeracy skills ( $r = 0.810$ ), suggesting that digital literacy strongly supports numerical understanding and related competencies, potentially through digital tools that enhance engagement and practice in numeracy tasks. Problem-solving skills also show a high correlation ( $r = 0.720$ ), indicating that digitally literate learners are better equipped to navigate challenges and devise solutions, likely due to the problem-solving exercises embedded in many digital platforms. Social and emotional development ( $r = 0.712$ ) and memory and recall ( $r = 0.710$ ) also exhibit strong relationships with digital literacy, implying that digital exposure supports empathy, social skills, and the ability to retain information. Attention and concentration ( $r = 0.653$ ) and literacy skills ( $r = 0.634$ ) are similarly correlated, showing that digital literacy aids learners in focusing and developing foundational reading skills. These results emphasize that digital literacy is a crucial contributor to cognitive abilities, with particularly strong associations in numeracy, problem-solving, and social-emotional skills, thus underscoring the value of digital literacy in comprehensive cognitive development.

## Discussion

The results of this study reveal substantial positive correlations between educational content accessibility, learning ability, and digital literacy with various cognitive abilities, affirming the significant impact of digital tools on early learning outcomes. Specifically, high-quality educational content was shown to significantly enhance core cognitive abilities such as numeracy, literacy, memory, and problem-solving skills, with numeracy displaying the strongest correlation ( $r = 0.642$ ), consistent with findings by García and Lee (2023), who emphasize that interactive and adaptive digital content improves mathematical reasoning and foundational numeracy skills. Similarly, strong associations were observed between learning ability and cognitive outcomes, highlighting the role of digital tools in fostering a conducive learning environment that motivates engagement and sustained attention. This is consistent with research indicating that digital platforms enhance attention and comprehension by creating an interactive learning experience (Sung & Yoon, 2022).

Moreover, digital literacy emerged as a crucial factor in supporting cognitive abilities, with particularly strong correlations in numeracy ( $r = 0.810$ ), problem-solving ( $r = 0.720$ ), and social-emotional skills ( $r = 0.712$ ). This is in line with recent studies that suggest digital literacy helps children develop resilience and critical thinking skills through interactive and game-based learning experiences (Kucirkova et al., 2021). Additionally, social-emotional development, which includes

empathy and collaborative skills, is positively influenced by digital literacy, supporting research by Lee and Thompson (2022), who found that digital platforms encourage cooperative engagement and empathy through interactive scenarios. The significant relationships across all cognitive domains underscore the value of integrating digital literacy into early education, as it not only enhances foundational skills but also prepares learners for complex problem-solving and social interactions essential in modern educational contexts.

## Conclusion

The findings of this study demonstrate that electronic devices play a vital role in enhancing various cognitive abilities in early learners, particularly in areas such as numeracy, literacy, memory, problem-solving, and social-emotional skills. High-quality educational content, effective learning abilities, and strong digital literacy are significantly associated with improvements in these cognitive domains, emphasizing the importance of well-designed digital resources. Specifically, educational content accessibility was shown to be particularly beneficial for numeracy and literacy, underscoring the value of diverse, interactive resources in supporting foundational academic skills. Additionally, the strong correlation between digital literacy and cognitive abilities, notably in problem-solving and social-emotional development, highlights digital literacy's role in equipping learners with essential life skills. These results suggest that the integration of digital tools and literacy into early education not only bolsters cognitive development but also prepares young learners for future educational challenges.

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